

## COMMENT

ONE are the days when nuclear disarmament campaigners focused their attention on the threat of mutually assured destruction (MAD); now they are becoming increasingly aware of the threat posed by nuclear proliferation.

The Non-Proliferation Treaty (NPT) which seeks to check the spread of nuclear weapons is up for review in 1995, at which time there will be calls for the treaty to be made permanent. Calls which will be resisted by several signatories who cannot fathom the logic of weapons states which seek to debar others from the nuclear club while escalating their own status as 'nuclear powers'. The UK is just such a weapons state: while condemning North Korea's decision to leave the NPT and pointing the finger at Iran and others, its actions fall far short of its words.

If the UK continues with its plans for developing a new Tactical Air-to-Surface Missile, builds the maximum number of warheads for Trident, and opens the Thorp reprocessing plant, it will be seen as the world's worst proliferator, and be in no position to encourage others to forego the so-called protection offered by the nuclear deterrent.

North Korea in particular has cited the planned operation of Thorp as one reason for its position. It is clearly worried about the massive stockpile of plutonium being built up in Japan. While the Japanese insist that it is for peaceful purposes, they are now a de facto nuclear weapons state. The availability in open literature of the technical information required for weapons manufacture and the high degree of industrialisation there, means it could use plutonium from its stockpile to create nuclear weapons in a matter of months.

Indeed, the Japanese who are at present building their own reprocessing facility to remove plutonium from spent fuel have criticised the North Koreans for similar ambitions. If there is to be a genuine commitment to ending the threat of nuclear calamity then all nations must make an equal effort and be subject to the same rules.

The UK Environment Secretary has decided to hold a further round of public consultation on Thorp to establish the justification for the plant. Such a consultation should give equal weight to consideration of the justifications for not opening the plant. If it opens and large quantities of fissile materials start travelling the world it can only be a matter of time before some of the material ends up in an 'unauthorised' nuclear weapons programme.

There is no justification for reprocessing, the government has rejected fast reactors, uranium supplies are abundant at low cost, its Radioactive Waste Management Committee says there are no waste management justifications for the process. All we are left with is the government and British Nuclear Fuels' belief that the plant will make a profit and even this position is subject to considerable doubt. That leaves only one question for the government to answer. How many pieces of silver are they willing to accept to derail the process of nuclear disarmament? The 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.

> scram, s*kram, v.* to shut-down a nuclear reactor in an emergency.

#### CONTRIBUTIONS

We welcome contributions of articles, news, letters, graphics and photographs, which should be sent to SCRAM at the address below.

#### LETTERS

SCRAM reserves the right to edit letters to fit the available space.

#### ADVERTISING

Advertising rates are:

Full page (190 x 265mm)	) £.	140
Half page (190 x 130mm	) 1	275
Quarter page (90 x 130m	ım) i	240

Inserts can be mailed out with the journal – details on request.

#### BACK ISSUES

Back copies of the journal are available for most issues. Copies from the previous year cost  $\pounds$ 1.50 (inc. p&p) or  $\pounds$ 7.00 for the set of six. Issues more than a year old are  $\pounds$ 1.00 (inc. p&p).

#### SUBSCRIPTIONS

For details of subscription rates see the form on the back page.

#### FOR THE BLIND

The text of Safe Energy is now available on disk for people who are registered blind. This service is available at a charge of £3 above the appropriate subscription rate – this covers the cost of the disks and administration. Further information available on request.

#### PRODUCTION

Editors: Mike Townsley Graham Stein.

Front Cover: David Shaw.

Published by SCRAM, 11 Forth Street, Edinburgh EH1 3LE.

☎ 031-557 4283 Fax : 031-557 4284

ISSN 0140 7340 Bi-monthly



## FEATURES

### 8 1993 nuclear review

Despite promises from government ministers of a wideranging review, the hastened examination of the nuclear industry may be no more than an assessment of whether the 'market' wishes to build new nuclear power stations. Financing of the industry's liabilities and the problems of nuclear waste could be ignored, warn **Dr Patrick Green** and **Simon Roberts** of Friends of the Earth.

CON	TENI	<b>`S</b>
Comment	ŧ	2
Nuclear N	News	4-7
Features		8-17
Safe Ener	gy .	18-21
Letters		22
Keviews	ick Rahh	23 it 24
Luite Diu	ich muuu	<i>u 2</i> 4

#### 10 Nuclear terrorism

World stocks of plutonium are growing and with them concern over potential misuse. **Dr Frank Barnaby**, former director of the Stockholm International Peace Research Institute, looks at the possible use by terrorists of both military and civil grade plutonium to produce nuclear bombs.

#### **13** Magnox gamma shine

Often overlooked in the controversy over the future of Britain's ageing Magnox reactors are the health risks of direct radiation from nuclear reactors. Ian Fairlie, of the Socialist Environment and Resources Association (SERA) energy group, argues that the Magnoxes cannot be operated within new radiation limits.

## **14** Clean-coal technology

Despite its environmental effects, coal will inevitably remain a vital world fuel for decades to come. The latest developments in reducing pollution from coal-fired generation are detailed in *Coal-use technology* — *new challenges, new responses* by Walter C Patterson and the report is reviewed by **Max Wallis**, a researcher in atmospheric science and energy systems at the School of Mathematics in Cardiff.

### 16 Thorp: to be or not to be

If the Thorp reprocessing plant at Sellafield gets government approval, BNFL's plan to return 'equivalent' amounts of high-level waste to customers rather than transport large quantities of intermediate-level waste will leave Britain the problem of dealing with dangerous foreign waste, explain **Professor Andrew Blowers** and **Dr David Lowry**, who call on the government to abandon the plant.

## Plus SCRAM's 1992/93 Annual Report

#### Privatisation and/or bust

NUCLEAR industry decommissioning plans have been slammed as untested and uncertain by the National Audit Office in a report which shows that despite the extensive debate and posturing of openness nobody actually has a clue what UK nuclear power costs.

The NAO says that Britain's nuclear decommissioning liabilities total around  $\pounds 17.9$  billion, undiscounted, a sum that the nuclear industry is in no way able to meet, and which according to the Office's "specialist engineering" advisors is "conservative".

Of this £17.9bn, March 1992 prices, £7bn is for Nuclear Electric's (NE) liabilities, £1.6bn for Scottish Nuclear (SN), £5.2bn for British Nuclear Fuels and £3.4bn for the Atomic Energy Authority. They have also identified further NE liabilities of £17.5bn, including the costs of reprocessing, which would have to be met before the costs of decommissioning.

Having based its calculations on nuclear industry estimates, it is worth noting that a 1991 review of the AEA estimate found it to be optimistic and incomplete. AEA agreed at the time that with larger risk margins the figure could be "substantially higher". However, little work was done to improve the estimate, "since much of the [decommissioning] work will be done well into the next century the Authority do not consider it cost effective to devote resources to the production of detailed estimates." AEA's liabilities will be met by the taxpayer.

#### Uncertain

In calculating their liabilities, the nuclear companies assume that the Nirex repository for low and intermediate-level waste will be available at Sellafield by 2010 and that decommissioning can be carried out in three stages: removal of fuel from the reactor immediately following shutdown; making the plant weatherproof and secure for over a century; and then finally removing the plant and any waste. The NAO notes that: "In the absence of adverse comment from the Department [of Trade and Industry] they [the nuclear companies]deemed their assumptions to be acceptable." However, it observes, "Detailed proposals have yet to be put to the Inspectorate for approval" and "until the Nuclear Installations Inspectorate have been given the opportunity to pronounce on this the adequacy of the allowances ... remains uncertain."

The industry estimates are also based upon current acceptable radiation doses of 50mSv per year, any reduction in this will significantly increase costs.

NE, however, is adamant: "We know exactly how to decommission all our nuclear stations, we know what it will cost — and that cost is coming down. NE's current total decommissioning liability in real terms is £2.8bn for our existing stations — and we're right on track to meet those liabilities without the need for subsidy or extension of the levy." Adding, "detailed engineering studies and experience in decommissioning around the world allowed us to reduce our overall estimates." Yet the NAO observes that "no large scale reactor has yet been decommissioned, either in this country or elsewhere."

Given that a "primary objective of the Department [of Trade and Industry] is to ensure that the companies minimise their decommissioning and other liabilities and the extent to which the government may be called upon to meet them," the policy of delaying the most expensive stage of decommissioning is inevitable. Here a principle called discounting comes into play — a practice which involves reducing the final sum required over the life of the decommissioning process by the rate of inflation and estimated return to be gained on capital investment. The UK industry assumes a real rate of return



of 2% a year, thus, obviously, the longer the timescale the less cash needs to be provisioned for now, with equally obvious benefits for the balance sheet.

Reducing provision for liabilities in tandem with a 15% increase in output from its stations and the reduction in its staff by 1,000 are all geared towards helping the company become self sufficient by the 1998 cut-off for the nuclear subsidy. It is also intended to improve its balance sheet in time for the nuclear review.

The company is shortly expected to announce an operating profit for 1992-93 of over £700 million, compared to last year's figure of £482m. NE has also employed the chartered accountants Price Waterhouse to advise on attracting private capital in anticipation of a favourable outcome from the review. In particular Price Waterhouse will examine the commercial viability of a second PWR at Sizewell.

The NAO observes that NE could meet "almost half of the decommissioning provisions in NE's accounts, were it not for significant other nuclear liabilities in the short term." It also reports that: "To the extent that the company is unable to meet its liabilities in the longer term, the Department [of Trade and Industry] regard this as a result of under-funding of its liabilities at vesting." Hence, the government is arguing that NE is not to blame for the shortfall, the government is as it set the vesting funding levels.

SN does not fare so well when placed under the NAO's microscope. The Office calculates that "Scottish Nuclear are expected to become technically insolvent" as a result of its decommissioning liabilities, ie bankrupt. While denying that it will become "technically insolvent" the company plans to ask the government for around £1.1bn to cover the liabilities it inherited from its predecessor, the SSEB, despite the fact that it has already been given a £1.4bn tax write-off and will receive some £716 million already promised to meet its liabilities in decommissioning Hunterston A and its share of the Chapelcross Magnox reactor.

