

SAFE ENERGY

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COMMENT

HAROLD BEALE is not "dismayed". He should be! As Nirex's technical director he has the job of defending the deep dump. Hoist by their own petard, Nirex's research has established that Sellafield's geology can't meet the original site selection criteria.

Could this mean Nirex will return to Dounreay, where they will be about as welcome as Hannibal Lecter at the Vegetarian Society's Annual Dinner? No, claim Nirex, their information says Sellafield is still the best site. What then does their information tell them about Dounreay? That it would be more expensive, certainly. Emigrating north would also mean they would be 'late, late, for a very important date' - the 1994 Government tea party - at which the nuclear industry will have to justify its existence. With no 'solution' to the waste riddle they are likely to get their heads chopped off.

Even if they do decide to pack up their troubles in their old kit bag, the problems wouldn't magically disappear at the border. Their concession to public opinion - a soft concrete allowing retrievability - will undermine the structural integrity of the hole, according to RWMAC, the Government's advisory committee on radioactive waste disposal. "Mini-earthquakes" are another unwanted side effect identified by RWMAC, who also mock the idea of the vertical drift rail access waste delivery system (*Safe Energy* 87).

If all that isn't enough, Department of the Environment research shows that gas generated by the waste could explode when the hole is been dug and filled (see p8-9).

Nirex would be well advised to give up now: no hole will be deep enough to bury the objections that will be registered if they go to a public inquiry next year, as they still plan.

AN eleventh hour bid to persuade George Bush to attend June's "Earth Summit", in Rio, appears to have failed. At an emergency meeting of the preparatory committee (Prep Com), for the UN Conference on Environment and Development in New York, at the end of April, the US was resolute in refusing to face up to its responsi-

bilities. Prep Com has gone Def Con.

The US is the world's largest polluter. It is the engine house of global environmental destruction. Yet, in the run up to "the last chance to save the planet" it has refused to set targets for curbing the use of fossil fuels. Such is US intransigence, the committee whose task it is to negotiate a convention on global warming is called the "Intergovernmental Negotiating Committee", the Bush Administration having outlawed the words "climate change".

So far none of the committee's recommendations have been agreed. Among the statements the US refuses to accept is: "That the largest part of emissions of greenhouse gases has been originating from developed countries, and those countries have the main responsibility and should take the lead in combating climate change and the adverse consequences thereof."

102 presidents and prime ministers are attending, but stacked up against the most powerful man alive this amounts to nought.

The failure to show of the man who claimed during his election campaign that he would be the "Environmental President" will be a massive vote of no confidence in the proceedings. Any developing country willing to eschew western development models and their attendant pollution is likely to change its mind in the absence of real commitment from the nation which has benefited most from that model.

It is two decades since the 1972 Stockholm conference first linked environmental and development issues placing them on the international political agenda. There are now 2 billion more people scrambling for diminishing resources and over 50 million Third World children have died from drinking polluted water. Over 500 million acres of tropical rain forest have been cleared and almost 500 billion tonnes of precious top soil - equivalent to the entire cropland of the United States - lost. The gap between rich and poor countries has doubled. The ozone layer is disintegrating and the world's climate is heating up. All of these processes are accelerating and will soon reach the point where we are travelling too fast to jump off. It is now or never.

SCRAM's *Safe Energy* journal is produced bi-monthly for the British Anti-nuclear and Safe Energy movements by the Scottish Campaign to Resist the Atomic Menace. Views expressed in articles appearing in this journal are not necessarily those of SCRAM.

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to shut-down a nuclear reactor in an emergency.

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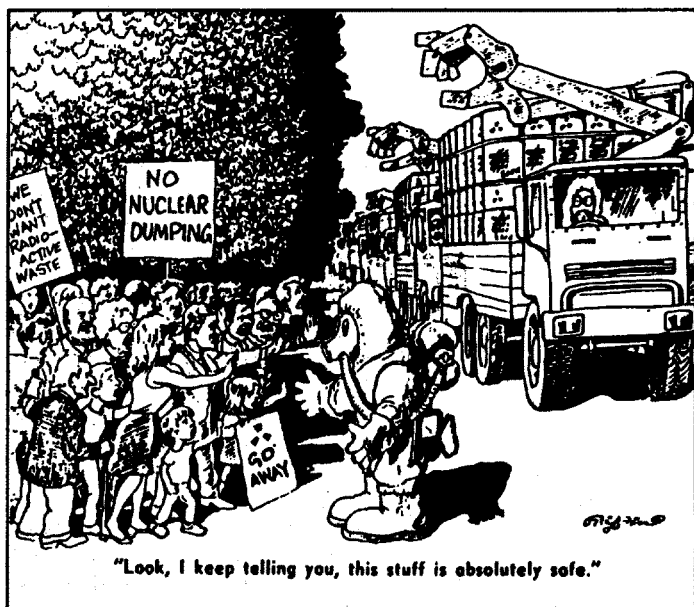
The 'dash to gas' which has followed electricity privatisation in England and Wales is the disastrous consequence of an energy policy which neglects the environment, argues Michael Harper, Friends of the Earth Assistant Energy Campaigner.

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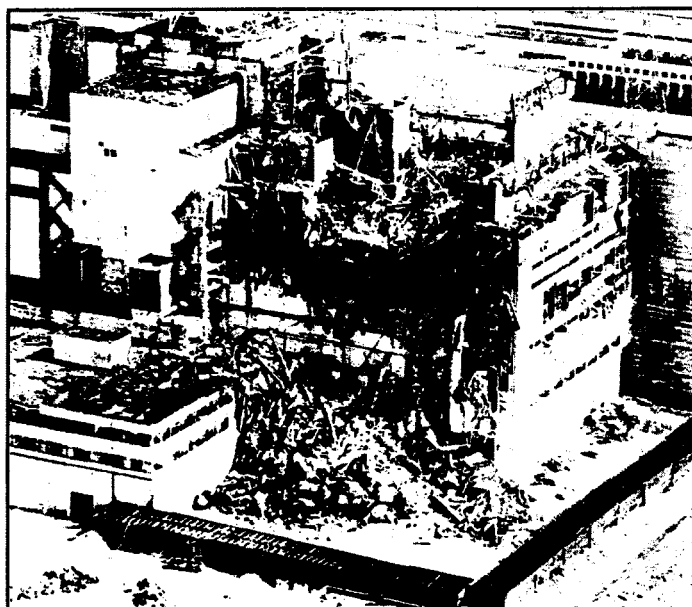
Six year after the accident, many lasting effects from Chernobyl continue to give cause for concern. Crispin Aubrey, freelance writer on environmental issues and author of *Meltdown: the collapse of a nuclear dream*, reports on the 'Legacy of Chernobyl' conference organised by the Nuclear Free Local Authorities.

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From: Daily Mirror



From: The Legacy of Chernobyl

Hidden costs

CONTRARY to claims that privatisation laid bare the true cost of nuclear power, the Commons Select Committee on Energy has been unable to get a clear picture of nuclear costs from either of the UK's publicly owned nuclear companies* - Nuclear Electric (NE) and Scottish Nuclear (SN).

The failure of the companies to provide adequate information threatens the validity of the 1994 review of the UK nuclear industry. The Committee believe "that sufficiently detailed material be published at the time of the 1994 review to permit an informed public debate before any decisions are taken."

NE who receive an annual subsidy of £1.2 billion from the electricity consumer - around 55% of their annual turnover - through the Non Fossil Fuel Obligation (NFFO) continue to hide behind a wall of commercial confidentiality. This is despite the fact that "NE, apart from being state-owned, have an effective monopoly of their share of the market," National Power (NP) told the Committee. No mention of the NFFO is made in NE's accounts.

NP fear that NE may be using the NFFO to obscure the true operating costs of the Magnox stations, which could be displacing "inherently economic plant". NE argue that it is the inadequate funding of the inherited liabilities that "reflect negativity in the company's balance sheet". However, their refusal to provide an adequate break down of their costs leaves them open to the suggestion that they are using the levy to "yield a pre- and post- tax profit."

Much play is made by NP over the fact that SN do not find it necessary to hide behind NE's wall. While SN supply all of their power to ScottishPower and Scottish Hydro-Electric they do not receive money from a Non Fossil Fuel levy. Instead, SN had a debt of £1,368 million wiped from their books by the Government, when the SSEB fissioned into SN and ScottishPower. And SN do receive money direct from the tax payer to help with long term liabilities associated with their now defunct Magnox.

Dry store & reprocessing

OVER three-quarters of the spent fuel from Scottish Nuclear's (SN) AGR stations will go into dry storage (*Safe Energy 84*) the company said at the beginning of February.

Announcing a new £2.7 billion reprocessing deal with British Nuclear Fuels Ltd (BNFL), SN's chair, James Hann, said: "SN will send 330 tonnes of AGR fuel to Sellafield for reprocessing, beyond that already contracted for. They will also proceed with the development project for two Dry Fuel Stores to accommodate spent fuel from the companies' two power stations at Torness

SCOTTISH NUCLEAR LIMITED GENERATION UNIT COSTS LIFETIME LEVELLED COSTS: 1991 PRICE LEVELS				Total p/kWh	Levelised generating costs
	Hunterston B p/kWh	Torness p/kWh			
Capital	2.14	4.70		3.56	
Front-end Fuel Costs	0.95	0.84		0.89	
Back-end Fuel Costs	0.49	0.39		0.43	
Operations and Maintenance	1.24	1.05		1.14	
Transmission	0.11	0.13		0.12	
Decommissioning	0.16	0.13		0.14	
	5.09	7.24		6.28	
Discount rate: 8 per cent					
					Magnox 6.0p/kWh
					AGR 7.0p/kWh
					Discount rate: 5%

NP also point out that SN chose to shut their Magnox at Hunterston, despite its superior operating performance - 80.8% over-life load factor. However, even when it was operating, SN gave figures for Magnox and advanced gas cooled reactors separately. "One of the most important factors in the economics of Magnox plant is the costs of reprocessing ... they affect the level of provision required to cover future liabilities both from past operations and from current operations. They are also important in assessing the avoidable costs of Magnox generation ... it is for this reason it is essential that these costs are clearly identified." Reprocessing NE's Magnox spent fuel accounts for 40% of British Nuclear Fuels turnover.

"Such information should not be withheld", concludes NP, "because the technology involved is obsolete and ... very large sums of public money are involved."

Gordon MacKerron of Sussex University's Science Policy Research Unit, was asked to appraise the memorandums submitted to the Select Committee by the nuclear generators. He picked up on a number of areas where nuclear economics are still confused:

- Both companies gave a "misleading impression of the true economics of past investment decisions". Especially when considering the English AGRs, costs for which were given using a 5% discount rate, despite the fact that an 8% rate was used in their appraisal. Using 8% takes their unit costs from 7p/kWh to over 9p/kWh.
- Of vital importance in deciding whether nuclear plant should continue operating is the question of avoidable costs. "If nuclear

avoidable costs are higher than those of fossil-fired stations then on orthodox economic grounds there would be a strong case for early closure." The "extent of 'unavoidability' in both SN, but especially NE, figures is high. Given the crucial importance of this issue for current decisions, it is to be regretted that such sparse detail or explanation is provided."

- "The Committee have been provided with no serious analysis of Magnox costs at all, and none for the English AGRs (the largest single category by capacity of operating reactor in Britain) ... NE have provided [a better breakdown of costs] to other audiences, but the public accessibility of such data is minimal."

MacKerron calls for NE to provide a breakdown both by cost category and station. "Individual station costs are exceptionally important to know with respect to avoidable costs: while average avoidable costs may be low enough to continue running Magnox or AGR stations, the important questions, for economic efficiency, concern the costs of individual stations: if, for instance, Dungeness B (or any other station) consistently showed avoidable costs above those of fossil-fired stations, the justification for continuing to run it would have to be found on grounds other than running a cost-minimising electricity system." □

- * "Information on Nuclear Costs: report with appendices together with the proceedings of the Committee" House of Commons Energy Committee. HMSO; March 1992, £6.90.

and Hunterston."

The agreement, to be back dated to April 1989, will cover a 15 year period.

Putting on a brave face, Christopher Harding, chair of BNFL, welcomed the deal, saying, "With the future development of nuclear power in Britain subject to Government review in 1994 it is important that the industry itself should not be divided on the major issues, and we have avoided this with this new agreement."

However, the companies are still clearly divided over the best way to manage spent fuel. SN told the Commons Energy Select Committee (see "Hidden costs" above): "In view of the plentiful supplies of low priced uranium likely to be available for the foreseeable future and the time horizon for the

commercial operation of the fast reactor being put back to the middle of the next century, early reprocessing of AGR fuel cannot be economically justified.

Dry storage costs will be about £40 million per year - half the cost of reprocessing - according to SN. They intend to submit a planning application for consent to build the first dry store at Torness as soon as an environmental statement has been circulated. A planning application for Hunterston B will follow in 1993. SN "fully expect a public enquiry at both sites" and hope to have the Torness facility operation by 1995.

Such storage, which could last 100 years, according to Hann, could still be followed by reprocessing, but the best cost option would be direct disposal. □

Nirex nonsense

DEEP dumping is in deep crisis. Yet despite a series of set-backs which would have shaken the confidence of lesser mortals, Nirex intend to press on regardless.

Nirex have conceded that their own research establishes that Sellafield, in Cumbria, is incapable of meeting their original site selection safety specifications: that there should be low rates of water movement; and a long 'return pathway' so that the water takes a long time to return to the surface.

According to Nirex documents, submitted to local planning authorities in preparation for a planning inquiry to be held next year, ground water will carry radioactivity up through the area of the repository rather than channelling it deep underground to the Irish Sea. "Any sort of upward migration is what they do not want in that area and they have got it," comments London University's Professor of geology, John Mather.