#### Unverified

The NAO report was not allowed to interfere with the launch of SN's 1992-93 annual report which claimed a pre-tax profit of £65.8m, more than quadruple last year's figure. However, £14m of its profit is due to a planned extension of the life of the Torness AGR by 5 years - thereby reducing depreciation loses on the plant - the validity of which the company says has been proven by an engineering study. Yet, this has not been verified by the Nuclear Installations Inspectorate and must at this stage remain wishful thinking which has no place in annual accounts. According to the annual report SN's operating costs have fallen from 3.21p per unit to 2.98p, which SN Chair James Hann says is "still not good enough," admitting that there is still some way to go to its ultimate goal of 2.5p a unit and commercial viability.

The company plans to reduce its costs further by extending the life of its Hunterston B AGR by five years, opting for on-site dry storage at both its stations and improving reactor availability to 80% from the current level of 68%. It also plans to adopt NE's decommissioning policy of delaying the final stage to 135 years after shutdown.

It is also worth noting that while SN does not receive a direct subsidy like the non-fossil fuel levy it is paid over the odds (around 3.6p a unit) for its power by the two private Scottish electricity companies.

The final paragraph in the NAO report could be taken as a warning to the Department of Trade and Industry over plans to limit the scope of the nuclear review, instructing it to ensure that "the assumptions underlying the estimates and related provisions ... are reasonable and realistic in terms of risk to the taxpayer. This will ensure that the full cost of nuclear energy is identified."

# **NUCLEAR NEWS**

#### Safety compromised

THE National Radiological Protection Board (NRPB) has finally published a formal response to the 1990 Recommendations of the International Commission on Radiological Protection (ICRP). Its response shows that it has bowed to pressure from the nuclear industry and has failed to recommend a reduction in the public dose limit, despite acknowledging that radiation is more hazardous than previously recognised.

The ICRP recommendations were widely criticised for failing to recommend a reduction in the 1 milli-sievert (mSv) public dose limit in response to its recognition that radiation was five times more hazardous than previously assumed.

Radiation dose limits represent the legal maximum that must never be exceeded. They act as boundary between a level of risk that might be considered tolerable and risks that are clearly unacceptable.

Previous ICRP recommendations, published in 1977, were based upon a maximum tolerable risk of death from cancer of 1 in 100,000 per year. At that time, such a risk was considered to be carried by a dose of 1mSv.

Since then, radiation risk estimates have been revised upwards, implying a need for proportionate reduction in the dose limit. In 1989, the NRPB's Director, Professor Roger Clarke, commented that their assessment of the risks of radiation exposure and a maximum tolerable risk of

#### **Nirex troubles**

**F**URTHER investigations into the hydrogeological conditions at Sellafield may fail to provide enough evidence to establish a deep repository for low and intermediate-level waste, warns the 13th annual report from the government's Radioactive Waste Management Advisory Committee (RWMAC).

Given the "complex" nature of the areas hydrogeological conditions RWMAC comments that "it is open to question as to whether the observed viability in the hydrogeological conditions at Sellafield will provide unequivocal evidence that the stringent hydrogeological conditions required for a deep radioactive waste repository can be met at this site."

The Committee is particularly concerned about the possibility of ground water travelling through the repository and returning to the surface with a radioactive burden after a relatively short time. Its fears are borne out by research conducted at Glasgow University which "shows that the model Nirex published is much too simple ... Water from the Lake District flows downwards, along and up 1 in 100,000 per year would imply a public dose limit reduction from 1mSv to 0.2mSv.

One year later, the NRPB criticised the ICRP for failing to make such a reduction, saying that the ICRP had failed to "answer a straightforward question, that is: radiation risk factors have increased by a factor of four to five, why have doses limits not come down pro rata?"

In 1992, an NRPB study of cancer mortality in UK radiation workers suggested that radiation may be twice as hazardous as recognised by the ICRP. This would imply that radiation is 8-10 times more hazardous than recognised when the 1mSv limit was introduced.

Despite this, the NRPB has now failed to recommend a reduction in the 1mSv dose. A dose of 1mSv would now carry risk of around 1 in 33,000, three times higher than the NRPB's previous



through the site of the repository."

The researchers modelled the flow of ground water through a cross-section of the repository site using information published by Nirex. It calculates the flow at between 1.1 and 19 meters per year: "if we take 10,000 years as the safety limit then the permeabilities that Nirex measured are forty times too great to meet that target." Stuart Haszeldine, leader of the Glasgow group said that it was unlikely that Sellafield would be a suitable site.

#### Unproven

Speaking on BBC Radio Scotland, Nirex's technical director, Harold Beale, admitted that the suitability of Sellafield is unproven: "I agree that it is far from certain that Sellafield will prove to be suitable but that is the focus of our attention at the moment and we certainly shan't be looking elsewhere until we are satisfied that Sellafield is either up to scratch and will meet the safety targets, or indeed if it proves unsuitable then we shall have to turn and look elsewhere." A spokesperson for Nirex earlier told The Scotsman that "if it is found that Sellafield is unsuitable, Dounreay could well then be an option."

tolerable maximum. The NRPB has failed to justify this weakening of safety standards.

The NRPB has also issued recommendations on a new ICRP concept, the dose constraint. A dose constraint is only a target maximum set to ensure that doses are kept as low as reasonably achievable within the dose limits. Exceeding a dose constraint will not attract the same legal penalty as exceeding a dose limit. The NRPB recommends that a constraint of 0.3 mSv should apply to new sources of exposure.

This public dose constraint will not apply to radiation doses received from existing contamination of the environment, even though such exposures may be sufficient to cause an intolerable risk. At Sellafield, over 80% of the dose received in any year by the most exposed members of the public is from existing contamination. Friends of the Earth scientists recently revealed that that source of exposure alone is sufficient to cause a dose in excess of 0.3mSv. This should result in Sellafield being refused a license to discharge further contamination in the environment.

Under the new NRPB system, members of the public can receive up to 0.3mSv from current activities and up to 0.7mSv from historical contamination, even though the risk from the total dose is clearly intolerable by its own criteria.

The NRPB argues that its new recommendations are intended to "provide a tight, but not unreasonably restrictive standard of protection against ionising radiation".

RWMAC also cast doubt on Nirex's planned commissioning date for the repository of 2006. The Committee is of the "opinion that disposal of radioactive waste is very unlikely to take place in the repository any earlier than 2010, if it were to be constructed at Sellafield."

Although not specifically directed to examine the issue of the Thermal Oxide Reprocessing Plant, RWMAC Chair Professor John Knill repeated the view that there "were no compelling waste management reasons" for reprocessing and questioned the validity of British Nuclear Fuels (BNFL) belief that "radioactive substitution" is an environmentally neutral process.

BNFL does not intend to return all of the radioactive waste generated during the reprocessing of foreign spent fuel but to dispatch a "radiological equivalent" of high-level waste. Knill said: "The full range of tests to prove that substitution is environmentally neutral has not been carried out — at least, we have asked for these tests but have not seen them." Adding, that because different types of waste have different rates of decay substitution that was neutral at one time might not be at another.



#### Dry storage support

**P**LANS for the on-site dry storage of spent nuclear fuel at the Torness AGR in East Lothian look set to be approved by the Scottish Secretary, Ian Lang, in the autumn. ("Dry store re-run", *Safe Energy 93*)

According to a draft of the Torness Inquiry report, a number of safety issues had been raised during the inquiry, however, "there is no reason to conclude that any of them is likely to present an insuperable problem that would justify rejection of the application at this stage."

Commenting that the recognised disposal route, by government, for the disposal of spent AGR fuel is via the Thorp reprocessing plant, the Reporter, Richard Hickman, said: "Long term storage of irradiated AGR fuel at Torness would therefore be a departure from the published Government policy and established practice, which involves early transfer to Sellafield, reprocessing and vitrification."

Hickman's report will be seized upon by those who are opposed to the Thermal Oxide Reprocessing Plant (Thorp) being opened: "The reprocessing route no longer appears to offer any immediate and significant advantages from a waste disposal point of view." It also repeats the opinion of the government's Radioactive Waste Management Advisory Committee (RWMAC) "that direct disposal of spent fuel, as proposed by Scottish Nuclear Ltd, appears consistent with sound radioactive waste management practice."

Further, the Reporter concludes: "I find that the irradiated fuel is unlikely to be reprocessed or used for any future purpose. I find that it falls into the statutory definition of waste." It was a matter of considerable debate at the inquiry that if the spent fuel was to be considered as waste then storing it on site would be contrary to government policy and the Torness site licence. However, the Nuclear Installations Inspectorate judged that the site licence authorised the inclusion of "any storage facility required for the operation of the reactors."

While finding that whether or not the spent fuel is to be considered waste "has no effect on the engineering and safety considerations for the dry store ... if there is a Government policy on the disposal of nuclear waste, then some thought should be given to whether the material to be stored constitutes waste, and if so, whether the proposal is consistent with Government policy, or should be approved as an acceptable departure from that policy."



#### US uranium return?

TO the surprise of research reactor operators worldwide, the US government now appears to be making steady progress towards developing a policy for taking back US-origin weapons-grade spent research reactor fuel, a move which could end Dounreay's attempts to become a centre for spent research fuel reprocessing.

Formerly, US-origin spent highly enriched uranium (HEU) fuel from research reactors could have been sent back to the US. However, increasing opposition to imports of spent HEU fuel forced the US Department of Energy (DOE) to declare a moratorium in December 1988, until an environmental assessment (EA) could be carried out. This left the world's research reactors with a major problem: having been designed with the knowledge that spent fuel would be returned to the US they have only small storage facilities.