Professor John Knill, chairman of the Government's Radioactive Waste Management Advisory Committee (RWMAC) and a specialist on deep underground water flows associated with reservoirs and tunnels, said: "If you apply the flow rates from Nirex's own data, it would imply a return of water from the repository in less than 1,000 years," over 9,000 years earlier than Nirex claims.

Nirex's technical director, Harold Beale, is "far from dismayed." While accepting that their two volume analysis of "The Geology and Hydrogeology of Sellafield" contradicts their stated requirements of 1989, he says, "We have not yet determined where the water goes. We believe it would come out further into the sea."

To get a full understanding of the site "you have to go to depth and tunnel

horizontally through the rock - you can't get down there and get the information without planning permission to dig the hole." Which is why, he claims, Nirex must press on with the planning inquiry prior to completing its safety case.

By the time they have enough information to present a full safety case to Her Majesty's Inspectorate of Pollution, in 2001, about £1 billion will have been spent: "It is a gamble which we think is worth taking, because on our information Sellafield is still the most suitable site."

The company's original plan was to present a safety case based upon a combination of man-made and natural barriers being sufficient to isolate the radioactivity from the environment for tens of thousands of years. They will now have alter their approach, focussing far more on the integrity of the man-made barriers.

Yet the validity of these barriers is now being questioned by RWMAC. Nirex intend to use a "friable grout", a soft concrete which can be cut by a knife, as a concession to public fears over retrievability. While the grout would provide for "a long-term chemical barrier" it would permit the movement of gas and water between the waste-filled vaults and the surrounding rock mass. This means that, with time, gas generated within the repository and water flowing through it would transport radionuclides to the surface.

RWMAC, in their latest report*, express the fear that the friable grout will undermine the long-term "structural integrity of the vaults," especially as the vaults are progressively filled with radioactive waste and then sealed with the grout. Further blasting to create new caverns could make the grout unstable and reduce the strength of the repository.

The Committee call upon Nirex to "clarify the position regarding the current concept of the multi-barrier and its wider implications particularly in terms of long-term safety, structural stability and retrieval."

Yet another possible effect of the Nirex operation is a modification of the local pattern of earthquakes, giving rise to 'mini-earthquakes' in Cumbria, this requires further investigation say RWMAC.

While welcoming the decision to abandon the four vertical shafts by which waste was originally to be de-

livered to the repository, RWMAC doubt Nirex's ability to carry out the new design. They believe that the excavation of the inclined access tunnels (*Safe Energy 87*) is "at the limits of international tunnelling experience. Hence the feasibility of the current tunnel layout published in the Engineering Progress Report must be questioned."

Nirex hope to begin construction work in early 1996, following a year long public inquiry in 1993. RWMAC consider this "timetable as optimistic, in view of the complex issues which may be addressed at the inquiry." Adding, "This will be dependent upon decisions made by the Inspector and directions given to him by the Secretary of State."

■ British Nuclear Fuels (BNFL) claim that statements made in one of their leaflets saying that high level nuclear waste would be dumped in the Nirex repository are a "mistake".

The leaflet handed out to journalists at a THORP open day said: "High level liquid waste resulting from the reprocessing operation ... will be mixed with glass making material and poured into stainless steel containers. These will be placed in a purpose-built store for about 50 years before being moved to the proposed underground repository."

While Nirex "held up their hands and admitted" they've made a mistake, anti-dumping campaigners have seized upon the leaflet as proof of a hidden agenda. "Someone at the plant was being honest about what the management intended. We have believed this was the plan all along," commented Martin Forwood of Cumbrians Opposed to a Radioactive Environment.

The Government have no policy on dealing with high level waste, other than that it must be stored for at least 50 years to allow levels of radioactivity to fall. However, last year, in their 12th annual report, RWMAC "examined the practicability of co-disposal of spent fuel and vitrified High Level Waste within a deep repository primarily designed for Intermediate and Low Level Wastes," and concluded "there would appear no inherent reason which would prevent the infrastructure for a deep repository being expanded in this way." □

* "Response to UK Nirex Limited's revised design for the Sellafield Repository." RWMAC, April 1992.



Convention controversy

SEA dumping of "bulky" decommissioning wastes is the "best practicable environmental option" according to the Government. It intends to oppose calls for a permanent ban on sea disposal of radioactive wastes at a meeting of Environment Ministers from member states of the Oslo and Paris Commissions in September.

For the past 20 years marine pollution in the North-East Atlantic has been regulated by the two Commissions. The Oslo Commission covered dumping at sea, but not radioactive waste, and the Paris Commission covered land based discharges.

September's meeting is being convened with a view toward improving the existing framework of marine pollution control in the region, and establishing a new convention to replace the Oslo and Paris Conventions.

One of the issues which will be the subject of intense negotiations in the run up to the meeting is the question of sea dumping of radioactive wastes. The

Spanish delegation has made a proposal for radioactive wastes to be included in the new convention and for their dumping at sea to be permanently banned. The Danish Government have announced that they will not sign the new convention unless it includes the ban. Only the UK and France are actively opposing the Spanish proposal.

An international study of sea dumping is currently being carried out within the framework of the London Dumping Convention, and will not be completed until next year, "it would be premature for North-East Atlantic states to pre-empt its conclusions," commented David Curry, the then Parliamentary Secretary at the Ministry of Agriculture, Fisheries and Food. Sea disposal in this area "is a safe option for radioactive wastes and has no significant adverse effects on man or the environment." It is "the UK's general policy that wastes should not be dumped at sea where there is a safe and reasonably practicable land-based alternative available ... In the case of decommissioning wastes there is no such alternative available," concluded Curry. □

Korean proliferation

BRITISH Nuclear Fuels (BNFL) are putting profit before non-proliferation by negotiating a reprocessing deal with South Korea, despite the country being on the Department of Trade and Industry's (DTI) list of nuclear sensitive nations.

Following Department of Energy endorsement in November, BNFL plan to set up an office in Seoul to market their range of services to the state owned South Korean electricity company, Kepco.

Should a reprocessing deal be struck, it could lead to one of two unacceptable outcomes: either South Korean nuclear waste being disposed of in the UK, contrary to the

Government's insistence that such deals contain a 'return to sender' clause; or plutonium being transferred to South Korea.

The country is one of 33 listed as sensitive destinations for nuclear exports because of "proliferation concerns and other criteria, including the risk of diversion and the lack of effective controls," by the DTI.

BNFL have admitted that negotiations were continuing with South Korea but argue that, "It is unfair to put problems there before any deals are signed."

"We would hope that in terms of nuclear power they are interested in our technology skills as much as anything else ... But in respect of any eventual movement of spent fuel, that would be controlled by international safeguards." □

Dounreay developments

DOUNREAY has secured its first contract to reprocess spent research reactor fuel since 1974, amidst growing concern that the site could become a dump for over 3,000 spent fuel elements from Germany's beleaguered research reactors.

The deal between AEA Technology and Physikalisch-Technische Bundesanstalt (PTB) is the first of the controversial storage/reprocessing contracts to move to the second phase. Heralding the signing as "a very important contract for us ... we expect other customers to follow PTB's lead," David Thom, divisional manager of product services at Dounreay, said, it proved "beyond any doubt that Dounreay was not going to become anyone else's dump."

However, rather than allowing PTB to store their waste at Dounreay until 1996, the new deal will allow it to remain until 2017.

Walte Hayjek, manager of the 1MW re-

actor, said: "This contract closes the back end of the reactor fuel cycle which is essential for continued operation." Under German law a reactor must have spent fuel storage capacity for 6 years' operation to gain an operating licence (SCRAM 82).

PTB is not the only research reactor facing an uncertain future because of fuel storage problems. Over 3,000 highly enriched uranium spent fuel rods are currently being stored in Germany. Unless they can get rid of their accumulated waste, warns a report from a working group set up by the German Ministry of Research and Development, they could lose their operating licences.

The report states: "The process to find a disposal solution - without depending on the US - should be stepped up on an EC level given that other European research reactors are affected as well." It continues: "As an alternative to the expansion of storage capacities available in the short term, interim storage at AEA Technology, Dounreay, Scotland, offers itself." It suggests

Uranium check

ROSSING, the world's largest open cast uranium mine, is to be the subject of a detailed investigation by a team drawn from the International Atomic Energy Agency (IAEA) and the World Health Organisation, who will visit the mine in September.

The team has been called in by the Namibian Government following the publication of a report by the Namibia Support Committee and Partizans. It details, through the use of confidential documents from the mine's operators, Rio Tinto Zinc, breaches in international regulations exposing workers to dangerous levels of radioactivity and quartz dust. It also describes inadequate health monitoring, environmental mismanagement and misleading of the workforce and the press.

RTZ dismiss the charges as "false, unjustified and grossly defamatory," while conceding to parts of the report which quote internal documents. In particular the company does not dispute claims that levels of quartz dust have reached 20 or 30 times the international safety standard. However, they claim "no employee is exposed to such conditions without the proper respiratory protection." The company's chief medical officer, Jamie Pretorius, says maintenance workers and welders find respirators a nuisance and "tend not to wear them."

Jasim Ahmed, head of the IAEA safety section, says they will focus on three main issues: workers' health; the monitoring of their exposure to radiation; and management of the mine's radioactive "tailings", a mixture of uranium ore and processing liquids.

This will be only the second time that the IAEA has undertaken such a comprehensive study of a uranium mine. □

"European co-operation on Domestic disposal policies, in parallel to the Dounreay disposal solution."

AEA Technology said that Dounreay does not have the capacity to handle the amount of fuel rods discussed in the German report, but refuse to reveal what storage capacity is available: "It would take many years to transport this number of elements to Dounreay and this would be well beyond the September 1994 deadline by which time operators need to decide whether or not they wish Dounreay to carry out reprocessing."

■ Meanwhile, Dounreay has greeted the Government's decision, announced in March, to pay £10 million for a new discharge pipe at the plant as "an article of faith" in its future.

However, the then Dounreay Director, Jerry Jordan admitted that the new pipe would have been required even if the plant were to be decommissioned tomorrow. It would be needed to drain contaminated liquids away for anything up to 50 years. □

First blood

STUDIES into the effect of alpha radiation on stem cells, conducted by the British Medical Research Council (MRC), could go some of the way to explaining the "Gardner phenomenon" (*SCRAM* 76).

Gardner found a 6-8 fold risk increase of contracting leukaemia in the offspring of fathers receiving a total radiation dose of 100mSv or greater before the child's conception. However, the result was met with some scepticism because no known biological mechanism could account for the effect.

Now MRC researchers have published a paper in the science journal *Nature* which shows that stem cells - immature forms of red and white blood cells - suffer damage from alpha radiation which is not evident in the original cells but becomes apparent after a few cycles of cell division. This challenges established theory in which an affected mother cell transmits a mutation directly to the daughter and so on. Eric Wright, leader of the MRC team, says their interpretation is that the damage is not passed on in this way but rather by an "apparent random" transmission of "some sort of underlying chromosomal instability."

The experiments, conducted on

cells in mouse bone marrow, cannot be linked directly to human cells. MRC plan to conduct new experiments using cells taken from human bone marrow.

However, Wright comments that linking their results with Gardner may be considered by some as "wild speculation" but such a mental leap could be supported by biological principles even if sufficient hard experimental evidence is so far lacking. "That is going to take an awful lot of research," said Wright. "But clearly it has alerted us to the possibility that those changes could be associated with leukaemia."

A number of connections would have to be established between Wright's work and Gardner's: comparable phenomena would have to be demonstrated between sperm forming cells, allowing the possibility that damage could arise in a sperm; and you would then have to assume that such a sperm is capable of fertilisation, with the subsequent development maintaining some sort of instability. What we do "offer is a biological mechanism that is worth thinking about," says Wright. □

* "Transmission of chromosomal instability after plutonium alpha-particle irradiation." E G Wright et al, MRC Radiobiology Unit, Chilton, Didcot, Oxfordshire OX11 0RD. *Nature*, Vol 355, 20 Feb 1992.

Trawsfynydd troubles

NUCLEAR Electric (NE) have been refused permission by the Nuclear Installations Inspectorate (NII), to bring Trawsfynydd back into operation for a test period of 6 months.

Of five Magnox stations suspected of suffering embrittlement of their steel pressure vessel welds, only Trawsfynydd failed to get a clean bill of health from the NII earlier this year (*Safe Energy* 87). Following experiments on steel placed inside the reactor, NE asked the NII for permission to run one of the station's two reactors for 6 months at a higher temperature in the hope that this would increase the pliability of the welds to avoid cracking.

Trawsfynydd manager, John Moores said: "We are disappointed that the NII does not share our belief that the margins of safety identified in our submission are sufficient as to allow the short period of generation we had sought."

NE are not going to give up on the plant which has so far cost them £50 million in lost generating reserves. They now intend to switch to their "long-term" plan, which will involve submitting a revised safety case to the NII by the Autumn. They hope to get approval to run the station until at least 1995, the year of its 30th birthday.

If NE want to operate Trawsfynydd beyond 30 years a safety case covering the following decade will be required, as the NII will not accept annual licensing requests following only minor modification to the plant. □

CIS reactor shutdown plan

WHILE western nuclear companies rub their hands in anticipation of lucrative contracts for back-fitting safety systems onto the former Soviet Union's dangerous and decrepit nuclear plant, Greenpeace have published a strategy for shutting them down, which would be quicker, cheaper and more effective than back-fits.

Fuelled by the latest nuclear accident, at Sosnovy Bor in St Petersburg on March 24 - which led to the release of radioactive gas following damage to a fuel channel - the strategy calls for:

- mobilisation of western financial and technical aid to bring on-stream the equivalent of 9 nuclear plants' worth of combined heat and power plant, which is 85% efficient compared to the 35% efficiency of RBMKs;
- a \$589 million investment in improved electricity efficiency in industry, lighting and district heating networks to reduce electrical demand by 15-20%;
- \$1,136 billion in targeted investments in small hydro plants, wind turbines, and biomass energy sources, plus the development of new factories producing heating controls and insulation.

On presenting the strategy to the Russian Government, Dima Litvinov, Green-

peace Moscow, said: "If this programme had been introduced after the Chernobyl disaster in 1986, there would be no RBMK reactors operating today and the accident at Sosnovy Bor would never have happened. How many near misses do we need before we act."

Talk is cheap, and that is just what has been happening. There are now a number of national and international aid and investigation teams looking at all the facets of fixing the stations, yet most nuclear experts agree that it will not be possible to bring the reactors up to western standards. A technical fix could cost anywhere between £8.88-25.12 billion for a total safety upgrade, say Greenpeace, based on calculations made by Asea Brown Boveri who believe the reactors would still not deserve to be called safe.

Greenpeace estimate that the cost of their emergency shutdown programme will be \$7.5-8.8 billion, a small sum in comparison with the \$45.43 billion it would cost to replace the 16 ropey RBMKs with shiny new ones, or the \$300 billion costs of the Chernobyl accident to date.

Litvinov said the strategy has been sent to decision makers all over in the world in an attempt to spur "the transformation of so much talk into the required action."

One body that seems unlikely to listen is the International Atomic Energy Agency (IAEA), whose board rejected a bid for increased funding from its safety

department. The issue of Soviet-design plant was discussed only during the budget debate. It had a "cool reception and it was perfectly clear that there was resistance to increasing the budget for (these) safety activities above certain levels," according to *Nucleonics Week*, March 5.

■ In the absence of international help the Ukraine is considering restarting the two undamaged reactors at Chernobyl, warned the EC Environment Commissioner, Carlo Ripa di Meana, at the end of April.

Speaking following a trip to both Moscow and Kiev, where he discussed the problems of the Soviet Union's nuclear legacy with senior scientists and Government officials, he said he had returned "shocked" by the nuclear risk in the former Soviet republics: "I think every night without a problem is a good night. They are aware that at any moment there could be another Chernobyl."

Describing the scale of the clean up operation required as "staggering", he said it will be a matter of "survival both for them and us." He described the Soviet Union's 11 working RBMK reactors as "using obsolete technology ... being managed in a relatively unsafe and inefficient manner." The cost of decommissioning them and replacing them with new ones would be \$1.2 billion each, however, he added, an energy saving policy would cut energy use by 25%. □

What goes down must come up – but when and how? Rachel Western and Dr Patrick Green of Friends of the Earth take a detailed look at Nirex's underground dump plans and consider the possibility of a gas explosion.

Nirex and the Big Bang

NIREX's £5 million a year research programme into the 'safe disposal' of radioactive waste is still failing to adequately address the problems of gas generation in its proposed underground radioactive waste dump. Far from being 'Safe for all time' the dump could explode with a very big bang. This is not Friends of the Earth (FoE) scaremongering, but is a genuine fear expressed in a research report commissioned for the Inspectorate of Pollution at the Department of the Environment and recently uncovered by FoE.

Regular readers of *Safe Energy* will be aware that gas will be generated inside NIREX's repository. As previously stated, the total volume of this gas will be around 400 times that of the repository itself. Some will be methane of ancient geological origins which is trapped in the host rock. Further, NIREX estimates that 3,000,000m³ of methane will be evolved from the breakdown of organic material in the waste; this will be produced at an initial annual rate of 10,000m³. In addition, 1 billion m³ of hydrogen will be generated due to the corrosion of steel and the action of microbes on the waste.

In addition to the methane and hydrogen, NIREX has identified nearly thirty different radioactive and toxic gases that may form in the repository. These include chlorine and ammonia, as well as radioactive gases such as radon and krypton. Moreover, the substitution of radioactive isotopes such as tritium, a radioactive form of hydrogen, and carbon-14 for natural isotopes will further increase the production of radioactive gases. NIREX have concluded that essentially all the tritium associated with solid radioactive waste has the potential for being released as a gas, and they have estimated that gases containing carbon-14 will be released at a rate of 0.6TBq/y for 500 years.

The production of non-radioactive gases in the repository presents NIREX with a very difficult dilemma. Research commissioned for the Department of Environment shows that this gas could explode in an Abbeystead type explosion.

The Abbeystead explosion occurred in the underground concrete structure of the valve house of the Lune Wyre Water Transfer Scheme in 1984. It took place on the evening of Wednesday 23 May when a group of 44 people were assembled at the valve house to hear a presentation intended to allay local fears on the effect of the installation on flooding. During the visit there was an intense flash followed immediately by an explosion. Sixteen people were killed and no one escaped without injury.

Investigations into the explosion found that it was caused by ignition of a mixture of methane and air which had accumulated in the valve house. The source of the methane was found to be of ancient geological origins. It had percolated through the concrete walls of the tunnel. Its presence was completely unexpected.

Repository risk

The DoE's report into gas generation in the NIREX repository stated: "A similar condition may occur during the construction and operational phase of the repository".

The cause of the ignition of the methane at Abbeystead has not been positively identified. Apart from obvious possible causes such as smoking and sparking from electrical equipment, a report by HM Electrical Inspector indicated that sufficient energy to initiate the explosion could have been generated by a spark of static electricity from clothing. It is possible that the explosion may have been ignited simply by someone taking off a garment made of synthetic material.

The DoE report on the dangers that arise due to gas production in the NIREX repository commented that: "It is a matter of common observation that flammable vapours and gases are very easily ignited when mixed with air or oxygen ... During construction and the operational phase of the repository several potential sources of ignition would be present".

Given the proposed geometry of the disposal caverns it is possible that "the flame may accelerate and undergo transition from deflagration to detonation." The pressures generated

by gas detonation are complex and can be as high as 20 bar. The detonation shock wave and flame front travel at constant velocity of the order of 1800m/s. If there is an explosion in the NIREX repository the waste containment could be breached, the surrounding rock and concrete could be shattered and the waste displaced causing the ingress of groundwater.

Fire hazards

Even if detonation does not occur, because of the obstacle effects, the DoE research shows that flame propagation could produce pressures of the order of 5 bar which might cause subsidence and damage to the structures of the repository or give rise to ground instability. The integrity of the waste-containing steel canisters may also be threatened.

A fire in the repository could present serious problems producing noxious and possibly toxic fumes and creating voids preventing work in the repository. The theoretical maximum flame temperatures for methane/air fires is 1,100°C. A fire at up to 1,000°C could release volatile radionuclides such as Cs-134, Cs-137, Ag-110m, Ru-106 from the radioactive waste in the dump.

In addition to the risk of an underground explosion, NIREX have also expressed concern that should, "either gas (hydrogen and methane) escape from the repository and reach the surface in sufficient quantity, then a potential flammable/explosive hazard exists".

The production of gas inside the repository presents NIREX with a significant problem and an insurmountable contradiction in its safety case.

The design that NIREX have proposed for the repository has been chosen due to the inevitable fact that groundwater contaminated with radioactivity will escape from the dump and leak back to the surface. NIREX have emphasised the safety importance of the depth of the repository and the extensive use of steel and concrete to seal in the waste. NIREX propose to bury radioactive waste in caverns half a mile underground and to use concrete to grout the waste into steel containers which will then be back filled

into the vault with additional concrete. They assume that burying the waste in this manner will ensure that the rate of leakage of contaminated groundwater will be low enough to ensure that the leaks are 'harmless'.

In attempting to avoid the safety problems that will arise if high gas pressures are allowed to build up inside the repository they propose to deliberately jeopardise the containment of the radioactivity in order to allow the gas to escape.

NIREX have indicated that it is likely that they will puncture holes in the waste containers to allow the gas to escape. This disruption of the containment offered by the steel is in direct contradiction to their stated requirement that, "stainless steel containers for LLW and ILW in a NIREX repository ... will be required to remain intact for up to a few hundred years".

The containers need to remain intact in order to prevent water access to the waste - many of the short lived radionuclides in the waste will be highly soluble.

Significant escape

Calculations undertaken by NIREX have shown that significant concentrations of activity will escape from the canisters into the backfill even if holes as small as 1mm are made. The diameters of the holes that NIREX are considering range from 10mm to 100mm.

Radioactivity that has escaped from the containers into the surrounding concrete could leak directly out into the surrounding rock if the concrete is cracked. NIREX have expressed concern that: "Cracks in concrete structures within a radioactive waste repository could provide fast transport pathways and as such could impair the performance of the concrete as a barrier to radionuclide migration."

NIREX claim that the concrete used in the repository may be "autogenous" (sic) and able to heal itself if is cracked. However, if any cracks do reveal this would confine the gas and could lead to a dangerous pressure build-up. NIREX research indicates that: "If the flow (of gas) were sufficiently impeded the pressure rise could ultimately lead to fracturing of the vault or the flow field environment, possibly providing pathways that could accelerate the movement of nuclides to the surface."

The structural concrete that NIREX propose to use in the repository could "provide a major barrier to gas migration". A preliminary review of the

problem by NIREX has demonstrated the reliance of the safety case on "interconnected fissures in the concrete to allow the gas to escape." Thus cracks in the concrete could provide: "fast transport pathways" for the escape of radioactivity, but without them it is possible that gas pressure build-up could provide pathways that could "accelerate the movement of nuclides to the surface."

It is difficult to reconcile these two positions. On the one hand the NIREX design aims to ensure a high level of containment of the radioactive wastes within the repository and therefore corrosion resistant steel and "autogenous" concrete are favoured. On the other, in order to avoid dangerous gas build-ups, NIREX propose to deliberately damage the steel containers and suggest that cracks in the concrete are an asset.

Once the gas has escaped from the repository and into the surrounding rocks these intractable contradictions in the safety case continue. Fractures in the rock can provide express routes for the escape of radioactivity back to the surface. NIREX's bland assumption that, "gas is likely to be able to escape relatively easily through the fractured hard rock environments that are found at the sites selected for further investigation," begs the question of how easily leaking radioactivity could reach the surface. One geologist has commented, "it can be assumed that faults in crystalline rocks will be regions of increased transmissivity and that they will act as 'express routes' between the repository and the biosphere. Hence their properties and disposition become of crucial importance to the viability of a proposed repository."

Lack of Available Data

The DoE report contained a number of damning conclusions on the current state of research into gas generation. It stated that "considerable deficiencies" in current methods for dealing with the gas had been identified. It complained of a "lack of relevant data" and stated that "there is relatively little published work directly related to the potential risk of the presence of gas and none on the effects of gas on radionuclide migration".

Furthermore, it also stated: "there is no published information on whether the intention is to seek to expel or contain any gas generated within the repository".

Of particular concern was the reports conclusion that, "HMIP do not currently have access to a repository design of sufficient detail to enable near field migration phenomena to be realistically assessed"

The DoE report's executive summary stated that gas effects do not appear to have been considered in the current repository design. Yet, despite these obvious deficiencies NIREX continues, in its publicity material, to make its bland assurance that the repository will be "safe for all time". The fact that DoE contractors complain of a deficiency of data and lack of information from NIREX is significant. The DoE is one of the regulators that will be responsible for assessing the safety case presented by NIREX. If the DoE doesn't have the information that it needs, can we have any confidence in its ability to critically examine the NIREX safety case in the run-up to a public inquiry? □

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Ten years after the termination of the Government's wave power research programme, DAVID ROSS, freelance journalist and author of *Energy from the Waves*, reviews the stalling tactics which have so far stemmed the tide of further progress in the UK.

Paddling on the beach

THE enemies of progress inside the Government machine have once again managed to delay the irresistible advance of the waves. They played for time, right up to the General Election, and succeeded in absorbing and damping down much of the surge of protest that had developed over the way in which wave power had been treated. They were faced with a crisis: Norway had made wave energy work, MPs were becoming suspicious and two Select Committees were calling for independent inquiries. There was no credibility left to the arguments used by the Energy Technology Support Unit and by some in the Department itself to justify the claim that wave power would never be viable. So they resorted to the classic formula: they set up a committee and an inquiry. And proceeded to use the one to hold back the other.

There have been major advances, at least in official attitude. Anti-wave people have been replaced in key positions inside the Department of Energy and ETSU and the official attitude is less hostile. To this extent, public and political pressures have been successful. But there is still no sign of readiness by Government to recognise that if it seriously wishes to embark on a programme of non-polluting wave energy it will have to engage in major investment for full-scale prototypes in the open sea, where the big waves are. The time has come to stop paddling on the beach.

Two year study

It was three years ago, on April 6 1989, that Baroness Hooper, Energy Under-Secretary for a weekend or so, read out a statement in the House of Lords saying that a study of wave energy was to be made, including offshore technologies. It was only later that it was discovered, to everyone's surprise, that the review was intended to take two years. Why? What was new?

At a Coventry wave energy conference Professor David Evans,

inventor of the Bristol Cylinder, demanded of the ETSU people: "What are you going to discover that you didn't know in 1982?" There was no answer. The inquiry has now dragged out to three years and we are still waiting.

The fault does not lie with the scientist in charge, Dr Tom Thorpe. He has won the confidence of the research teams who are, by happy chance, still intact after the 1982 axeing of the official programme. But he is being held back by a silly problem: he has to obtain agreement between the teams and ETSU over the probable cost of a unit of electricity if, one of these days, a wave power station is actually built in the open sea. He might equally reasonably have been asked, how many angels could dance on the beak of a Duck? Given the history of cost-estimates even with known, conventional technology (like the Humber Bridge and the Channel Tunnel), it is absurd to imagine that a figure obtained now would prove accurate.

Anyway, the answer is very simple: it depends on the discount rate that you assume. If you don't like the figure, lower the discount rate. But that would bring everyone involved to a difficult point: they would have to decide to take action.