The US had assured research reactor operators that the EA would take only six months or so. However, when the US tried to resume taking back HEU the Sierra Club — a powerful US environmental lobby group — intervened, arguing that the EA was inadequate and called for a full blown Environmental Impact Statement, while the DOE maintained that the more limited EA was sufficient. Upon taking the disagreement to a federal court, the court ruled that an EA would be sufficient but that the EA already conducted by the DOE was deficient.

In 1991 a further EA was issued, outraging environmentalists as it failed to cover many of the inadequacies highlighted by the federal court. In particular it rejected outright any possibility of the spent HEU being returned for storage and disposal as "infeasible", offering no other explanation. The DOE had used the spent fuel as a valuable feedstock for its nuclear weapons programme.

Then in April 1992, with the ending of the cold war, the DOE announced a phase-out of all reprocessing, leaving them with an EA which contradicted their spent fuel policy. This, in conjunction with increasing pressure on the DOE to meet its non-proliferation obligations ("Dounreay's Deadly Trade", SCRAM 79), has forced a return to the EA in the hope that it can be upgraded under the National Environmental Protection Act. A process which the DOE believes could be complete within 6-8 months, at which point it could implement its new draft policy which states that returned research reactor spent fuel would not be reprocessed but would ultimately be buried in a geological repository.

The draft also states that the US would

pay for the return and disposal of spent fuel from developing countries (those eligible for aid under the UN's Assistance Programme). Developed countries would have to meet all costs for transport and disposal. However, this is more favourable than the terms being offered by the UK's AEA Technology, which operates a research reactor reprocessing plant at Dounreay in the north of Scotland. AEA, bound by UK government policy, must return all waste generated during reprocessing along with the reclaimed plutonium and uranium.

According to a report by the US Nuclear Regulatory Commission the US has over the years exported 25,875kg of HEU and HEU equivalent: 8,394kg have been returned, leaving 17,489kg in 51 countries which could be returned to the US. The report says that 13,677kg are located in Euratom countries, 1,184kg in Canada and 1,973kg in Japan. Other countries with US origin HEU include: Argentina (58kg), Australia (146kg), Austria (39kg), Brazil (9kg), Chile (12kg), Columbia (3kg), Iran (6kg), Israel (34kg), Jamaica (1kg), Mexico (12kg), Norway (4kg), Pakistan (16kg), Philippines(3kg), Romania (39kg), Slovenia (5kg), South Africa (10kg), South Korea (25kg), Sweden (127kg), Switzerland (82kg), Taiwan (10kg), Thailand (5kg) and Turkey (8kg).

#### Confused Thorp policy

WHILE the government has decided it wants British Nuclear Fuels' (BNFL) Thermal Oxide Reprocessing Plant (Thorp) to open as soon as possible, the Environment Secretary, John Gummer, has announced a further consultation period, to assess the justification for the plant.

In an amendment to a parliamentary motion tabled by the Liberal Democrats, the government — John Major, Douglas Hurd, Kenneth Clarke, Michael Howard, Michael Heseltine and John MacGregor — "subject to receipt by BNFL of such consents that are required by law, supports the commissioning of the plant at the earliest possible date."

Clearly many in the cabinet consider that the fundamental question of whether the plant is required has already been answered: their amendment reads, "the plant is needed to fulfil the customers' requirements for reprocessing, represented by contracts already won worth £9 billion" further, they express "confidence in the non-proliferation arrangements that underlie the pant's work for all overseas customers."

However, it is Gummer's intention to publish a formal justification for operating the plant by the end of July, public consultation will then begin which is expected to last at least ten weeks. This pushes back the prospective date for commissioning the plant until November.

If the plant is cancelled the energy minister, Tim Eggar, has warned that the UK will face a bill of £5 billion to compensate power utilities which have already committed funds to the plant. He denounced the Liberal Democrat motion and their calls for a fuller inquiry, saying it would lead to "a loss of confidence" by overseas investors many of which has "shown interest" in signing additional contracts beyond the initial ten years.

Adding their weight to criticism over British Nuclear Fuels' (BNFL) plans to operate the Thermal Oxide Reprocessing

#### **UK proliferation**

THE UK is failing to meet its commitments under the Non-Proliferation Treaty and its actions threaten to undermine moves to make the treaty permanent when it comes up for review in 1995.

According to a report from Greenpeace, the UK has failed to meet its commitments in six major areas:

- it is failing to live up to its commitment to negotiate a Comprehensive Test Ban;
- it is failing under Article VI of the treaty to work towards general and complete disarmament. The new Trident submarine system represents a massive

Plant (Thorp) at Sellafield, both the Committee on Medical Aspects of Radiation in the Environment (Comare) and the Paris Commission have further strengthened calls for a second public inquiry into the plant.

Comare, a government advisory committee, has complained in a letter to HM Inspectorate of Pollution that it has been allowed insufficient time to adequately consider the implications of Sellafield's proposed new discharge limits, encompassing emissions from Thorp. Comare comments: "Although the limits are reduced, the actual levels of discharge of the majority of radionuclides will be higher than at present". For this reason, says Comare "the Committee cannot rule out completely the possibility that the increased discharges of these specific radionuclides, which the proposed authorisations would permit, could result in an increased risk to the general public living in Seascale."

#### **Cancer** risk

In particular Comare says the public consultation documents failed to include data on historic discharge levels for specific radionuclides and that on its request such data was made available, but too late to allow a comparison between past and future practices. "The Committee's remit is to comment on the possible effects on the health of the population which might arise as a result of the discharges allowed under the proposed authorisations. Such comments would require estimates of detriment (of whatever magnitude) to the population in terms of fatal and non-fatal cancers and genetic effects, which are not contained in the public consultation."

When considering the observed excess in cancer in the 0-24 year old range in the village of Seascale, Comare comments: "There are a number of possible causes which may have led to this excess. There is insufficient evidence to point to any one particular explanation and a combination of factors may be involved. As exposure to radiation is one of these factors, the possibility cannot be excluded that unidentified pathways or mechanisms involving environmental radiation are

escalation in the UK's nuclear capacity. If the government, as planned, develops a new Tactical Air-to-Surface Missile (TASM) this will represent a further escalation;

- the UK has received considerable assistance from the US for the Trident missile system, in contravention of Article I. The UK, itself, has been accused of breaching Article I in its dealings with Iraq;
- the UK will be assisting countries in western Europe and Japan to stockpile plutonium, if the government allows the new Thermal Oxide Reprocessing Plant (Thorp) to open. The number of countries being supplied with plutonium could increase after the first decade of

implicated. In the light of this, proposals to increase the level of discharges of any specific radionuclide as proposed in the draft authorisations should be viewed with some concern."

Thorp "is a new practice", observes the Committee, quoting the first principle of the system of protection suggested by the International Committee on Radiological Protection: "No practice involving exposures to radiation should be adopted unless it produces a sufficient benefit to the exposed individuals or to society to offset the radiation detriment it causes"

Comare's comments have been endorsed by the Department of Health.

In Europe, Britain's partners in the Paris Commission — which deals with pollution in the North and Irish seas passed a motion calling for cuts in radioactive discharges to the "maritime area". The 13-member Commission — Germany, France, Belgium, Sweden, Norway, Denmark, Spain, Portugal, UK, Netherlands, Iceland, Ireland and Finland (observers) — agreed:

(i) to adopt further measures including the application of Best Available Techniques for the reduction or elimination of inputs of radioactive substances to the maritime area;

(ii) that a new or revised discharge authorisation for radioactive discharges from nuclear reprocessing installations should be issued by national authorities only if special consideration is given to:

(a) information on the need for spent fuel reprocessing and other options;

(b) a full environmental impact assessment;

(c) demonstration that the planned discharges are based upon the use of the Best Available Techniques and observe the precautionary principle; and

(d) consultation with the Paris Commission on the basis of (a), (b) and (c) above.

Only the UK government voted against the motion which in effect calls for the abandonment of Thorp. However, in September 1992 the government gave an undertaking to abide by the Commissions decisions.

Thorp's operation;

- the Dounreay nuclear establishment is seriously undermining efforts by the US to eliminate weapons grade uranium from commercial transactions; and
- the Trident programme is a major obstacle to ending the use of weapons-grade uranium for fuelling nuclear propelled ships.

The report concludes: "If the UK continues with its plans for TASM, builds the maximum number of warheads for Trident, and opens Thorp it will be seen as the world's worst proliferator. The UK will become a major obstacle to non-proliferation, not its champion as John Major would like to think."

Dr PATRICK GREEN and SIMON ROBERTS of Friends of the Earth preview the government's nuclear review brought forward to this year, and fear it may no longer be as wide-ranging as promised.

# 1993 nuclear review

THE government's longpromised review into the future of the UK nuclear industry has now been brought forward to 1993, with a statement on its terms of reference expected in Parliament in July.

Contrary to previous government commitments, sources in the Department of Trade and Industry (DTI) have indicated to Friends of the Earth (FoE) that it no longer intends to hold a wide-ranging review. Instead, the DTI would like the review to be limited to whether the 'market' wishes to build new nuclear power stations.

As a result, key political questions about the future financing of the nuclear industry's existing liabilities would be side-stepped and the persistent problems of managing the expanding legacy of radioactive waste would be ignored.

#### Origins of the review

The government first announced a review into the future of the UK nuclear industry in November 1989, when the then Secretary of State for Energy, John Wakeham, announced that the UK's nuclear power stations

"Open discussion of nuclear issues is very important if the nuclear industry is to achieve the public acceptability which is so essential to its future."

> John Wakeham then Secretary of State for Energy August 1991

would not pass into the private sector along with the rest of the electricity supply industry. He also announced a moratorium on the construction of new nuclear power stations beyond Sizewell B until 1994, at which point the government "would review the prospects for nuclear power as the Sizewell B project nears completion."<sup>(1)</sup> Since 1989, the government has indicated on a number of occasions that the 1994 Review would take a wide-ranging look at all aspects of the nuclear industry.