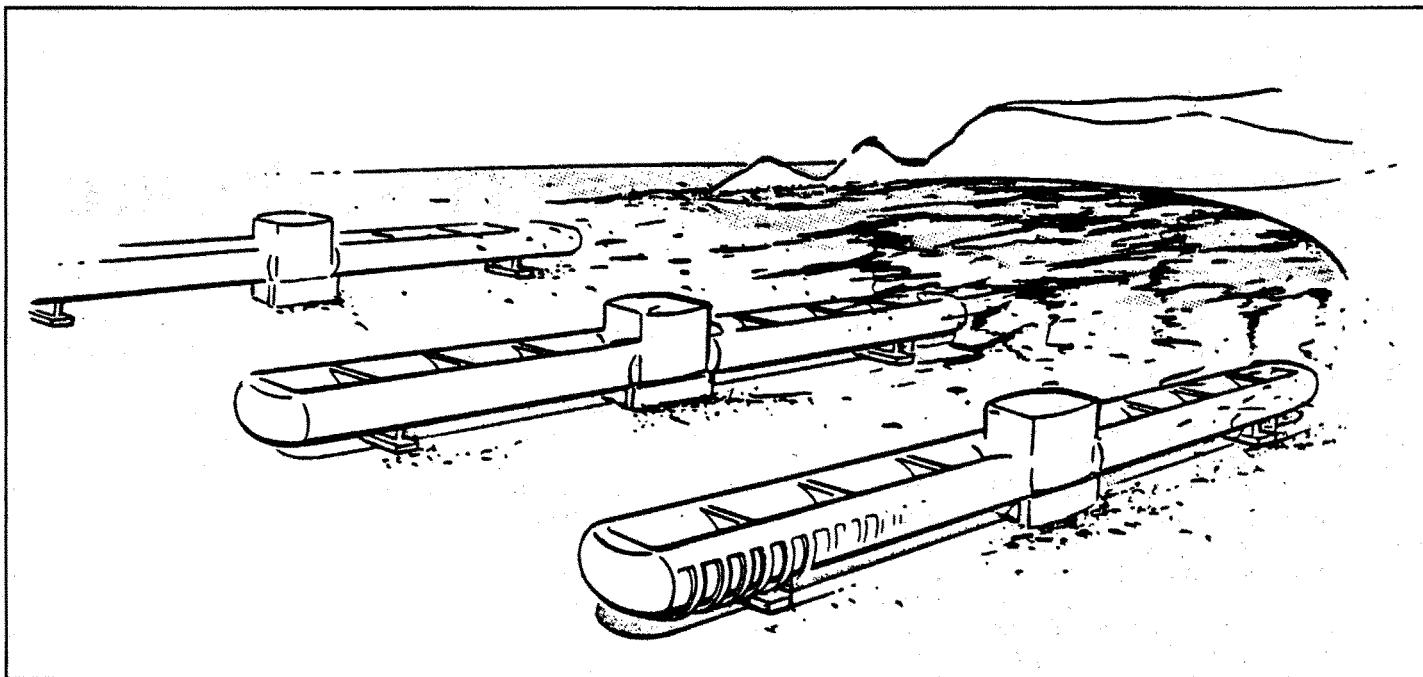
Final report

Thorpe's full report should have been published in the summer of 1991. Nothing emerged, so on November 18 John Home Robertson, Labour MP for East Lothian, asked in Parliament when it would be coming. An interim report would be out "shortly", replied Colin Moynihan. The very next day, November 19, as if by magic it appeared. Somebody had been sitting on it and needed a jerk. It illustrates the hostility of some people still in a position of power. The final report is, at the time of writing (March 1992), still awaited, nearly a year late.

A similar lack of urgency has descended on the European Community. It was spurred into a



The Edinburgh University Salter's Duck



Vickers Attenuator, 1982 design

show of action when its Vice President, Signor Pandolfi, was briefed by his wave energy experts to give a false report to the European Parliament.

He was exposed, apologised handsomely and allocated 1.2 million Ecus (£840,000) to wave energy. That was in April 1991. The actual money is still awaited. A report (yes, another) on the wave energy resource was commissioned and is also still awaited. The EC relies for much of its information on the International Energy Agency, which relies on the UK, as lead country on wave power. And you can guess who provides the UK's information ...

Misleading

I had a personal experience of the way in which the wave review is being run by Government: I sent to the Ministerial Advisory Group, which is considering the Government's programme on renewables, what I thought might be helpful, if slightly radical, suggestions for their deliberations. I received a reply from the Department of Energy saying that the group "will be considering issues which you have raised." That suggests (without saying it) that they would see and consider my suggestions, but after 16 years of writing about wave energy I have a suspicious mind. So I asked around and discovered that none of the members had seen it. The letter to me was designed to mislead.

With such items to consider, why do I say that the atmosphere is more

hopeful? The facts show that, despite the obstacles, and the rearguard action by those who once said wave energy would never be viable, the prospect has been changed by the irresistible force of events.

The opponents of wave energy were defeated on November 13 1985 when Norway launched the world's first wave power station at Bergen. The IEA sent as its representative, Ken Major of ETSU. We drove out together to see the wave station the day before the launch. But on the day itself he pleaded other commitments, pulled out and was not present for the actual event. I think he could not face it.

The Norwegians have proceeded to make commercial deals, and should soon be building one of their Tapchans in Shetland. They have been followed by Queen's University, Belfast, which has built a small unit on the shore on Islay and will probably get funds for a larger repeat. But these are all shore based, receiving smaller waves and generating smaller outputs.

What is, in my view, most needed is a decision to fund the devices now ready to go to sea - particularly the Oscillating Water Column designed by the National Engineering Laboratory and the Coventry Clam. There is also every reason why Vickers, with their vast capital, their skilled workforce and their desperate need in Cumbria for jobs, should not be encouraged to proceed now to building their own-designed, undersea oscillating water column. The Bristol Cylinder (also under the surface) seems

likely to get some funding, but it is still at an early stage and may be used as an excuse for avoiding major investment. I would also like to see Stephen Salter - despite his own reluctance - encouraged to build a solo Duck now, with acceptance that later models will be superior. The most important thing, I believe, is to go out to sea now and avoid any more studies, committees, advisory groups and other time wasting contrivances of the Whitehall machine.

Genuine support

Inside the Department of Energy, there appears to be genuine support for wave energy from such people as Colin Moynihan, the Minister, and Godfrey Bevan, the head of the Renewables branch. And among the public and the politicians there is growing awareness of the need to invest serious money in the energy sources that can replace the growing pollution of the environment by nuclear and fossil power. It is this public mood which has taken us this far.

But it will triumph only when there is firm political leadership. It is needed to overcome Britain's secret government, the unofficial, rank-and-file committee of Permanent Under-Secretaries, dominated by the Treasury, who do not intend to allow anything to happen which would cost money and would change the pattern of energy production in Britain, which they devised and imposed and which they intend to guard in the way that a parent protects a wanton child. □

Following the leak of a highly critical report commissioned by Nuclear Electric, DOUGLAS RAITH highlights the growing concern over the reliability of the proposed Reactor Protection System for Britain's first PWR.

Suspect Sizewell safety software

THE pressure is on at Sizewell in Suffolk, in the race to complete testing and commissioning of the UK's first Pressurised Water Reactor (PWR), before the contract deadline of summer 1994, and within budget. In the run up to the 1994 nuclear review, the future of nuclear power in the UK is seen to depend largely on the outcome of this race.

With the stakes so high and the finishing line in sight, Nuclear Electric (NE) are understandably concerned that nothing should get in their way. A huge question mark hangs over the viability of the primary Reactor Protection System (RPS), which will, for the first time in the UK, be controlled by computer software rather than hardware.

Software and hardware

In computing and electronic terminology, 'hardware' covers all of the physical components of a system, including sensors, switches, circuits and displays. Software is the name for everything else: in its narrowest sense, 'software' refers to the coded instructions, or program, which tell the system what to do. 'Software' can also be taken to include the data and information which is stored and processed by the system, under the direction of its program.

A computerised control system is 'software-based', since its behaviour is dictated by the coded instructions in the software. The operation of a 'hardware-based' system, on the other hand, depends on its physical layout and wiring. Such a system is often said to be 'hard-wired', and is 'dedicated' to performing a particular task. As the names imply, software can be modified more easily and quickly than hardware, giving software based systems their principal advantage of flexibility.

Computers are already used in the control systems of Britain's Advanced Gas-cooled Reactors (AGRs). However, the Reactor Protection Systems (RPSs), responsible for shutting down the reactors in emergencies, use a hardware-based control system (LADDIC Magnetic-core logic manufactured by GEC).

Sizewell will have a Secondary Protection System, not using software,

as a safeguard against any failure of the Primary system to deal with those emergencies deemed most probable (i.e. with an estimated likelihood of one occurrence every 1,000 years or less).

There is no fundamental reason why software should be any less trustworthy than hardware – the problem lies in assessing reliability. In the case of Sizewell B System, experts agree that comprehensive testing would be impossible. In November, an 'Independent Design Assessment (IDA) team' is due to present its final report to the Nuclear Installations Inspectorate (NII). Given the impossibility of exhaustive testing, the NII have devised their own acceptance criteria, according to a 'Special Case Procedure', which the IDA team must apply. However, independent experts appear unanimous in the opinion that these criteria are not stringent enough.

Why use software?

Software control offers several operational advantages. The flexibility of software – the ease with which it can be modified – allows the system to be adapted quickly to changes in reactor design. Routine testing and calibration procedures can also be carried out under computer control, reducing the system's vulnerability to human error.

When the reactor at Three Mile Island overheated in 1979, operators were faced with a bewildering array of alarm signals. A computerised system can be programmed to prioritise alarms, provide more intelligible operator displays, and perform automatically controlled shutdown procedures, again reducing the risk of human error.

Inevitably, NE must have also been attracted to the software option by expected commercial advantages: automated testing and calibration, and the ability to diagnose certain types of failure, can reduce the amount of time for which the reactor has to be taken out of service. Also, the instantaneous calculation of operating parameters, and their close monitoring, theoretically allows the reactor to be run at higher power levels without increased risk.

Since their original decision to choose the software option, NE and the manufacturers, Westinghouse, have

invested many worker-years in the development of their computerised RPS. Over a period of ten years, a vast and complex web of software has been created, amounting to some 100,000 lines of computer programs designed to run on a network of several hundred microprocessors. It is about ten times larger than comparable Canadian systems. What's more, NE are now completely committed to it, having no alternative proposals in place: to change horses at this stage would put them back years in the race to commissioning, forcing them beyond the deadline and over budget.

The reliability of software

Why is the assessment of software reliability so difficult? The answer lies in its complexity, and in the unpredictable nature of any failures. In a hardware-based system, the reliability of different components can be established by testing them individually. The probability of failure of a whole system can then be calculated, using a standard mathematical procedure. Also, the consequences of any single failure can be predicted, and allowed for in a 'fail-safe' design.

Unfortunately, no such calculations or predictions can be performed on software. Failure is not caused by known processes of material degradation, and does not follow predictable patterns.

The two major sources of 'bugs', or software defects, are errors in the specification, and coding errors, which range from simple typing errors to the use of an inappropriate mathematical expression or program instruction. A software specification is a detailed description of the intended behaviour of the system in all conceivable conditions. The main difficulty in developing a specification is in trying to cater for all conditions in a systematic way. Even with a system a fraction of the size of the Sizewell-B RPS, an exhaustive test of all possible system states would take trillions of years.

The very flexibility of software creates problems. System developers are tempted, and indeed encouraged, to add features to the system to make it easier to

use, or allow quicker or more efficient plant operations. Unfortunately, the continual adding of 'frills' increases the overall complexity of the system and the risk of errors, and makes the task of testing more difficult. The hard part of software systems development is not the adding of impressive new features, but keeping them under control.

In general, faults in computer software are due to old-fashioned human error. Compared to other forms of human error, however, they can be particularly difficult to trace, and far-reaching in their consequences. They can lie dormant for any number of years before the right conditions bring them into play. In January 1990, for example, a pipe ruptured at the Bruce A reactor on Lake Huron, Canada, allowing radioactive coolant to escape. The cause of the accident was eventually traced to a bug which had got into the refuelling control software during an update four years previously, and had not been revealed by subsequent tests.

At the Darlington, Ontario plant, the Canadian regulators were sufficiently concerned about proposals to use a software based RPS, that they commissioned an independent investigation costing over \$4 million dollars. It took 3 years and delayed the station's startup by a year. It uncovered many discrepancies, some of which were described as serious. Investigation director, Professor David Parnas, said the problems were mainly due to the complexity of the software, which consisted of some 10,000 program lines. A spokesman for the operators, Ontario Hydro, said if they had known about the cost and delays caused by the choice of software, they might have opted for a hardware-based system.

In light of the proven ability of software systems to fail, professional bodies are anxious that their use in safety-critical applications should be approached with the utmost caution. The Department of Trade and Industry commissioned the British Computer Society and the Institution of Electrical Engineers (BCS/IEE) to form a joint working party to investigate the relevant issues. They concluded: "The degree of trust which we can justifiably place in the software is often much less than that which we can place in other aspects of the system."

Software engineering

Since the complexity of most software systems precludes exhaustive testing, an alternative approach has to be taken in the effort to ensure reliability. The relatively new discipline of Software Engineering deals with the new formal methods of generating software, from specification to final coding. Only with the application of such methods is software development transformed from an individualistic art or

craft, into a science. The collective aim of these 'formal' methods is to reduce the scope for human error. The Sizewell B RPS predates the introduction of these methods by several years, and they are not expected to be applied retrospectively.

The sizewell tests

In 1980, three employees were seconded to the understaffed NII by the UK Atomic Energy Authority, apparently to help compile the initial safety assessment on the PWR - a slightly unorthodox example of self-regulation. In light of public concern, the NII have taken the unusual step of publishing in advance their safety requirements for the RPS. This has done nothing to reassure people.

Since its inception over 30 years ago the NII has been evolving its Safety Assessment Principles, a set of non-prescriptive guidelines, which make no stipulations about development methods. Given the impossibility of exhaustive testing, the NII is invoking a 'Special Case Procedure' (SCP), intended to provide an adequate level of confidence through inspection of the production methods and limited testing of the finished software.

A central element of the SCP is said to be the 'Excellence of Production' criterion, which stipulates that the best current development methods should be used. However, there is no requirement that relevant national or international industry standards should be applied. The most obviously applicable standard in this case is the Ministry of Defence standard 00-55 for safety-critical software, which stipulates the use of the new 'formal methods' for the creation of software. The Sizewell RPS in its present form does not satisfy this criterion.

The Special Case Procedure requires independent design assessment (IDA) and independent testing of the software. However, the IDA team are in fact employees of Nuclear Electric. According to Sizewell B project manager, Brian George, the team is a "separate group of people within our own group ... in-house people." An internal interim report, produced by the team in January 1990, raised the alarm when it was leaked to Channel 4's *Dispatches*. In it, the IDA team were highly critical of the software, rating its reliability at only one tenth of the required standard. In short, the software is badly designed, fails to follow sound development practices and is too complex to be tested properly.

Evidence presented to the Hinkley Inquiry by Martyn Thomas, then Chairman of the BCS Safety Critical Systems Group and the senior BCS representative on the joint BCS/IEE study, explained the difficulties of assessing the reliability of software. He expressed the Society's concern that the

system (which NE also propose to use at Hinkley) may not conform to MoD standard 00-55. The issue was never raised at the Sizewell Inquiry. In view of the shortage of relevant expertise in the NII, he proposed that the BCS should be asked to convene a review team. This offer was rejected on the grounds that the NII could employ outside consultants when necessary. Despite such assurances, the fears of the BCS and others have still not been allayed.

Conclusions

NE's responses to repeated questioning about the system have not inspired confidence. These have ranged from an assurance that it will be "exhaustively tested at works and at site" (clearly impossible), to claims that the system is "state-of-the-art". This particular epithet can hardly be applied to the development methods.

NE assert that additional independent review is unnecessary, and that full access to the details of the system could undermine commercial secrecy. Such statements raise doubts about the company's priorities, leaving them open to the charge that commercial interests are held to be more important than safety. The NII states that "the pedigree and experience of the manufacturer" is an "important consideration" in the assessment of any installation. In this case, the pedigree and experience of the manufacturer (Westinghouse) includes the building of a \$2.6 billion nuclear plant in the Philippines, which has been mothballed since 1985 because of unsafe design and construction. Following a three-year legal battle over accusations of bribery, the corporation has agreed to pay a quarter of the \$400m cost of upgrading the plant to current safety standards.

Of course, it may well be argued that such matters bear no relation to the technical competence of a company. Point taken: but surely we are entitled to question the ends to which such competence is devoted. □

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Acknowledgement:

Charles Barnett, Shut Down Sizewell Campaign.

The UK is witnessing an explosion of gas-fired electricity generating projects which are set to supplant current base-load generating capacity within the next few years. **MICHAEL HARPER**, Friends of the Earth Assistant Energy Campaigner, explains why burning gas in large power stations is a disastrous consequence of an energy policy which neglects the environment.

It's a Gas

SINCE privatisation, the National Grid Company has received at least 39 applications for new power stations totalling over 26GW of capacity. Friends of the Earth has identified over 24GW of new gas-fired power plant proposals at different stages of development (See Table 1). Taking account of proposed power station closures and committed new generating capacity (8,200MW), it is estimated that by 1995/96 the UK will have a plant margin just over 36%. That means the UK will have nearly two fifths more capacity than peak demand. If all the proposed plants were to come to fruition (as opposed to only those which are committed), the potential overcapacity (or the amount of plant replacement) would be even greater.

Until 1990, the use of gas in electricity generation was discouraged by a European Commission Directive. This was repealed as a result of increased discoveries of natural gas and improvements in technology which led to increased thermal efficiency of gas turbines.

The move to gas is motivated primarily by economic considerations. Capital and operating costs are considered low compared with the construction of a new nuclear or coal fired power station. Modern gas-fired power stations are more efficient at converting energy into electricity than most efficient modern coal plants - excluding those using Combined Heat and Power (CHP). Gas power stations can be built incrementally and relatively quickly. In addition, gas is often portrayed as a 'clean fuel' and the new gas power stations as 'environmentally acceptable'. On account of their relatively low sulphur dioxide emissions, the industry see their development as a cheaper alternative to fitting flue gas desulphurisation technology to existing coal-fired power stations.

However, the 24GW of capacity listed in Table 1, would produce annually, about 72,000,000 tonnes of carbon dioxide, 132,000 tonnes of nitrogen oxides and 19,200 of sulphur dioxide. It takes breath-taking imagination to describe power stations pumping out pollutants on this scale as 'clean'. Most analysts believe that not all the gas

plants will come to fruition - failure to secure economic gas supplies being the chief barrier. But even assuming that the level of new gas-fired capacity evens out at 10-12GW (which is the most oft-repeated figure given by analysts), this will still result in the emission of 30-40,000,000 tonnes of CO₂ each year.

Despite these figures, the overall emissions of carbon dioxide are still less than existing generating capacity, on account of the lower carbon content of gas compared to coal and the higher efficiencies of gas turbines compared to conventional coal-fired power stations. Gas is clearly therefore going to play a part in ensuring a transformation to a

sustainable energy policy. The question is, how is it to be used so as to maximise its benefits and minimise its impacts.

How do we use it?

To date, debate on gas exploitation and use has focussed on the issue of post-privatisation competition within the electricity supply industry and the merits of independent power production. Of greater concern is whether we should be using gas to generate electricity in large centralised power stations at all. Friends of the Earth believes the growth of gas-fired power stations is a disastrous consequence of an energy policy which

STATUS OF COMBINED CYCLE GAS TURBINE PROJECTS
In England and Wales (April 1992)

Project	Developer	Size(MW)	Efficiency(%)	Genuine CHP?	Status	Commissioning Date
Angle Bay, Dyfed	Texaco Ltd.	1,100-1,280	c.50	No	Consent	Mid 1995
Ardleigh, Essex	Eastern Generation Ltd	380	c.50	No	Pub. Inquiry	Early 1995
Barking, London	Thames Power Ltd.	1,000	48	No	Consent	Early 1995
Brigg, South Humberside	Regional Power Generators	240	48	No	UC	November 1993
Calder Hall, Sellafield	British Nuclear Fuels plc	170	88-75	Yes	UC	October 1993
Chelsea, London	MetroPower/Scottish Power	370	c.45	Not Decided	Prospective	1997
Cornah's Quay, Clwyd	PowerGen plc	1,350	c.50	No	Proposed	1995-8
Corby, Northamptonshire	Corby Power	350	c.50	No	UC	October 1993
Corby, Northamptonshire	East Midlands Electricity	800	c.50	No	Proposed	1996 (?)
Croyton, Essex	Mobil	460	c.60	Yes	Withdrawn	
Deeside, Clwyd	Deeside Power	450/500 [1]	c.50	no	UC	1994
Didcot, Oxfordshire	National Power plc	1,300	c.50	No	Pub. Inquiry	Late 1994
Ellesmere Port, Cheshire	Associated Octel	120	N/A	Yes	Withdrawn	
Greenwich, London	MetroPower/Scottish Power	370	c.45	Not Decided	Proposed	1996
Isle of Grain, Kent	AES Electric	700	c.50	No	Proposed	Early 1995
Keadby, South Humberside	Energy Resources Company Ltd.	720	54	No	Consent	1994
Killingholme, Humberside	PowerGen plc	900	c.50	No	UC	1992
Killingholme, Humberside	National Power plc	650-1,020	c.50	No	UC	Late 1993
King's Lynn, Norfolk	Energy Supply Co. Ltd	118	50+	Yes	Consent	Late 1995
King's Lynn, Norfolk	Eastern Generation Ltd	380	c.50	No	Proposed	1996 (?)
Little Barford, Bedfordshire	National Power plc	880	c.50	No	UC	1994
Newcastle-on-Tyne	Merz and McLellan / Forth Energy	150	c.80	Yes	Proposed	1994
Peterborough	Eastern Generation Ltd	380	c.50	No	UC	Mid 1993
Plymouth, Devon	PowerGen plc	350-450	c.50	No	Proposed	1994
Port Clarence, Cleveland	Hydro-Electric	1,200	N/A	N/A	Prospective	Late 1996
Roosecote, Cumbria	Lakeland Power	224	c.50	No	In operation	October 1991
Rugby, Warwickshire	East Midlands Electricity	380	c.50	No	Withdrawn	
Ryedale, N Yorks [2]	Kelt UK	50	c.50	No	Pub. Inquiry	1996 (?)
Rye House, Hertfordshire	PowerGen plc	680	c.50	No	UC	1994
Seabank, Avon	Seabank Power (British Gas/MEB)	1,212	c.50	No	Proposed	Mid 1995
Sheffield	Sheffield Heat and Power	120	80+	Yes	Proposed	October 1996
Shoreham, Sussex	South Coast Power Ltd	450	c.50	No	Proposed	1996
Shotton, Clwyd	Shotton Paper Company	200	50+	Yes	Proposed	1996 (?)
Spondon, Derbyshire	Courtaulds	318	c.70	Yes	Consent	Mid 1994
Stallingborough, Humberside	IVO Energy	1,100	51	Not Decided	Proposed	1996
Staythorpe, Nottinghamshire	National Power plc	1,500	c.50	No	Pub. Inquiry	Late 1994
Sutton Bridge, Lincs	East Midlands Electricity	700-880	c.50	No	Consent	1996 (?)
Trarford, Manchester	Electricity System Industry	680	c.50	No	Proposed	1996 (?)
Wilson, Cleveland	Enron Power UK	1,725	50+	No	UC	April 1993

TOTAL: 23,527MW

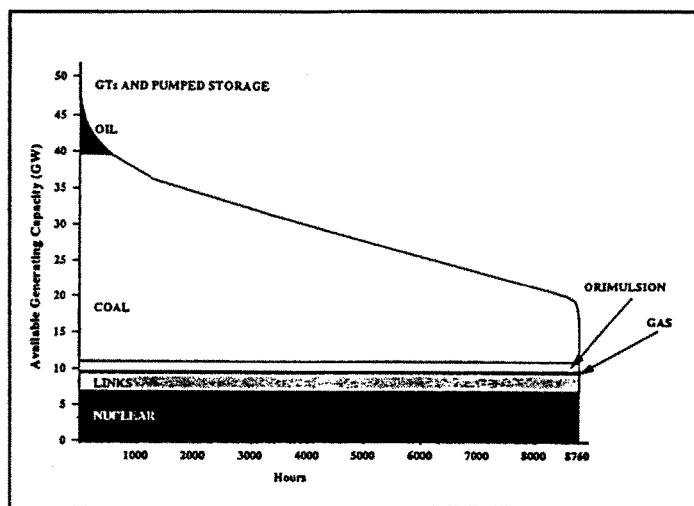
UC: Under Construction.

Consent: Indicates that consent under Section 36 of the Electricity Act 1989 has been granted.

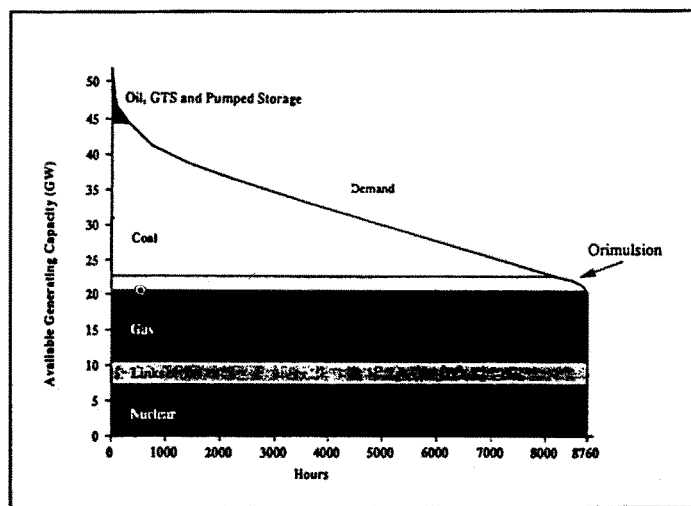
[1] Consent has been given for 450 MW plant but new application for increase to 500 MW is now under consideration.

[2] Project is using *sour* gas not *natural* gas and is an open cycle gas turbine not a CCGT.

Status of combined cycle gas turbine projects, England and Wales, April 1992



Graph 1: Simplified generation duration curve 1991/92



Graph 2: Simplified generation duration curve 1995/96

wholly neglects the environment. There are four principal reasons.

1. The priority for the UK electricity industry should be to focus on reducing electricity demand through energy conservation and energy efficiency measures. Reducing energy consumption in any climate is difficult enough; achieving significant reductions within an industry which has committed itself to large new supply options is an absurd proposition.

The Office of Electricity Regulation (OFFER) is in the middle of consultations over how to restructure the industry so as to ensure improved promotion of energy efficiency thereby leading to reduced electricity consumption. What is the likely response of electricity companies who are in the process of constructing new power stations which will require paying for over the next 15 years? "Go slow on energy efficiency improvements" I venture.

2. The development of renewable sources of energy (which generally involve no net emissions of atmospheric pollutants) must be the favoured method of meeting new electricity and heating needs in the UK.

In the last two years over 500 MW of new renewable energy projects have been accepted under the Non Fossil Fuel Obligation. Though what is to happen for future tranches of the NFFO is still in doubt, the inevitable effect of gross over-capacity as a result of new gas-fired power stations will be less commitment from the industry and Government towards harnessing renewables.