This commitment was reaffirmed in its 1990 environment white paper, *This Common Inheritance*, which stated that a "full scale review" of the prospects for nuclear power would be carried out in 1994: "The government's full scale review of the nuclear industry will enable it to assess the advantages and constraints of nuclear power and determine its potential for the 21st century."<sup>(2)</sup>

The government also stated, in its response to the House of Commons Energy Committee's report on the costs of nuclear power, that the nuclear review would be "comprehensive".<sup>(3)</sup>

Following the recent review of coal policy, the '1994' Nuclear Review has now been brought forward to 1993. Senior DTI officials have confirmed to Friends of the Earth that the government currently intends to make a statement to Parliament on the terms of reference, scope and timing of the review before the summer recess in July. It is acknowledged that its scope and remit are still formally 'under discussion'.

However, contrary to the government's previous commitments, these officials have also made it clear that the DTI is not planning and does not wish to hold a wide ranging review into all aspects of the future of the UK nuclear industry from nuclear waste management and decommissioning to financial controls and government cover for future liabilities. This is reflected in the decision that the DTI division given the lead role in the 1993 Nuclear Review is the Electricity Division (headed by Christopher Wilcock) rather than the Atomic Energy Division (headed by Timothy Walker).

The DTI prefers that the review be limited to whether the 'market' will

'decide' to build new nuclear power stations in the future. This approach carries two vital assumptions:

• that allowing the 'market' to decide about new nuclear power stations somehow frees politicians from the need to make political decisions about nuclear power in the future;

"the nuclear industry ... will need to dispel, once and for all, the view often voiced in public, that [it] is a closed world where secrecy prevails ... openness and public access to information will be crucial if the nuclear industry is to allay the concerns of the wider public."

> David Heathcoat-Amory then energy minister August 1991

 that the nuclear industry's existing structure, policies and financial controls are adequate.

Both of these are highly questionable.

#### Letting the market decide?

The DTI's limited approach seems to be either oblivious to, or concealing of, the nature of the political questions associated with any 'market' decision about nuclear power. It is certain that before the private capital markets even begin to contemplate seriously the prospects of investing in new nuclear power stations, potential investors will want to know who will be responsible for covering the financial liabilities and risks associated with any new station: decommissioning and waste management costs; insurance against damage done by an accident; the risk of accident or generic safety faults closing the plant before the expected end of its lifetime; etc.

Since it is highly unlikely that any private capital will be forthcoming to build a nuclear power station if the owners carry all these risks and liabilities, the government will have to come to a view about whether it will saddle any of them on behalf of taxpayers. At present, Schedule 12 of the Electricity Act 1989 covers the state-owned nuclear operators — Scottish Nuclear, Nuclear Electric and British Nuclear Fuels — for unexpected costs associated with decommissioning, spent fuel and waste management.

The Nuclear Installations Act 1965 limits their liabilities in the event of an accident to just £20 million. Can the 'market' assume that these arrangements will continue in the future for new, privately funded stations? And if so, on what basis would the government justify such state support?

In addition, full decommissioning liability for a station is incurred almost from the moment it is commissioned. The government will therefore presumably need to take a view about the financial controls required for a privately-funded nuclear company in order to protect the taxpayer in the event of early closure of a plant and a consequent shortfall in company decommissioning funds.

#### Maintaining the status quo?

The current arrangements controlling the nuclear industry have failed to secure adequate funds to pay for decommissioning costs and failed to

#### "Government has made clear on several occasions since the November statement that the review will be comprehensive."

Department of Energy and The Scottish Office July 1990

deliver an effective strategy for nuclear waste management or disposal. They also allow the continued operation of the Magnox nuclear reactors in spite of continuing doubts about safety, costs and distorting impacts on the electricity market.

The financial liability associated with the UK's existing civil nuclear installations is likely to run to more than £30 billion. Those funds are not currently available from the industry itself. Nuclear Electric officials have claimed that they will be able to pay for the decommissioning of existing stations as the costs arise over the next 130 years or so.

Yet this makes the questionable assumption that the company can maintain a steady or expanding asset base which delivers enough income both to recover on-going costs and meet these historic liabilities. The government has yet to indicate its view on how these decommissioning costs will be fully funded. The review offers an ideal opportunity to do so.

DTI officials indicate that they do not believe the review should concern itself with spent fuel and nuclear waste management. This is in spite of the sustained failure of the nuclear industry to deliver effective waste management policies and continuing uncertainty over the future of reprocessing as a spent fuel management option in general and the new Thorp plant at Sellafield in particular.

The Government's Radioactive Waste Management Advisory Committee (RWMAC) is currently conducting a forward looking review of the waste management issues that will arise in the next 20 years. This review will consider alternatives to current UK waste management policy, including other decommissioning strategies and alternatives to reprocessing such as spent fuel storage.

RWMAC's Chair, Professor John Knill, has stated that he expects his committee's review to be fed into the 1993 Nuclear Review. FoE has outlined elsewhere ("British Nuclear Heritage", *Safe Energy 94*) its views on future waste management and decommissioning options and considers this issue to have considerable bearing on any review of the future of nuclear power in the UK.

#### **Magnox** decision

The DTI believes that the issue of the economics of Nuclear Electric's Magnox power stations was adequately covered by the Coal Review. That review concluded that the avoidable costs of Magnox stations were low and it would therefore be uneconomic to close them now.

However, this analysis remains open to question, particularly bearing in mind that most of the relevant data from Nuclear Electric remained confidential under the guise of protecting the company's commercial interests. This approach contrasts

"The government has said that it will undertake a full-scale review of the prospects for nuclear power in 1994, in the light of progress with the completion of Sizewell B, the expected cost of nuclear and fossil-fuelled generation, and diversity of supply and environmental considerations. The review will be wide-ranging and will take account of all relevant factors."

> Department of Energy August 1991

with an earlier government commitment that it would ensure that the "full costs and risks associated with nuclear power are transparent."<sup>(3)</sup>

Questions about Magnox operations and costs remain unanswered because of the narrow focus of the Coal Review. A 'full-scale', 'comprehensive' Nuclear Review would be a better place to consider these.

#### Conclusions

FoE believes that the government must abide by its original commitment to a wide-ranging nuclear review in 1993. It must accept the political nature of the decisions involved and broaden its concerns to examine current arrangements to cover nuclear liabilities and risks. A full consideration of the nuclear industry's legacy is, in Friends of the Earth's view, an essential prerequisite for any discussion of the nuclear industry's future.

#### References

1. Hansard, Cols 1175-6, 9 November 1989.

2. Cm 1200, This Common Inheritance, Britain's Environmental Strategy; London, HMSO.

3. Energy Committee, Third Report Information on Nuclear Costs, Session 1991-91; London, HMSO. Government Observations on the Fourth Report from the Energy Committee (Session 1989-90) The Cost of Nuclear Power, Session 1990-91; London, HMSO. While the fear of nuclear war has declined, a new nuclear threat has emerged. With mounting stocks of plutonium, Dr FRANK BARNABY, former director of the Stockholm International Peace Research Institute, considers the risk of nuclear terrorism.

# Nuclear terrorism

S the amount of plutonium produced worldwide in civilian nuclear reactors and chemically separated from spent fuel in commercial reprocessing plants increases, it will become correspondingly easier to obtain plutonium illegally. Increased availability means decreased cost, putting it in the price range of sub-national groups.

This, however, is not the only reason why the risk of nuclear terrorism is increasing. Other factors which magnify the risk include the relatively small amount of plutonium needed to fabricate a nuclear explosive, the availability in the open literature of the relevant technical information, and the small number of people required to do so.

We can be sure that terrorist group leaders have considered acquiring and using nuclear explosives. Presumably, they have until now decided that killing, or threatening to kill, large numbers of people indiscriminately and/or badly contaminating cities with radioactivity, would not further their political ends.

But, as time passes, terrorists are becoming more sophisticated, while wars, and society itself, are becoming increasingly violent. We must expect that moral restraints on mass killing will weaken. The sabotage of a PanAm jumbo jet over Lockerbie shows a trend to increasing terrorist violence. A future rung on the terrorists' ladder of escalation may well be the use of a nuclear explosive.

#### Amounts of plutonium

The world stockpile of plutonium is about 1,000 tonnes: 260 tonnes was produced for military purposes and about 740 tonnes in civilian reactors. Civilian plutonium is contained in: fuel elements in reactors, spent fuel elements in stores awaiting reprocessing or disposal, reprocessing plants, and in civilian plutonium stores.

Today, there are about 420 civilian nuclear-power reactors operating in 29 countries,<sup>(1)</sup> producing about 46 tonnes of plutonium annually. Another 76 are under construction. When operating they will produce about 10 tonnes of plutonium a year. Taking into account the reactors which are shut down, the rate of plutonium production in the year 2000 will be about 50 tonnes a year.

Currently, about 135 tonnes of civilian plutonium has been separated from spent fuel. By the end of the year 2000 some 300 tonnes of plutonium will have been separated. Of this about 60 tonnes will be stored in the UK, 50 tonnes in Japan, 40 tonnes in Germany, 40 tonnes in Russia, and 15 tonnes in France. By 2011, some 550 tonnes may have been separated.

A major problem with large-scale reprocessing is the difficulty of keeping track of the separated plutonium. Even with the best available or foreseeable safeguards technology it is virtually impossible, when thousands of kilograms are separated a year, to detect the diversion of an amount of plutonium sufficient for a nuclear explosive.

Safeguards are unlikely to be better than 98 per cent effective. A large commercial plant may separate about 12 tonnes of plutonium a year. About 240 kilograms may, therefore, be unaccounted for.

#### **Transport risk**

Spent fuel is transported from the countries owning nuclear reactors to reprocessing plants, which are usually in another country. After reprocessing, plutonium is normally returned to its owners. Civilian plutonium will, therefore, be increasingly transported worldwide on virtually all the main transport systems and it is while being transported that plutonium is most vulnerable to theft.

The smallest amount of fissile material in which a self-sustaining chain reaction can be achieved — when just as many neutrons escape per unit time as are released by fission — is the critical mass.

If the mass of material is increased, the number of neutrons produced by fission builds up, with more fissions occurring in each successive generation of fission. In a super-critical mass the rate of production of fission neutrons exceeds all neutron losses and a rapid and uncontrollable increase in the number of neutrons within the mass occurs and a nuclear explosion takes place.

The critical mass depends on a number of factors: the nuclear properties of the material used for the fission, whether it is U-235 or Pu-239; the shape of the material - a sphere is the optimum shape minimising the surface area which, in turn, minimises the number of neutrons lost to the fission process; the density of the material (the higher the density the shorter the average distance travelled by a neutron before causing another fission); the purity of the material (if materials other than the one used for fission are present, some neutrons may be captured by their nuclei); the physical surrounding of the material used for fission (if the material is surrounded by a medium like beryllium, which reflects neutrons back into the material, some of the reflected neutrons may be used for fission).

Using a cunning technique called implosion, in which conventional chemical explosives are used to produce a shock wave which uniformly compresses a plutonium sphere, the volume of the sphere can be reduced and its density increased. If the original mass of the plutonium is just less than critical it will, after compression, become super-critical giving rise to a nuclear explosion.

Plutonium produced specifically for military purposes is rich in the isotope Pu-239, typically containing more than 93%, with about 7% Pu-240. Pu-239 metal in the delta phase, which has a density of 15.92 grams per cubic centimetre, is normally used in nuclear weapons. Using implosion, the density of the plutonium can be roughly doubled so that a nuclear explosion could, with the best modern design including an neutron reflector, be achieved with about three kilograms of delta-phase Pu-239.

Reactor grade plutonium is most likely to be available as an oxide, the form in which it is stored after reprocessing. It can, however, be easily converted to the metal form using straightforward chemical methods. The critical mass of reactor-grade plutonium in the oxide crystal form is about 35 kilograms, giving a sphere with a radius of about nine centimetres.

The critical mass of a sphere of typical reactor-grade plutonium, containing 60% of Pu-239 and 25% of Pu-240, in metal form is about 15kg.<sup>(2)</sup> If the sphere is surrounded by a natural uranium reflector, about ten centimetres thick, the critical mass is reduced to about seven kilograms.

The presence of Pu-240 is undoubtedly a nuisance for weapon designers. Pu-240's spontaneous fission rate is much greater than that of Pu-239. In a

sphere of military plutonium used in a typical nuclear weapon, spontaneous fission produces a neutron background of about one neutron every two or three microseconds — very much longer than the duration of the fission chain reaction. In reactor-grade plutonium the average time between neutrons is a small fraction of a microsecond.

Extremely fast assembly would be needed in a reactor-grade nuclear device to achieve supercriticality. Implosions techniques to provide the very high shock velocities and compression needed to prevent pre-detonation are available but would lead to uncertain explosive yields. And the technology is probably not available to sub-national groups, at least in the foreseeable future.

Also, with so much spontaneous fission the temperature of a subcritical mass of reactor-grade plutonium will be raised well above room temperature. Nevertheless, that reactor-grade plutonium can be used to produce a nuclear weapon has been shown in the USA, where such devices have been built and tested.<sup>(3)</sup>

The fact that a non-nuclear-weapon state could fabricate nuclear weapons from reactor-grade plutonium has been discussed in detail by Victor Gilinsky, an American Nuclear Regulatory Commissioner: "So far as reactor grade plutonium is concerned, the fact is that it is possible to use this material for nuclear warheads at all levels of technical sophistication. In other words, countries less advanced than the major industrial powers but, nevertheless, possessing nuclear power programs can make very respectable weapons ... Of course, when reactor-grade plutonium is used there may be a penalty in performance that is considerable or insignificant, depending on the weapon design. But, whatever we might once have thought, we now know that even simple designs, albeit with some uncertainties in yield, can serve as effective, highly powerful weapons — reliably in the kiloton range."<sup>(4)</sup>

In spite of this, it is often still said that civilian plutonium cannot be used in nuclear weapons. Amory Lovins explains that this view is based on the following assumptions:

• that reactor-grade plutonium is far more hazardous than weapons-grade plutonium to people handling it;



- that a nuclear explosive device made from reactor grade plutonium is much more likely to explode unintentionally;
- that such a device, if it explodes at all, will not explode violently enough to do much damage, nor to accomplish the main aims of the makers; and
- that its explosive yield is too unpredictable to be acceptable to its makers.

Lovins concludes: "each of these assumptions contains, in certain circumstances, an element of truth" but, adds "each is generally, or can by plausible counter-measures be rendered, false ... [the] implication that reactor-grade plutonium is not very dangerous is wishful thinking, and causes the proliferation risks of civil nuclear activities to be gravely underestimated."<sup>(5)</sup>

#### Terrorist nuclear weapon

The ease with which a terrorist group could construct a nuclear weapon is discussed in detail by Carson Mark, Theodore Taylor, Eugene Eyster, William Maraman, and Jacob Wechsler,<sup>60</sup> a group which contains eminent American nuclear-weapon designers. They say that, so far as crude nuclear devices (devices

guaranteed to work without the need for extensive theoretical or experimental demonstration) are concerned:

1. Such a device could be constructed by a group not previously engaged in designing or building nuclear weapons, providing a number of requirements are met.

2. Successful execution would require the efforts of a team having knowledge and skills additional to those usually associated with hijacking or conducting a raid on a plant.

3. To achieve rapid turnaround (making the device ready within a day or so of obtaining the material), careful preparations extending over a considerable period would have to be carried out, and the materials would have to be in the form prepared for.

4. The amounts of fissile material necessary would tend to be large — certainly several times the minimum quantity required by expert and experienced weapon designers.

5. The weight of the complete device would also be large — not

as large as the first atomic weapons (about 4.5 tonnes), since these required aerodynamic cases to enable them to be handled as bombs, but probably more than a tonne.

6. The option of using oxide powder (whether of uranium or plutonium) directly, with no post-acquisition processing or fabrication, would seem the simplest and quickest way to make a bomb. However, the amount of material required would be considerably greater than if metal were used.

7. There are a number of obvious potential hazards in any such operation,

among them those arising in the handling of a high explosive; the possibility of inadvertently inducing a criticality; and the chemical toxicity or radiological hazards inherent in the materials used.

Failure to foresee all the needs on these points could bring the operation to a close. However, all the problems posed can be dealt with successfully provided appropriate provisions have been made.

The devices considered by Carson Mark et al are of types similar to those dropped on Nagasaki and Hiroshima. But much cruder designs that will still give a powerful nuclear explosion are possible. These could produce nuclear explosions equivalent to between 100 and 1,000 tonnes of TNT. They might yield several thousand tons, but are unlikely to yield 10,000 tonnes.<sup>(7)</sup>

Even if the explosion from a crude device was equivalent to the explosion of only a few tens of tons of TNT, it would completely destroy the centre of a relatively large city.

For comparison, the largest conventional bomb used in the Second World War used about ten tons of TNT; it was called the 'earthquake' bomb! An explosion equivalent to that of 100 tons of TNT exploded on the surface would produce a crater about 30 metres across.

#### Medium-sized van

The plutonium oxide, for example, could be contained in a spherical vessel placed in the centre of a large mass of conventional high explosive, such as TNT. When detonated remotely the shock wave from the conventional explosive could compress the plutonium enough to produce some nuclear fission.

In a primitive device, no effort would be made to focus the shock wave and so the high explosive would be simply stacked around the plutonium, probably in the form of a cube. A few detonators could be used, arranged to go off simultaneously. The device would easily fit into a medium-sized van.

In its publication Nuclear Proliferation and Safeguards, the Office of Technology Assessment of the US Congress discusses the risk of nuclear terrorism. It states that: "A small group of people, none of whom have ever had access to the classified literature, could possibly design and build a crude nuclear explosive device. They would not necessarily require a great deal of technological equipment or have to undertake any



experiments. Only modest machineshop facilities, that could be contracted for without arousing suspicion, would be required. The financial resources for the acquisition of necessary equipment on open markets need not exceed a fraction of a million dollars. The group would have to include, at a minimum, a person capable of researching and understanding the literature in several fields and a jack-of-all-trades technician ... There is a clear possibility that a clever and competent group could design and construct a device which would produce a significant nuclear yield (i.e. a yield much greater than the yield of an equal mass of high explosive)."<sup>(8)</sup>

#### Dispersal of plutonium

Even if the terrorist nuclear device did not produce any nuclear fission, the detonation of the chemical high explosive would widely disperse the plutonium (or uranium). Dispersal would be even more widespread if the explosion caused a fire.

The plutonium would be scattered in the form of small particles, capable of being inhaled. Inhaled particles can become embedded in the lung and seriously irradiate surrounding tissue. Irradiation by the alpha-particles, given off when plutonium nuclei undergo radioactive decay, can cause lung cancer. It has been calculated that the radiation from approximately 27 micrograms of Pu-239 in the lung is sufficient to cause lung cancer with almost complete certainty.<sup>(9)</sup> In animals plutonium has also been found to cause bone and liver cancer.

The half-life of plutonium is 24,000 years. This is such a long time in human terms that once plutonium gets into the environment it stays there, for all intents and purposes, indefinitely.

The threat of dispersion is perhaps the most likely danger that would follow the illegal acquisition of plutonium. The dispersal of some kilograms of the material would make a significant area, of a city, for example, uninhabitable until it had been decontaminated, a process that could take a long time. The very possession by a terrorist group of significant amounts of nuclear material is, therefore, a threat in itself.

A government being blackmailed by a group known to have plutonium would not need to be convinced that the group had the expertise to construct an effective nuclear explosive. The authorities would know that if the device failed to produce a significant nuclear explosion it would almost certainly scatter nuclear material over a large area. And this would be threat enough.