3. Gas can be far more efficiently used directly in homes and industry (for cooking, space and water heating, etc) than for generating electricity which is then used to satisfy the same needs.

4. Large power stations are not suitable for Combined Heat and Power (CHP) applications as the heat load is just far too big for there to be any customers. Skimming down the list in Table 1 shows that only a handful of proposals have anything other than rudimentary plans for utilising the waste heat. A genuine CHP plant should be aiming at achieving 80% efficiency. Instead most of the proposed new power stations will be wasting up to half of the energy content of their primary fuel.

About 2,000MW of electrical generation in the UK uses CHP (roughly 3% of total installed capacity). Progress is being made in small-scale applications and in industrial sized units (4 to 50MW capacity). No progress is being made in large scale CHP district heating schemes despite the Government's own estimates that the UK could be using up to 22,000 MW of CHP by 2005 and 30,000MW by 2020⁽¹⁾. Attaining this level of CHP development would reduce total UK CO₂ emissions by some 15%.

An ordinance under the German 1991 Federal Act on Pollution Control will oblige power suppliers generating waste heat through industrial processes, wherever possible, to make excess heat available for community heating of domestic and business premises. Local authorities in Germany will be able to use this new ordinance, and existing powers under planning law, to ensure that sites chosen for new power stations are close to potential users of heat. If similar policies existed in the UK, many of the current proposals would be stopped dead in their tracks as being wholly inappropriate for CHP.

The political commitment?

For the Conservative Government, the proliferation of gas-fired power stations is not all rosy competition springing from the success of privatisation. Firstly a significant proportion of the new generating stations will be owned

by the big two generators (National Power and PowerGen), undermining claims that the new stations will produce competition. Secondly, those which are not owned by the generators are mostly financed by consortia involving at least one of the Regional Electricity Companies (RECs), thereby raising suspicions of conflicts of interest. The RECs will effectively be supplying electricity to themselves under guaranteed contracts and passing the possibly inflated costs on to consumers. This would expose the Government to justified criticism from the electricity consumer.

Most importantly however, as can be seen by Graphs 1 and 2, the development of gas-fired power stations will dramatically impact on the prospects for British Coal. Because gas supplies are on 'take-or-pay' contracts, all the proposed stations will aim to supply base-load capacity (ie to supply electricity most of the time). This will take a devastating chunk out of the area currently supplied by coal. Yet, the implications for a Government attempting to privatise the coal industry are unpalatable - a vanishing industry with a vanishing market. It is not clear yet how the new Government will square this circle.

To register our disagreement with the direction in which the current energy 'policy' is taking us, Friends of the Earth has targeted its resources on fighting the large power station proposals. We are still awaiting the results of the two public inquiries at Didcot in Oxfordshire and at Staythorpe in Nottinghamshire (where Friends of the Earth, as represented through its local groups, were major objectors), both 1,300MW stations, and we are pressing for public inquiries for the other main station proposals. □

Reference:

(1) Memorandum to Intergovernmental Panel on Climate Change, Department of Energy, Energy Paper 58, 1990.

The after-effects of the Chernobyl accident show no signs of diminishing, as CRISPIN AUBREY, freelance writer on environmental issues and author of *Meltdown**, discovered at the Nuclear Free Local Authorities 'Legacy of Chernobyl' conference at Bristol in March. Continued efforts to gloss over the dangers, and the economic predicament of the CIS, make Chernobyl a lasting cause for concern.

Chernobyl six years on

AS the sixth anniversary of the Chernobyl accident approaches, the environmental and health situation in the areas most severely contaminated by the radioactive cloud shows little sign of improving, a crisis only compounded by the economic and political convulsions of a shattered Soviet Union.

This was the depressing message issued by a cluster of prominent Ukrainian and Byelorussian scientists at the March 11 Nuclear Free Local Authorities' "Legacy of Chernobyl" conference in Bristol. As one speaker put it in broken, understated English: "For a few million people, the environment has become unfriendly."

According to Dr Vladimir Tikhii, a physicist and member of the Ukrainian environmental group Green World, one unsuspected problem is emerging from the disintegration of "hot particles" of molten fuel thrown out into the atmosphere by the explosion, and scattered over a wide area of countryside. In some places a hundred of these minute particles, which contain plutonium, strontium and caesium, can be found per square metre of ground, he said. Their decay is now increasing radiation levels in areas where the expected pattern would be for a gradual decrease.

In some districts the level of activity measured in grass and milk is higher

than it was in the first year after the accident, said Tikhii. The greatest exposure, and therefore health risk, was to small holders who grew and consumed their own food, especially milk. Even up to 100 kilometres away from the power station, contamination in cow's milk could be well above the 370 becquerels per litre limit set by the authorities, he said, in some cases up to 3,000 Becquerels per litre.

Tikhii explained that the greatest proportion of radiation dose to the general population in the region continues to come from the Dnieper river, which flows into reservoirs north of Kiev, and is used for both drinking water and irrigation. About 30-40% of the collective dose to the population now comes from this water.

Deformities

He also described experiments being conducted on laboratory rats forced to live near Chernobyl and fed locally grown food. The rats displayed an increase in both general illness and tumours. Unusual deformities such as extra legs and even additional heads continue to be found among farm and domestic animals in the region.

The continuing observable health effects of the accident on humans were described by Dr Natalia Preobrazhenska, a biologist from the Ukrainian Academy of Sciences. Her

statistics showed that the number of children with enlarged thyroid glands (assumed to be the result of exposure to radioactive iodine in the immediate aftermath of the explosion) had steadily increased - from 34% in 1987 to 68% in 1991. The level of birth defects had also increased since the accident. At the same time, the proportion of healthy children had decreased.

One of her most interesting statistics was for the growth in population. This has been falling dramatically since the accident, having even reached the point now where the death rate is higher than the birth rate. "I can still remember the summer of 1986 when Kiev was emptied of children," she said. "It is very strange and terrifying when you can't hear children's voices any more."

Preobrazhenska directed her strongest words, however, against the authors of last year's International Atomic Energy Agency (IAEA) report, which minimised the direct health consequences of the accident and laid much of the blame on psychological stress (SCRAM 83). Its findings have been rejected in both the Ukraine and Byelorussia, and its optimistic gloss continues to rankle.

The large sums of money spent on the IAEA study can also now be seen in stark contrast to the severe financial and organisational problems faced by the newly independent republics,





which have had to take over responsibility for the Chernobyl aftermath from the collapsed central authorities. The economic and social confusion produced by the breakup of the Soviet Union has meant that the ambitious plan to relocate further large sections of the population from the contaminated zones (agreed only in 1991) have now effectively been abandoned.

Chernobyl taxes

Tikhii gave the example of the town of Poliske, only just outside the 30 kilometres "exclusion zone" around Chernobyl, where it had been planned to remove the entire population to new settlements.

The evacuation has now been limited to families with small children. In the current climate, it is simply not economically or practically feasible to do more. To finance emergency measures, special new "Chernobyl taxes" have had to be introduced in both the Ukraine and Byelorussia.

In contrast to these gloomy prognoses, Zhores Medvedev, author of one of the definitive books about Chernobyl, took a characteristically forthright approach, arguing that the disaster had transformed an environmental

and medical crisis into a political and social one. The politics of mistrust between the republics and the now discredited Soviet authorities had effectively swamped the environmental reality, which had now substantially stabilised.

Medvedev argued that the main emphasis now should be on solving the new republics' future energy needs. In a situation where uncertainties surrounded the supply of fossil fuels, and where electricity shortages have already occurred, he could see no alternative to a revival of nuclear power - now enhanced by a greater concern for safety. This would mean taking the mothballs off projects frozen by Chernobyl.

He gave the example of Armenia, where the nuclear station was closed in the aftermath of the 1988 earthquake. Especially in the context of Armenia's conflict with its neighbour Azerbaijan (normally a source of both oil and gas), the government is now considering reopening the plant.

However, consulting engineer John Large believes that the collapse of the Soviet Union's economic and social system meant that emergency plans where in disarray, and that "the people

of the republics are at greater risk of nuclear catastrophe than ever before".

Other speakers made direct connections between Chernobyl and the British situation. Plaid Cymru MP Dafydd Elis Thomas told a cautionary tale about the changes wrought on a Welsh farming household, especially in their attitude to the authorities. Don Arnott (who presented the latest version of his paper, written with Robert Green, arguing that Chernobyl was primarily a nuclear, not a steam, explosion) said that serious accidents on the same scale were just as possible in British reactors. Alan Jones, Somerset County Council's Emergency Planning Officer, said there was "still no acknowledgment that there will be a regional or national emergency" associated with an accident at a British nuclear power station.

The Russian visitors, meanwhile, who the day before had been shown round the Hinkley Point site (35 miles south west of Bristol) at the invitation of the Stop Hinkley Expansion group, expressed amazement that the official evacuation zone still only extends to a few kilometres. □

* "Meltdown: the collapse of the nuclear dream" by Crispin Aubrey. Collins & Brown; 1991, 188pp, £6.99.

Call for electricity shake-up

WIDESPREAD changes to the English and Welsh electricity industry are called for by the House of Commons Energy Committee. Their report, *Consequences of Electricity Privatisation*,* is highly critical of the new structures, in particular: the lack of genuine competition, the 'dash to gas' (see p14-15), the rundown of coal, the failure to promote energy efficiency and the reduction in research and development (R&D), writes *Graham Stein*.

The Committee's concerns over the low priority given to energy efficiency date back to 1988, when they unsuccessfully recommended changes to the electricity privatisation Bill. They call for alterations to the current pricing structure which offers no incentive to the Regional Electricity Companies (RECs) to promote energy efficiency, and express disappointment at the failure of the Director General of OFFER, Professor Stephen Littlechild, to be more imaginative in promoting energy efficiency. The position in England and Wales contrasts with the Government's planned privatisation in Northern Ireland which includes "a cap on the transmission and distribution company's revenue and makes provision for least cost planning." OFFER have now "endorsed the principle underlying least cost planning 'that there should be no distortion in the choice between demand-side and supply-side investments'" and the Committee call for "more vigorous and urgent action by OFFER in respect of energy efficiency than appears to be contemplated."

While there is currently overcapacity - and the National Grid Company (NGC) has predicted in its annual statement this will rise to 60% by 1997 - there is uncertainty over possible plant closure in the long-term, and there is now "no-one in the electricity supply industry with an obligation to supply." The Committee recommend that "generators be required to offer surplus sites for sale as an essential safeguard against this risk."

The length of notice given to the NGC of plant closure is nominally six months, but as plant can be declared unavailable without notice, prior to closure, there is in effect no notice. This could cause particular problems where closure(s) in one area would require grid reinforcement to maintain supply. The Committee recommended that the Notice of Disconnection time period be

Costs of electricity from gas-fired and coal-fired power stations

Power station type	Cost per unit of electricity without FGD (p/kWh)	Cost per unit of electricity with FGD (p/kWh)
New CCGT; gas at 23p per therm	2.89	—
New CCGT; gas at 20p per therm	2.64	—
Existing large inland coal-fired, using British coal	2.20	2.73
Existing large inland coal-fired, using imported coal	1.66	2.19

Sources: Alfred Roberts, *What PowerGen Wants*, *Colliery Guardian*, September 1991. See also *Min of Ev*, pp.36-7.

"related to the time needed to reinforce transmission or distribution systems."

Another doubt raised was "whether peaking plant will be sufficiently rewarded for generators to provide it or keep it available" and the Director General is urged to keep this matter under review.

The uncertainty of future supply is further confused by the nuclear power sector: whether the Magnoxes will be kept running; whether the EC will allow an extension of the nuclear aspects of the Non Fossil Fuel Obligation beyond 1998; and the 1994 review.

Market domination by the National Power/PowerGen (NP/PG) duopoly is preventing competition and therefore the benefits of efficient generation, lower costs and improved customer service which were meant to follow privatisation.

NP and PG "together account for 78% of electricity generation in England and Wales." There is "the temptation to 'tacit collusion' in a market where total demand is relatively insensitive to price but ... demand for each company's product is very price-sensitive."

The duopoly also has a "strong position in the contract market" and the "ability to influence and control Pool [wholesale electricity market] prices."

The Pool, which determines half hourly prices for electricity, comes in for much criticism. The three main aims of the Pool are: to determine the cheapest generating stations, to determine the cost and price at which electricity is traded, and to ensure that sufficient generating capacity is provided. However 95% or more of the Pool throughput is covered by contracts, "casting doubt on the Pool's ability to fulfil any of its three functions."

The only sizable opening in the new market for Independent Power Producers (IPPs) has been in the 'dash to gas'. As the Committee note: "All significant independent generation projects involve gas-firing using Combined Cycle Gas Turbine (CCGT) technology." And furthermore, "there

are not in fact any genuinely independent power producers in the sense originally envisaged ... [selling] electricity into the Pool at Pool prices." Instead, "all the substantial IPPs have long-term contracts [with] regional electricity companies (RECs) ... and in some cases RECs hold an equity stake in the IPPs they are contracting with."

The merit in this upsurge in gas generation is questioned by the Committee, who doubt the long term benefits of switching to gas. Where new gas-fired plant is currently cheaper than the coal-fired plant it will replace, this is due to the present low price of gas. And where generating stations are owned or part-owned by RECs, there is the suspicion that these stations "would be given preference [over coal stations] even if somewhat dearer."

While the Director General is meant to ensure that RECs purchase from the cheapest generating plant, his review is not due until 1995, and if any "breach had resulted in the closure of coal-fired stations producing cheaper electricity and of the pits supplying them, refunds would not bring the stations and pits back into service." They observe that "for practical purposes, closures of deep mines are irreversible."