#### References

1.International Atomic Energy Agency, Nuclear power status around the world, IAEA Bulletin, Volume 33, Number 3, 1991.

2. Carson Mark, J., Reactor-Grade Plutonium's Explosive Properties, Nuclear Control Institute, Washington, August 1990.

3. Gilette, R., Impure Plutonium Used in '62 A-test, Los Angeles Times, September 16, 1977.

4. Gilinsky, V., Plutonium, Proliferation, and Policy, Massachusetts Institute of Technology, report S-14-76, November 1, 1976.

5. Lovins, A.B., Nuclear weapons and power-reactor plutonium, Nature, 28 February 1980, and typographical corrections, 13 March 1980.

6. Carson Mark, J., Taylor, T., Eyster, E., Maraman, W., and Wechsler, J., Can Terrorists Build Nuclear Weapons?, in Paul Leventhal and Yonah Alexander (eds.) Preventing Nuclear Terrorism, Lexington, Massachusetts, 1987.

7. Willrich, M., and Taylor, T., Nuclear Theft: Risks and Safeguards, Ballinger, Cambridge, Massachusetts, 1974.

8. Nuclear Proliferation and Safeguards, US Congress, Office of Technology Assessment, Washington, DC, OTA, 1977.

9. IPPNW, Plutonium: Deadly Gold of the Nuclear Age, International Physicians Press, Cambridge, Massachusetts, 1992.

Direct radiation from Britain's ageing Magnox stations represents a serious health risk to workers, and the public and the reactors cannot be operated within new radiation limits, argues IAN FAIRLIE of the Socialist Environment and Resources Association (SERA) energy group.

# Magnox gamma shine

PERATING Magnox stations expose workers and those living within a kilometre to direct radiation: gamma from carbon dioxide (CO<sub>2</sub>) cooling gases (nitrogen-16 disintegrations); gamma from argon in the air used to cool the biological shields (argon-41 disintegrations); and neutrons emanating from unshielded roofs of reactor buildings and scattered back to earth through collisions with atoms in the air — the little-known phenomenon of 'skyshine' which can result in appreciable radiation fields.

The older Magnox designs result in relatively large radiation fluxes. For example, they use steel pressure vessels and air to cool their biological or concrete shields, thereby activating the naturally-occurring argon in air. This radioactive argon spreads downwind of the reactors, irradiating members of the public. Also, the  $CO_2$  cooling ducts of early Magnox reactors are outside their biological shields, exposing nearby residents and nuclear workers to gamma radiation. This radiation is particularly energetic and can travel relatively large distances in air.

It is widely believed that because Magnox reactors are up to 36 years old the increased radioactive inventories of their shields, moderators, and pipework result in increasing doses to the public. This is not correct, though doses to workers have increased slightly. Strong radiation fields have existed near these reactors since they started operating. The problem is not increased exposure, but that radiation limits have been reduced; now the radiation fluxes from the older Magnoxes substantially exceed newly recommended limits, as shown in the table. They represent the dose that would be received if one lived at the fence 24 hours a day, 365 days a year.

All of the dose rates given could result in the public being exposed to doses which exceed the National Radiological Protection Board's (NRPB) new 0.3 mSv per year limit. They could exceed other limits, such as the principal limit set by the International Commission on Radiological Protection (ICRP) for the general public of 1mSv per year. <sup>(5,6)</sup> They could also exceed the NRPB's recommended target dose of 0.5mSv for current discharges from a single site<sup>(7)</sup> and the NRPB's proposed dose constraint of 0.3mSv to members of the critical group for current operation of a single site.<sup>(8)</sup>

Three groups in the main are at risk. First, although few people live at the perimeter fence where the above maximum doses occur, a handful of households are situated very close to the perimeter fence at Dungeness and Bradwell and would receive doses near the maxima in the table. Second, there are more homes (10 to 100) slightly further away (100 to 1,000m) at the other stations. Third, are those passers-by who may frequent the stations environs. Until the mid-'80s, the Nuclear Installations Inspectorate calculated doses to passers-by by dividing the maximum annual dose at the perimeter fence by 30. If this were done now, it would result in half of the above stations exceeding the recommended limits for passers-by alone.

Under the recommendations, workers can be exposed to up to 20mSv per year. Because gamma fields intensify as you

MAXIMUM DOSE RATE AT PERIMETER FENCE Equivalent dose/annum (mSv	ר י <b>/עי)</b>
Calder Hall <sup>(1)</sup> Chapelcross <sup>(1)</sup> Bradwell <sup>(2)</sup> Hinkley Point A <sup>(2)</sup> Hunterston A <sup>(3)</sup> (closed, 1991) Sizewell A <sup>(2)</sup> Berkeley (was 16.6 in 1977) <sup>(4</sup> closed in 1988/89 — rate now <sup>(2)</sup> Dungeness A <sup>(2)</sup> Trawsfynydd <sup>(2)</sup> Wylfa <sup>(2)</sup>	22 20 14.6 11.7 8.3 3.4 2.5 2.0 1.5 1.1

#### NRPB recommended limit 0.3

At Hinkley, Sizewell and Dungeness, there are AGRs near the Magnoxes. Although most direct radiation emanates from Magnoxes, there are some AGRs with appreciable fluxes

Calder Hall and Chapelcross are owned and operated by BNFL, and Hunterston A by Scottish Nuclear. The rest are Nuclear Electric's.

This table only states external doses: nearby residents are also subject to smaller internal doses from ingested radionuclides.

get nearer the source, it would appear that workers receive larger doses than those at the perimeter fence. However, measurements from workers' gamma and neutron badges suggest smaller exposures. This inconsistency is unexplained, even considering that workers present for only 2,000 hours annually compared to 8,760 hours for those living nearby. It may have to do with doses from neutrons, as the extent to which correct doses are included in workers' reported exposures are not known. It remains difficult to detect, measure or calculate doses from neutrons for a number of technical reasons, and until recently these were not measured but calculated as a fraction of the gamma dose.

Put simply, the Magnoxes are obsolete and should be closed immediately. When built they were considered to conform to then existing radiation limits. Our knowledge of the dangers of radiation in the intervening years has grown by leaps and bounds and the public limit has been repeatedly tightened. The Magnoxes clearly can't be operated within this new limit.

#### REFERENCES

I. HSE, Calder Hall and Chapelcross Nuclear Power Stations. The Findings of the NII's Assessment of BNFL's Long Term Safety Review HMSO 1990.

2. Hurst M J and Thomas D J, Report on Radioactive Discharges and Environmental Monitoring at Nuclear Power Stations during 1991 Nuclear Electric Report HSD/OSB/R/004, 1992.

3. Taylor E E, Webb G A M, Radiation Exposure of the UK Population NRPB Report R-77 1978.

4. Spiers F W, Gibson J A B, Thompson I M G, A Guide to the Measurement of Environmental Gamma-Ray Dose Rate BCRU 1961.

5. ICRP, Quantitative Bases for Developing an Index of Harm Annal. ICRP 15, 3. ICRP 45, Pergamon, Oxford.

6. ICRP. Recommendations of the ICRP Publication 60. Annals of the ICRP, 21, Nos 1-3, 1991.

7. NRPB, Interim Guidance on the Implications of Recent Revisions of Risk Estimates and the ICRP Como Statement NRPB GS9 1987.

8. NRPB. Board Advice Following Publication of the 1990 Recommendations of ICRP NRPB-M321, 1991. Whatever the future for the UK's coal industry, coal will remain a vital world fuel for decades to come. Max Wallis, a researcher in atmospheric science and energy systems at the School of Mathematics in Cardiff, reviews the latest clean-coal developments detailed in Coal-use technology — new challenges, new responses by Walter C Patterson.

# **Clean-coal technology**

ALT Patterson is a long-time critic of nuclear power and advocate of "clean coal" and has devoted much effort to persuading the industry to come to terms with environmental issues. The (third) edition of his compendium on coal-use technology,<sup>(1)</sup> has a more cautious subtitle than the 1990 edition's "The advance continues"; indeed, he might almost have chosen "At the crossroads". Implicitly and explicitly, the questions facing the industry come across: will they recognise that 'big is not beautiful', but that rapidly built and/or locally-adapted CHP plants are needed; will they move towards providing energy services rather than supplying power; and will they recognise the advantage of technology that can utilise a range of solid fuels, including biomass and waste materials?

Walt rehearses the naive arguments for coal: it's abundant, widely distributed and cheap energy; and environmental constraints will determine its future. Much the same was said about CFCs and 'environmental constraints' have caused them to be abandoned. Walt does not ask if the same might befall coal. Non-scientists are provided with a simple guide to combustion chemistry, but not one to engineering units.

In Britain we tend to be unaware of the wide range and sheer numbers of coal-fired plant that are coming on-stream. The 'fluidised bed' concept, with air blown in under the bed of fuel and ash, is well-known. The circulating fluidised bed combustion (CFBC) version has been rapidly developed to become ubiquitous in little more than a The 'circulating bed' decade. combination appars incongruous the gas flows so strongly as to disrupt the fluidised 'bed' and carry combusting fuel and bed particles up through the combustion chamber. The ash is then separated in a hot cyclone (or in a U-tube) and recirculated back to the furnace. There's generally a 'loop seal', of an ash-filled U-bend where air injection for fluidisation is varied to control the recirculation rate. Heat exchange to water walls in the upper combustion chamber may be supplemented by in-bed water tubes or via the circulating ash to secondary

chamber water tubes. Secondary air feeds into the combustion chamber are another area in which designs differ, facilitating staged combustion to limit the temperature and NOx formation.

Ahlström Corporation's Pyropower system has won most orders - 73 in operation and 29 under construction or on order in 1992 — following the initial plants in Finland and Sweden in the early '80s. Nearly 40% of the plants are in the USA and include cogeneration plants in California that meet that state's strict emission standards  $(100 \text{mg/m}^3 \text{ SOx}; 133 \text{mg/m}^3 \text{ NOx})$ . One big advantage has been fuel flexibility and adaptability - Pyropower plants anthracite spoil heaps burn (Pennsylvania), coal and deinking sludge (Southeast Paper, Georgia), coal or oil or biomass (Rumford, Maine).

#### Caledonian power

The only Pyropower unit in the UK is the Caledonian Paper plant near Irvine, designed to fire 70% Scottish coal and 30% bark wastes, and to supply process steam to the mill. Originally intended to be a cogeneration plant, electricity was offered on such generous terms by the SSEB (determined not to encourage independent generation, says Patterson) that Caledonian Paper omitted the generator. However, Pyropower plants have spread east to India, to Taiwan, to Korea (seven in operation) and to China. With the recent take over of Poland's FAKOP, Ahlström is well-placed for refitting Poland's (and other east European) inefficient and polluting stations.

The rival CFBC system, promoted by Lurgi, has sold nearly 50 units, mostly 100-200MWth (thermal). Since most are cogeneration plants, the electrical and total thermal capacities differ, though this is not clear in the listing (Table 6.2: is 100 tonne/hr of steam equivalent to about 0.5MW?). Lurgi systems are adapted to many fuel types — wood, lignite, mill sludge etc as well as hard coal — and have low emission levels.

Lurgi has recently spawned a new company, Lurgi-Lentjes-Babcock which is looking to the eastern European market. Several other major vendors have built successful CFBC plants, Götaverken, Studsvik, Thyssen, Foster Wheeler, Babcock & Wilcox, Aalborg Ciserv and Bharat Heavy Electricals being cited. Foster Wheeler built the UK's first Lurgi-CFBC plant, for ICI Films at Dumfries in 1987, firing coal, peat, oil and plastic waste.

Pressurised FBC (PFBC) is the is the second major technological development that integrates readily with gas turbines. At 10 or 20 bars, the furnaces are compact and of lower temperature, which reduces NOx formation, avoids ash fusing and reduces abrasion problems. The fuel and sorbent (lime compounds as sulphur absorber) are fed in through pressure locks and the ash extracted likewise. The high pressure combustion gases may need some cleansing - and technologies for cleaning hot gas are coming - but they drive the gas turbine directly. By itself this is inefficient as exhaust temperatures are high (above 500°C), so the exhaust gases are generally used to raise steam for a steam turbine making up the "combined-cycle" system. With efficient heat exchangers and a water outlet temperature of 10°C, an electrical generation efficiency of just over 50% can be achieved. A combined-cycle cogeneration plant producing useful hot water or steam as well as electricity has overall fuel efficiency exceeding 80%. So Patterson asks, does electricity generation alone really make sense?

Several Japanese power companies are now, in an "explosion of interest" embarking on PFBC stations, with ASEA-Brown Boveri subsidiary ABB Carbon's technology under licence, and others from Mitsubishi Heavy Industries. ABB Carbon has sewn up a number of retrofit projects in the Czech republic too. Then, late last year, they proposed to bring PFBC back to Britain, its country of origin, with an innovative combined-cycle design incorporating British Coal's air-blown gasifier. Though discussions with BC, Babcock Energy and the electricity generators are continuing, the "turmoil in the British energy scene" makes progress "problematical", judges Walt.

The rival integrated gasification combined-cycle (IGCC) system begins with partial combustion with oxygen and steam to produce CO and  $H_2$  gases, and burns these after clean-up to drive the gas turbine, followed by steam-raising for the steamturbine. The sulphur, being converted to  $H_2S$ , is easy to remove. The problem with gasification lies in speeding up reactions at low enough temperature (under 1000°C) to avoid ash melting, or to deal with the molten slag at higher temperature.

The three basic gasifier types are depicted in the figure: the Lurgi, Winkler and Koppers-Totzek gasifiers.

The Texaco IGCC plant at Cool Water, California, was an impressively versatile demonstration plant, that won several environmental awards but is now closed. Texaco are supplying the gasifier for Tampa Electric, Florida, where a hot-gas cleaning system using a metal oxide sorbent is to be tried out. Avoidance of gas cooling would increase efficiency by at least 10%, it is claimed. The Texaco system is also to be used to upgrade a power plant in Delaware City, and will burn petroleum coke from the adjacent refinery. It will remove more than 98% of the sulphur and limit NOx to 60mg/m. Similar units are being exported to Sicily and Venice.

#### Water quench

The Croydon-based H&G Engineering proposed a higher pressure Texaco gasifier with water quench to wash out particulates, then a catalytic 'shift' reaction to convert CO to CO<sub>2</sub> and H<sub>2</sub>. The heating and H<sub>2</sub>O reduction enables direct feed into the gas turbine expander stage. The catalytic reactions degrade organic contaminants and convert sulphur compounds to readily removed H<sub>2</sub>S. The company did propose a retrofit to existing British

coal-fired stations, boosting efficiency and reducing sulphur (by 64%), but with no support from PowerGen, National Power or government, H&G turned overseas. This March, they announced that the H&G unit is to be fitted to the Sicilian Texaco plant.

Finally, British Gas have long collaborated with Lurgi in the prototype slagging gasifier at Westfield, Scotland. Designed to run on bituminous coals and operating at 25 bar, it used oxygen and steam to generate a mixture of CO,  $H_2$  and CH<sub>4</sub> with some tars, oils and naphthas that were extracted and recirculated. With testing complete, it shut down early in 1992. Foster Wheeler and John Brown developed a plan for a 300MWe IGCC plant; the BG-Lurgi was thought to be in contention for a project at Puertollano, southern Spain but excluded because the UK government showed no interest in supporting the design in Britain, suggests Patterson.

IGCC development in Britain has been set back by the "competing lure of natural gas" and the technological lead has passed to the USA. There are trade-offs to sort out over gas clean-up, air or oxygen feeding, and usable wastes. Walt suggests that front-end fitting of coal gasifiers to CCGT plants fired by natural gas is a possibility for the short-term.

#### **Topping cycle**

What about British Coal's own "topping" cycle? This was motivated by a desire to boost the temperature of a PFBC's flue gas to the 1300 or 1400°C needed for a gas turbine. Patterson describes evolution of the design to a pressurised, spouted bed gasifier plus CFBC steam-raising unit. British Coal claim economic advantage over alternative CFBC and IGCC systems, but the relatively poor emission performance - SOx and NOx at 100 and 200 mg/m — appears to put it behind the times. Its Grimethorpe test-bed closed down early in 1992 and the reprieved Coal Research Establishment is just limping on. The Commons Select Committee on Trade and Industry reporting on the coal review in January called for support for the "Bilthorpe proposal (by ABB for a PFBC plant with the BC gasifier), other demonstration work connected with the topping cycle, and a demonstration coal gasification plant". The British government ignored that call, claiming to remain "strongly committed to the development of clean coal



technologies" (the coal review white paper 'The Prospects for Coal'), but allowing a puny £7m annual funding for coal R&D.

Looking ahead, Walt outlines the promise of fuel cells - to operate like batteries in directly producing electricity from fuel gas with an 60%. efficiency of over German-Danish consortium is aiming to commercialise fuel cells based on molten carbonate electrolyte. Phosphoric acid and 'solid oxide' are alternatives, and a US consortium is committed to multi-megawatt sizes and to constructing a pilot plant. With so many diverse possibilities, how does one view the future for coal-fired power? There is immediate scope for clean-up modifications, including coal preparation (removing sulphur, ash, water and possibly chlorine -Patterson hardly mentions - see Coal Task Force report<sup>(2)</sup>) and SOx and NOx suppressants. Plants burning a range of fuels including waste materials will have an advantage - as will those whose 'wastes' have beneficial uses. Modular design with quickly-installed small units allows later additions and technical improvements. Low gas and dust emissions have increasing importance, for SOx and NOx standards will surely be tightened.

Patterson makes too brief a mention of  $CO_2$  suppression, expressing surprise that technical options for capture and disposal of this gas appear to have only modest economic penalties. He also overlooks the problem of nitrous oxide (N<sub>2</sub>O) from some fluidised bed systems — high levels produced during lower temperature combustion can produce a greenhouse effect at roughly 30% on top of the  $CO_2$  emitted. Saying that "the nuclear lobby is gunning for coal

without compunction", he does stress that coal must respond to the greenhouse/CO<sub>2</sub> argument. "There have to be genuine reductions in the use of fossil fuels — including coal worldwide. How can the world cope with the transition that will be necessary to control and mitigate the effects of climate change? Coal can and should be part of the solution."

#### References

(1) Coal-Use Technology: new challenges, new responses, Walter C Patterson. Financial Times Management Reports; 1993, 154pp, £248.

(2) Coal Research Development and Demonstration in the UK, Coal Task Force Report to Department of Energy, June 1991. As the commissioning of the Thorp reprocessing plant at Sellafield hangs in the balance, Professor ANDREW BLOWERS and Dr DAVID LOWRY\* consider the waste management implications of running the plant, and warn that Britain will become the permanent resting place for foreign intermediate-level waste.

# Thorp: to be or not to be

THE decision on whether or not to allow the Thermal Oxide Reprocessing Plant (Thorp) at Sellafield to open is the most momentous environmental decision facing the UK government so far this decade. The debate has focused mainly on the radioactive and other toxic emissions from Thorp's operations if it opens, and the economic costs in lost foreign contracts if the project is abandoned. The fact that, if Thorp goes ahead, Britain will be irrevocably committed to continued separation of plutonium has received less attention. The likelihood is that Britain will also become a dumping ground for foreign radioactive wastes.

In this respect a crucial issue has been almost totally ignored. That is the possibility of substitution by curie equivalent of high level wastes for the intermediate and low-level wastes arising from foreign reprocessing contract. Since 1976 all such contracts contain a clause, demanded by then Secretary of State for Energy Tony Benn, requiring all wastes to be sent back to the country of origin. If substitution goes ahead then Britain will certainly become a dustbin for significant volumes of foreign wastes. The present economic survival of Thorp may well be bought at the cost of serious environmental consequences for future generations, particularly for the people of west Cumbria.