Research and Development spending has fallen from £201 million in 1988/89 under the CEEGB, to a combined expenditure from its successor companies of £100 million a year. The Committee "recommend that the Department [of Energy as it then was] commission an independent assessment of electricity-related R&D to identify areas where too little R&D is being carried out and ways in which the Department could assist manufacturers or others to undertake it."

From the report it is clear that, with the exception of wider share ownership, none of the main objectives of electricity privatisation set out by the Government have been achieved. □

* "Consequences of Electricity Privatisation" House of Commons Energy Committee; HMSO, 26 Feb 1992.

Renewable review

A target for renewable energy generating capacity of 3-4,000MW, by the year 2000, should be adopted by the Government, says the latest report on renewables from the Commons Energy Committee*.

Representing a four fold increase on the current proposals, the Committee believe that "the technical potential of the resource in the UK justifies an ambitious target, and that such a target would stimulate increased use of renewable energy."

In giving evidence to the Committee the then Energy Minister for renewables, Colin Moynihan, said his Renewable Energy Advisory Group (see "Group in the dark" below) "will now reassess the 1,000MW figure in line with our belief that renewables could potentially produce 20% of our current electricity demand by the year 2025, if they can be commercially deployed." He also said that the high take up of the Non-Fossil Fuel Obligation (NFFO) had made the current target "effectively meaningless".

The NFFO - which was designed to protect the nuclear industry from the ravages of the privatised electricity industry - has been successful in so far as it has provided a "kick start" to commercial exploitation of renewables. However, as the renewable tranche, which was added as an after thought, has become "firmly established" the Committee agrees with Moynihan that "there are no significant advantages to combining the two."

Indeed, there is a significant disadvantage to the grouping. The European Commission has restricted the NFFO as a whole to the period up to 1998. According to the Commission this was "solely due to the fact that support for

renewables was included in what is basically an arrangement to subsidise nuclear power", and it did not wish to authorise subsidies for nuclear power beyond that date.

However, as Iain Lees, head of the Energy Technology Support Unit (ETSU), confirmed at the beginning of April, the Commission has told the Government that it will allow the renewable tranche to continue after 1998. A decision which had been expected by the Energy Committee who want the Government to "announce details of the extension beyond 1998 ... in time to make possible a third renewables Order later this year, and in time for the first renewables Orders in Scotland and Northern Ireland." While both Scotland and Northern Ireland were excluded from the NFFO, they are set to have their own obligations established by the end of next year.

External costing will play a large part in the take up of renewable energy sources. "There are clearly a number of costs associated with generation from conventional fuels which are at present not acknowledged in the prices actually charged," note the Committee, adding: "The economic case for renewables would be considerably strengthened by incorporating external costs in energy prices."

They agree with Professor Stephen Salter (*Safe Energy* 87) who said "nobody ever gets a bill for [external costs] but somebody really ought to", and also with Moynihan that assessing such costs "is one of the critical issues in environmental and energy policy in the 1990s, worldwide." They call on the Government to urgently establish the external costs of the various energy sources.

Research and development funding of renewables remains "low". While renewables received £24 million in 1991-92 the nuclear industry attracted £92.9 million: "We accept that there is no

necessary causal link between the amounts spent on renewables R&D and other R&D. However, since the Department's R&D budget is not infinitely elastic, we conclude, and regret, that some constraint is still being exerted on the renewables R&D budget by the demands of nuclear R&D."

After recounting the sorry story of Salter's Duck the MPs conclude: "It is difficult to regard the history of renewable R&D funding in the UK as other than a history of volte-faces, premature judgments and plain errors".

Further, a full analysis of the "costs and advantages of separating" the Energy Technology Support Unit from the UK Atomic Energy Authority should be embarked upon, because being at Harwell puts the Unit in a "vulnerable position" and "is sending quite false messages to the public and the market."

A number of specific Government responses are urged by the Committee:

- a demonstration off-shore wind farm, in light of the enormous potential and low environmental impact;
- passive solar design is capable of immediate expansion and would benefit from an information campaign amongst architects, developers and others; passive solar design features must be incorporated into building regulations when they are next up-dated, and all new Government buildings must also include passive solar;
- establishing, "now or in the near future", a demonstration project of between 500 and 1,000 domestic and commercial buildings where photovoltaics are built into the structures;
- giving significantly higher priority and funding to wave energy. "In view of the unhappy history of wave energy R&D in the UK, a substantial increase in funding ... would be a particularly strong signal of the Government's increased commitment to renewable energy." □

* "Renewable Energy: Vol I" House of Commons Energy Committee. HMSO; April 1992, £10.75.

Group in the dark

WITH the disappearance of both Colin Moynihan, former renewable energy minister, and the Department of Energy (DoEn), after the General Election, concern is now mounting over the fate of the Renewable Energy Advisory Group (REAG).

The Group brought together last August by Moynihan was established to prepare a comprehensive report and action plan on the development of renewable energy in the UK. Now, however,

as the DoEn's responsibilities have been taken over by the Department of Trade and Industry (DTI) it seems that the report, which was in draft form before the election was called, will never see the light of day.

David Lindley, of the Wind Energy Group and a member of REAG, said: "It would not be realistic of me to say that I was not anxious that the report will fall between the cracks. We just have to rely on finding a sympathetic voice within the DTI."

"A draft had been produced by the civil service and the intention was that

there would be at least two meetings to consider the report. Both were cancelled when the election was announced. But now we need to meet to finalise the conclusions and recommendations."

The DTI say they are under no obligation to publish REAG's report, which is believed to be highly critical of the Government's approach to renewable energy sources.

■ The new Minister with responsibility for renewables and the privatisation of the coal industry is Tim Eggar. □

Power plants

ENERGY from plants could provide an ideal solution to two of the European Community's most pressing problems - air pollution and the agricultural crisis - according to the European Commission who are proposing to both increase taxation on fossil fuels and cut tax on bio-fuels by 90%.

Plans drawn up by the 12 Agriculture Ministers outline alternative uses for food crops. They include converting sugar beet into paint and petrol solvents, vegetable oils into diesel fuel, straw into feedstock for electricity generation, oilseed rape into industrial lubricant, and flax and hemp into paper.

British farmers - who can currently net up to £70,000 annually for doing nothing - are keen to attract some of the £35 million which has been earmarked by the Agriculture Commission (AC) for pilot projects. Research conducted by the AC shows "that there is enormous potential for green fuels and that in future they could account for half our energy resources."

A discussion paper presented to the recent AGM of the National Farmers Union (NFU)

said: "Straw can be used as a fuelstock for electricity generation. Shell estimates that it could run a straw-fired district heating scheme for around the same cost as a coal fired station. Oilseed rape (OSR) straw would be more attractive because of its higher calorific content."

Last year British farmers' incomes fell to their lowest level since the war. NFU speaker Trevor Hayes said, "the very fact that local branches have requested that we discuss the matter at AGM gives an indication of how important the ideas are to our members, for whom financial disaster is the biggest concern these days."

The response of the Energy Technology Support Unit (ETSU) has so far been subdued. Energy Crops project officer at ETSU, Dr Faith Coleshaw remains sceptical: "There would still be a need for government support in terms of a tax incentive and this would have to be justified by the environmental benefit."

Plant Breeders International Cambridge (PBI), however, believe public concern over pollution and discontent over tax payers money being spent on land set-aside will force a Government rethink. They believe "there are several reasons why we may see

a significant bio-fuels industry in Europe within the next 12 to 48 months."

Austria already uses rape methyl ester (RME) - a combination of OSR and methanol - as a direct substitute for diesel. Trials are also being conducted in France and Germany. While power outputs are only slightly down on diesel, pollution is significantly reduced: soot production is cut by half and almost no sulphur is given off. Carbon dioxide (CO₂) is taken up in the growing cycle so RME does not in effect produce CO₂. The fuel is also biodegradable, with 98% breakdown in 21 days.

Meanwhile, the Science and Engineering Research Council (SERC) and the Agricultural and Food Research Council are also exploring the bio-fuel alternative. Under a £20 million new programme designed to explore clean technologies they will attempt to improve the energy capture of plants. Currently photosynthesis in wild plants and crops convert around 4.2% of solar energy falling on them. SERC hope to nudge the capture rate up to about 5%. If this were achieved then one-tenth of the world's cultivated land could provide all the fossil fuel energy currently used. □

Danube dam debacle

IF Czechoslovakia (CSFR) has not halted all work on the Danube hydro plant at Gabčíkovo (*Safe Energy 86*) by April 30 then the Hungarian Government, by an overwhelming vote, has been instructed by its parliament to cancel the 1977 agreement between the two countries on water use in joint stretches of the Danube.

One of the few people to oppose the vote was the Hungarian environment Minister, Sandor Keresztes. He proposed a compromise which would allow the CSFR to complete the plant. This brought immediate calls for his resignation and accusations of secret talks between him and Prague.

Czechoslovakia for its part has brought the case before the European Community for arbitration. It is willing to abide by the decision of an international tribunal. Julius Binder, head of the company building the facility, has told the Prague government that should competent authorities proclaim the project an environmental hazard then they would tear down the dam and restore the site. However, he believes the opposite to be true, that "only Gabčíkovo can save the Danube." The CSFR warns that without Gabčíkovo they will be unable to shut down any of their notorious brown-fuel fired power station and will be forced to continue operating dangerous nuclear stations.

Gabčíkovo is a fixed element in the Czechoslovakian energy plan to the year 2005, which was released at the beginning of February. □

Fuel cell advisory panel

BILLED as a "new opportunity towards exploitation of fuel cell technology for the UK", the Government have announced the establishment of a Fuel Cell Advisory Panel, aimed at accelerating the development of fuel cell systems (*SCRAM 76*) for early application in the UK.

Introducing the Group, drawn from a number of public, academic and private concerns, David Heathcoat-Amory, then minister of state for energy, said: "Fuel cells offer the prospect of high efficiency with low environmental impact and reduced

emissions of carbon dioxide - a major greenhouse gas. Potential applications ... include combined heat and power systems, power generation and transport."

Announced in early March, the Panel will "develop plans for a programme building on existing expertise and aimed at potentially attractive opportunities for early fuel cell applications in the UK."

It will also "provide a forum for monitoring and co-ordinating the development of fuel cells in the UK and advise the Department of Energy [now presumably the Department of Trade and Industry] on its support for an advanced fuel cell development programme". □

Solar market

PHOTOVOLTAICS (PV) could receive a boost following the Department of Energy's (DoE) assimilation within the Department of Trade and Industry (DTI). A recent report from the Energy Technology Support Unit (ETSU) indicated the technology's export potential - which was never an interest of the DoE, but should appeal to the DTI.

ETSU estimate that "World PV markets are expected to grow very substantially, and UK companies may anticipate obtaining significant market share. Export sales of value up to £700 million per annum are projected." They add: "Particular markets to note may be that for power plants in Southern Europe, and markets in the developing countries of Asia."

As for the domestic market ETSU state: "PV is unlikely to make a significant contribution to UK electricity supply by 2025. An installed capacity of about

200MW is projected, some two-thirds attributed to consumer products and one-third to grid connected (primarily building-integrated) systems. Although remote power systems are economically attractive, their potential contribution is limited by the size of the relevant markets."

PV offers advantages over wind turbines implies ETSU: "Compared with certain other electricity generating renewable technologies, PV may avoid problems associated with noise pollution and, in so far as it is deployed as building-integrated systems, land use and visual amenity."

The report concludes that the main areas of interest identified for the UK are: "distributed, grid-connected systems, mounted on buildings. Such systems integrated into new commercial buildings are identified as potentially the most promising PV technology for deployment in the UK." □

* "Review of Photovoltaic Power Technology" ETSU, 1991.

Carbon taxes Earth Summit

PLANs for a European Community (EC) carbon/energy tax are making progress, with agreement in principle expected in advance of the UN Earth Summit being held in Brazil in June.

The proposals, being vigorously promoted by EC Environment Commissioner Carlo Ripa di Meana, would impose a levy based half on energy consumption and half on carbon content of fuels (*Safe Energy* 85). The tax would rise from an initial \$3 per barrel of oil to around \$10 by the end of the century.

An environmental 'action programme' for 1993-2000, of which the carbon/energy tax is the major part, was approved by the European Commission on March 18. The programme aims to arrest a forecast 25% rise in energy use by 2001 and an associated increase in CO₂ of 20%, limiting emissions to 1990 levels by 2000.

A final decision on the tax is expected at a joint meeting of EC finance, energy and environment ministers on May 24. Opposition could come from those countries with large coal reserves - Germany, the UK and Spain - and from Portugal and Greece, concerned at the short-term effects on their struggling economies. Foratom, the European federation of nuclear industries, opposes the tax claiming nuclear power "is clean, friendly to the environment and emits no CO₂" and should be exempt.

Despite plans for either exemption or subsidy for intensive energy users, European business and industry has also challenged the carbon/energy tax claiming it

would cripple EC companies on world markets unless the USA and Japan introduced similar measures. It is with a world view that Ripa di Meana is pressing for agreement, to allow the EC to take a lead at the Earth Summit and persuade other countries to introduce similar schemes. However, the prospect of international accord in Rio is looking bleak. The main obstacle is the refusal by the USA to set a national target for CO₂ emissions. Their stance has emerged during a series of pre-Summit meetings of the International Negotiating Committee which is charged with drafting a convention to combat global warming.

Third World countries, angered at the US line, have highlighted a study by US economists which indicates that a 35% cut in CO₂ emissions could be achieved with little or no cost to the US economy. Without a lead from the US and other industrialised countries (which produce 75% of world CO₂ emissions) the developing countries see no reason for involvement in any sort of agreement.

Meanwhile, recent reports have suggested that both ozone depletion and sulphur dioxide emissions are having counter effects to global warming, but the serious prospect of a global temperature rise remains. The Intergovernmental Panel on Climate Change forecast a rise of 1°C by 2025 unless there is immediate action. The place to initiate such action will be in Rio this June.

■ While Britain will not be immune to rising sea levels from global warming, it may be protected from changes in temperature according to former Meteorological Office head, John Houghton.

Mixing of ocean waters in the Atlantic between Greenland and the North of Scotland may absorb any local warming. The sea around Greenland sinks to the bottom of the ocean as part of a

stirring of the oceans in a process which takes thousands of years. The only other area where this phenomenon occurs is in the Southern Ocean around Antarctica. According to Houghton, the ocean waters will carry the heat with them reducing local temperature rises.

■ Once again Britain is blocking progress on EC environmental action; after months of stalling, the British Government has won exemption from the first legal measure in the EC's environmental 'action programme', adopted in March.

Part of an energy efficiency plan - Specific Actions for Vigorous Energy Efficiency (SAVE) - the measure sets energy efficiency standards for domestic heating boilers. However, according to Andrew Warren of the European Association for the Conservation of Energy, Britain's exemption means the directive will achieve far less than it should. Instead of a saving of 10 million tonnes of CO₂ per year, half of this in Britain, the total saving is now estimated at 6.8 million tonnes.

While the directive will prevent sales of Britain's inefficient boilers to other EC countries, eastern Europe could provide a considerable new market. Warren believes that this could slow the adoption of efficient technologies in the east.

70% of British made boilers, and 60% of those sold in Britain, for domestic heating are small, cast-iron and with little insulation - rather than the larger well insulated copper boilers common in continental Europe - and could not meet the new EC efficiency standards. The Department of Energy argued that as British boilers are normally located in kitchens or old chimneys, rather than basements or garages, the heat 'loss' provides useful space heating. □

IN BRIEF

Irish wind interest

IRISH concrete maker, Sean Quinn Group, which spends £2m yearly on electricity, hopes to build a wind farm near its plant. A 5 year pay-back is expected on a £10m investment. Forty 250kW turbines will be erected 700 feet up Slieve Russell mountain on the borders of County Mayo and Fermanagh.

This project has raised Irish interest in wind technology, particularly at sites identified by the Department

of Energy along the west coast, among Europe's best wind energy sites. On one site, in County Mayo, Nordtank of Denmark is to build Ireland's first wind park, with British and Irish partners.

UK wind finance

NATIONAL Wind Power has signed loan contracts with Barclays for £18.5m for three wind farms, totalling 19.5MW at Cemmaes, Wales; Cold Northcott, Cornwall; and another Welsh site yet to be named. A further £7m demonstration grant has been allocated by the Department of Energy.

Danish wind success

DENMARK went into 1992 with an installed wind turbine generating capacity of 410MW and 3,230 turbines, owned by private individuals, commercial groups and power companies. From 1980 to the end of 1991, Danish companies produced 11,497 turbine units totalling 1,252MW. The bulk of this production - 8,267 turbines, 842MW - has been exported.

Clean-coal

CLOSURE of British Coal's clean-coal combustion trial at Grimethorpe, after 12 years (*Safe Energy* 87), may not be the end of the

story. "There is a very good chance of a major demonstration project going ahead," says Stephen Dawes, research manager at BC's Coal Research Establishment. Front runners to build the plant are GEC Alsthom.

Shetland wave

PLANs for the world's first commercial wave plant, at Fugla Ness, Shetland, depend on persuading the EC that it's a hydro-electric station. Only then, is the scheme likely to get a 40% grant towards the £5-10m costs. The Tapchan project's backers include Dutch construction company Volker Stevin and Scottish Hydro-Electric. □

REVIEWS

The Hinkley Point 'C' Public Inquiry: implications for policy outcomes by Jane Roberts.

The Open University Technology Policy Group;
1992, 37pp, £5.

The first section of this report looks at how the changing 'policy backdrop' of the Government's confused electricity privatisation affected the Hinkley Inquiry. While the pulling of first the Magnox stations, and then the rest of the nuclear plant had been widely predicted, "the CEGB, backed by the Department of Energy, [had been] basing its case on Government policy as set down in the [privatisation] White Paper and later the Electricity Bill". The effect of this was that the Inquiry "proceeded for fourteen months down a blind alley".

The last few weeks of the Inquiry brought new evidence showing a 10% increase in the

capital cost of Sizewell 'B', the Government's total retreat from privatisation of nuclear power, and the announcement of the moratorium and 1994 Review.

Roberts goes on to look at what impact the proceedings at the Hinkley Inquiry had on the Government's privatisation. She concludes that there is no evidence of any more than a minor effect. Opposition members on the Standing Committee scrutinising electricity privatisation were well briefed with evidence being presented by several groups to the Hinkley Inquiry. However, the only significant change to the Bill was on energy efficiency, which at the end of the day was a severely

diluted version of a House of Lords' amendment.

Media coverage of the Inquiry was very limited, and Roberts quotes the reason for this given by Roger Milne, one of the journalists responsible for most of the national press coverage: "Covering big public inquiries is a bit like punching blancmange. It's not that the issues themselves are insubstantial, but getting what us journalists consider 'a firm handle' on the proceedings can be extremely difficult, persuading a news desk to take the resulting copy even harder."

The most interesting section of the report is the third and final part on the 1994 Review. Roberts concludes that the Hinkley Inquiry could have a major effect on the Review. Most crucially she expects the concept of 'diversity credits' - which emerged at the Inquiry - to be presented to boost nuclear's case. Diversification was originally presented as an "unquantifiable" benefit by

the CEGB, but under pressure from the Inspector's economics assessor, Professor Alistair Ulph, some attempt to quantify the economic advantage, at least in regard to possible fossil fuel price rises, was made. The Inspector argued in his report that this idea, if it was to be used as a justification for nuclear power, would need to be further developed. Nuclear Electric and the Department of Energy (as was) are now working on this idea.

Together with 'environmental credits', 'diversity credits' could play a prominent role in the 1994 Review.

The report contains a lot of useful, well referenced material on the Hinkley Inquiry, the 1994 Review and the Public Inquiry system in general. Its message, for me, is that the nuclear industry will be well prepared for 1994, and any subsequent inquiries, so the anti-nuclear movement had better get its act together too!

GRAHAM STEIN

Global Warming: who is taking the heat? by Gerald Foley.

Panos; 1991, 99pp, £4.95.

Global warming is now established in the public consciousness. In this short and readable book, which is aimed at the lay reader rather than the expert, Gerald Foley sets out to outline concisely the causes and history of global warming. He explains what the greenhouse effect is, showing that it is necessary for life on Earth, and is caused by greenhouse gases in the atmosphere.

Each of the greenhouse gases, whether natural or manufactured, is discussed, and a useful table comparing the various gases, showing such quantities as concentration and lifetime in the atmosphere is shown, but, oddly, the table omits water vapour.

Foley highlights the particular menace of the chlorofluorocarbons (CFCs), not

only as greenhouse gases but also because they damage the ozone layer of the, thereby exposing living creatures to the dangers of increased ultra-violet radiation. It is sobering to realise that each molecule of CFC can destroy 100,000 molecules of ozone.

Scientific forecasts of the effects of steadily rising emissions of greenhouse gases are discussed in some detail, heavily qualified by the limitations of current computer models, cost restrictions on computing time, some lack of quantity and quality of global weather data, and considerable uncertainty about the exact role of the oceans.

The conclusions, however, point firmly towards doubled greenhouse gas concentrations by the year 2030,

accompanied by a rise of sea level of 20 cm, and more frequent extreme climatic events, if nothing is done to reduce the emissions.

The implications of global warming are presented on three fronts: food security, sea level change and ecological disruption.

For most of the world's people global warming will lead to greater food shortages. The change in sea level will affect millions who live in low-lying coastal lands. Intrusion of salt water into fresh water reserves will increase. Ecologies will be affected, from coral reefs through mangrove swamps to disease carrying insects and viruses.

Foley shows that reducing the effects of global warming can be achieved by energy conservation (*without* reduction in Western living standards), energy-efficient architectural design, improvements in transport efficiency, elimination of CFCs, switching fuel sources, renewable energy technologies and reforestation.

Lastly, the policy implications for the Third World are discussed. This entails allocating responsibilities for current and future emissions of greenhouse gases, increasing Third World participation in international discussions, support for research, energy pricing for efficiency and equity, monitoring the increase in fossil fuel consumption that is likely as Third World economies develop, and reviewing debt, trade and aid.

The overall tone of this book is neither alarmist nor complacent, and it presents its arguments dispassionately. It is disheartening that Foley considers that renewable energy will make only a small contribution to world energy demand until at least the middle of the next century. Nevertheless, this book is well researched and written, with many interesting facts about the global energy scene, and is worth having as a slim reference book.

KEN BENJAMIN

REVIEWS

Nuclear Power: Way Forward or Cul-de-Sac? by Peter Bunyard.

The Ecologist; 1992, 93pp, £7.*

This is a follow up to last year's Ecologist publication "Nuclear Power: Shut it Down" (*Safe Energy* 85), and is a logical step from providing groups with a collection of articles covering all aspects of the nuclear/safe energy debate.

Here, Peter Bunyard reprocesses the for and against nuclear arguments and produces a tight, no-nonsense, guide to the industry's downfall. He peels away the green veneer off the nuclear

industry's public relations, showing the superficially attractive idea that nuclear power is needed to combat global warming to be the antithesis of reality. "In terms of tackling global warming, any commitment to nuclear power is likely to be far less effective in terms of investment for carbon dioxide saved compared with the environmental benefits of energy conservation, including improved efficiencies, and the reforestation of degraded

lands. In the ... US, energy saved is four times more cost effective in terms of reducing carbon dioxide emissions than is nuclear power."

Several appendices are provided including: an outline of each of the main types of reactors operating world wide; a basic guide to reactor physics; and a brief look at matters of secrecy - "The nuclear industry needs cover-ups simply because so many details of its operations will not stand up to the light of day."

Tackling the issue in self contained sections - "The certainty of Nuclear Accidents"; "The problems of Reprocessing"; "Proliferation"; "A New Energy Strategy"; etc - each chapter provides well rehearsed anti-nuclear

arguments that would be invaluable to anyone, especially those in eastern Europe and developing countries, entering into public debate.

"From whatever point of view - safety, costs, environmental impact, energy efficiency or weapons proliferation - it has become manifestly clear that the world cannot afford nuclear power," concludes Bunyard.

MIKE TOWNSLEY

* Copies for sending to Eastern European and Third World groups can be obtained for £4 (inclusive of postage) from The Ecologist, Worthysvale Farm, Cornwall PL32 9TT. Institutions will be charged £15.

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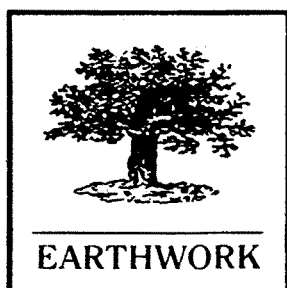
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LITTLE BLACK RABBIT



New(clear) age philosophy

Our friends at Nuclear Forum have finally clasped to their bosom the spirit of the New Age. A disciples of 'green guru' James Lovelock. They enthusiastically claim that, in his tome "The Ages of Gaia", Prof. Strangelove informs us that the dangers and benefits of exposure to radiation are equivalent to those of breathing oxygen. They quote, "...breathing is 50 times more dangerous than the sum total of radiation we normally receive from all sources." LBR suggests that they might also try the argument that higher levels of radiation can actually arrest the oxygen-driven ageing process - as illustrated by the reduced incidence of death by old age in the Chernobyl area.

Who knows, the Oxygen Poisoning Theory may yet be used to support the continuing decimation of the world's rain forests. But don't hold your breath ...



Stranger than fiction

The UKAEA have recently discovered that Fax messages are almost as difficult to keep track of as uranium. Two of their wayward communications, intended for Tory friends in the European Parliament, were mistakenly sent to Labour MEP Llewellyn Smith (not a

particular friend of theirs). One of these messages urged stalling measures against a planned socialist move to stop nuclear reprocessing in the UK, following the 'paper' loss of uranium at Dounreay. In a move which cannot be assumed to illustrate their general practices and policies with regard to leaks, the Authority then sent a third message, urging the involuntary mole to destroy the first two. As a result, of course, no-one ever heard about the matter.



Underground dumping

British Nuclear Fuels continue to impress with their clear vision of what they're going to do with all that waste. At a recent PR event, they issued a fascinating brochure to the assembled hacks how high-level nuclear waste would be sent to an underground dump in Sellafield, after 50 years storage. But the hopes of the anti-nuclear lobby that their long-denied claims had been vindicated, were dashed when it was revealed that the offending bumf was two years out of date. However, it was still held as a possibility that the waste would be redefined as 'medium-level' after 50 years, to allow this very course of action to be taken. Perhaps BNFL are working along the lines that, if they bury it deep enough, the troublesome material can then be described as 'low-level'?



Wildlife (1)

A heart-warming story from Tormess: environmentally-friendly staff at the East Lothian AGR station have voted to sponsor a family of giraffes at Edinburgh Zoo. Could be that the decision was swayed by a wave of fellow-feeling amongst the power industry's very own endangered species. A fair choice, in the circumstances, as the Zoo is currently fresh out of white elephants.



Wildlife (2)

The Independent has reported a plague of bunnies in the grounds of Hunterston power station. It appears that, having found some gaps in the old perimeter fence, they are now protected from predators by the new one which encloses their rapidly increasing population. Any jokes about fast-breeders to LBR. Sorry, no prizes.



Fast breeders

A recent report by Spanish scientists reveals that workers at the Kuzoduy nuclear plant in Hungary have an increased sex drive.. LBR suggests that the workers, aware of the effects of radiation on the gonads, are anxious to get their reproduction in first.

Three ways to promote safe energy

Three ways to help SCRAM: fill in the appropriate section(s) together with your name and address and return the form to the address below.

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