One by one the main planks in the justification for Thorp have disappeared. With the ending of the Cold War the demand for plutonium has fallen to virtually zero as military stockpiles have been created through Fast breeder disarmament. programmes which might have used plutonium as a fuel have been abandoned or suspended in the US, UK, France and Germany, and the Japanese programme is being slowed down. Mixed oxide fuel (MOX) which uses plutonium is expensive relative to uranium and creates a waste product that is difficult to manage and therefore it is unlikely there would be a significant demand. There is now a worldwide surplus of plutonium estimated at around 300 tonnes in the civilian programme and perhaps as

much as 1,000 tonnes in the military sector. Far from being a precious raw material, plutonium is now a highly dangerous waste product. Continued reprocessing at Sellafield will add three tonnes per year to a stockpile already standing at around 68.5 tonnes in the UK, according to government figures published in February.

The justification for Thorp now rests heavily on its role in nuclear waste management and on its claimed benefits to the national and local economy. These arguments are now being severely scrutinised. It is certainly true that reprocessing reduces the volume of high-level waste (by about half) and concentrates it in one or two locations, though in multiple waste streams. But the volume of intermediate and low-level wastes are vastly increased through reprocessing. Consulting Engineer John Large estimates an increase of 189 times the volume of the original fuel assembly if total decommissioning wastes are included.<sup>(1)</sup> By comparison he suggests that fuel encapsulation increases the volume by only seven times and direct storage by a factor of only three.

#### **Commercial doubts**

Severe doubts have been cast on the commercial viability of Thorp. Last year Dr Frans Berkhout of Princeton University provided a detailed analysis suggesting that the £500 million profit BNFL estimates will come from the first ten years of operation could easily disappear if the costs of decommissioning are higher, if prices are discounted to attract future custom, if there are extra costs imposed for krypton-85 gas removal or if there are extra costs arising from late return of wastes to customers.<sup>(2)</sup> Above all, any delay in the Nirex repository currently being planned for Sellafield (which many critics feel is highly likely) would inflict higher storage costs on BNFL which would not be rechargeable to its customers.

Thorp undoubtedly represents a considerable original investment in jobs for west Cumbria during its construction phase although it will

employ only around 1,300 staff if it operates. Certainly the social costs of the deliberate decision not to open Thorp are a critical part of the political decision over its future. But the opportunity costs of maintaining Thorp are high and deny the possibility of investing in the long-term economic restructuring and diversification in the area which would reduce its dependence upon the nuclear industry. In any case, considerable employment over a long period will be necessary to undertake decommis- sioning if the whole facility were to be run down. In the meantime BNFL's 13,000 or so local employees will be needed for the management of waste, spent fuel and plutonium already stockpiled at Sellafield.

#### International concerns

Although Thorp will undertake some domestic reprocessing, over time this will become less than a third of the total. Already some of this market has been lost with Scottish Nuclear's switch to dry storage of spent fuel. Thorp's long term future rests primarily on its ability to attract foreign customers. Several political developments are beginning to make it look vulnerable.

In the first place, partly resulting from public opposition, reprocessing is being seriously questioned in Germany, a prime customer for Thorp. It is even conceivable that the Germans could back out of existing contracts (though they would remain liable for the costs according to reports on the commercially confidential contracts). More importantly future custom from this source is looking unlikely. In Japan, too, there is considerable opposition to plans for future reprocessing and the risks of long-distance transfer of plutonium and radioactive wastes have already been exposed by campaign groups. Potential contracts from countries such as South Korea may be difficult to secure in the face of the USA's fears about nuclear proliferation, increasingly shared by the British Foreign Office.

Opposition in other countries to the dangerous trade has already been aroused in the UK, particularly as the role of Sellafield as the international focus for the plutonium and nuclear



The Thorp reprocessing plant at Sellafield

waste trade has become more widely recognised. But the issue which may cause critical escalation of public concern is substitution.

#### **Effects of substitution**

Since 1976, BNFL has had the option of returning all the residual radioactive waste arising from foreign contracts. In practice, foreign spent fuel awaiting reprocessing and wastes stored before repatriation are likely to remain for long periods in the UK (perhaps 25 years or more). So far, no wastes have been shipped back to the country of origin. In effect the UK is a already a temporary centre for foreign nuclear waste management at Sellafield and Dounreay. Furthermore, it seems unlikely that the bulk low-level wastes will be returned but instead will be disposed of at the Drigg repository near Sellafield and, in future, in the Nirex repository. In this respect the UK has already tacitly become a permanent repository for foreign low-level wastes.

Substitution will take this process much further, making Britain the permanent resting place for the much more dangerous plutoniumcontaminated foreign intermediatelevel wastes. Under substitution, in addition to the return of high-level wastes (HLW), an equivalent quantity, in radiological terms, of HLW will be sent back instead of the wastes of lower radioactivity arising from reprocessing. In other words, HLW produced either from domestic reprocessing or from pre-1976 foreign contracts will be returned instead of the more voluminous intermediate wastes. But, and this is the crucial point, since the exchange is on the basis of radioactivity and not volume, the UK will have to dispose of the remaining foreign intermediate-level This contradicts the so-called 'proximity principle' accepted by the government and the EC which holds that developed countries should, as far as possible, be self-sufficient in the management of all their waste. Substitution will breach the principle and make Sellafield (and to a lesser extent Dounreay) the European dumping ground for radioactive waste. As recognition of this grows we may expect the local opposition to the Nirex plans for a repository to intensify.

waste in a deep repository.

#### **Political ramifications**

From BNFL's point of view substitution has commercial advantages in that much smaller volumes of waste will have to be shipped (though more space will have to be found for storage and disposal of foreign wastes). Lower costs would, of course, contribute to the viability of Thorp. But the proposal raises political concerns.

One is that substitution will be difficult to implement. Even if there can be an agreed scientific and commercial basis for substitution (by no means certain), its implications are likely to arouse strong opposition. Regardless of contracts it remains to be seen whether vitrified HLW can, in practice, be returned. The first shipment back to Japan of HLW is not due until 1996, and shipments to Germany, Italy and Switzerland are scheduled for a later date. Already opposition has dogged the shipment of plutonium and could well be mobilised against waste shipments in the UK, the destination country and at points along the route. If opposition is successful then the proposals for substitution must be regarded as dead in the water.

Already HM Inspectorate of Pollution is sifting through the 55,000 submissions received objecting to the proposed draft authorisations for disposal of gaseous and liquid wastes from Thorp. The substitution issue brings the problem of solid waste management to the centre stage. In view of the doubts it raises about the whole reprocessing project, public exposure to the proposals would appear to compound the case against.

There is, as yet, no long-term waste management programme in place. The Nirex repository may or may not be permitted and it will certainly not be open at the earliest until around 2010. It is also unlikely that BNFL's foreign customers will have permanent repositories for HLW ready to receive back their wastes, including substituted amounts. Thus Thorp will spawn an international trade in dangerous materials for which there are no agreed or publicly accepted long-term management plans.

The government's advisory body, the Radioactive Waste Management Advisory Committee, submitted its observations to the Secretary of State for the Environment on the possible waste consequences management of substitution as far back as last October. Although the minister acknowledged in Parliament on 27 January this year, in reply to a question from Llew Smith MP, that the matter would be taken into account in deciding the future of Thorp, there has since been silence. If substitution goes ahead the UK will be irrevocably committed to managing foreign wastes in perpetuity. This prospect alone should be a major reason for the government to abandon the Thorp project in the interests of the environment for the present and future generations.

#### Notes and references

\* Professor Andrew Blowers, a member of RWMAC and teaches at the Open University, is writing in a personal capacity; Dr David Lowry is a visiting research fellow at the Open University's Energy and Environment Unit and is an independent environmental consultant.

Andrew Blowers and David Lowry are co-authors (with Barry D Solomon) of The International Politics of Nuclear Waste, published by MacMillan Press, 1991.

(1) Comparison of the radioactive waste arisings generated by reprocessing, encapsulation and storage of LWR and AGR irradiated fuels, Large and Associates. Greenpeace, 14 December 1992.

(2) Fuel reprocessing at Thorp: profitability and public liabilities, Frans Berkhout, Greenpeace, 1992.

#### **Row over VAT on fuel**

THE plan to impose VAT on domestic fuel bills ("VAT's no carbon tax", Safe Energy 94), announced by Chancellor Norman Lamont in his March budget, was passed in the House of Commons on 10 May by just ten votes. Two Tory MPs voted against the government, and a handful more abstained on the controversial measure contained in the Finance Bill.

Opponents of the "tax on warmth" hope that following the sacking of Lamont at the end of May, his replacement, Kenneth Clarke, can be persuaded to drop the charge.

Another reshuffled minister, John Selwyn Gummer, managed to confuse matters less than two days into his new job as environment secretary. Speaking on Radio 4's *Today* programme he declared that the government would "ensure that pensioners and those who are vulnerable are more than compensated." A commitment the government had previously not been prepared to make, and one which Whitehall officials subsequently discredited.

Confusion over compensation for those on benefits and low-incomes, and the revelation that the VAT will even be

#### Warren Springs' closure

THE government's leading environmental laboratory, Warren Springs, has been axed by Michael Heseltine's trade and industry department following a secret consultants' report. Its site near Stevenage is likely to be sold to the Glaxo pharmaceutical company.

Warren Springs, employing around 200 scientists, carried out research on air pollution, acid rain, waste management, land contamination and other environmental issues. Last year alone it undertook £5 million of research for the Department of Environment.

In early May Michael Heseltine

#### CO<sub>2</sub> measures urged

**P**RESSURE is mounting on the UK government to place more of the burden of meeting carbon dioxide (CO<sub>2</sub>) emission limits onto the transport sector after a Department of Environment (DoE) conference on 7 May.

The meeting of business leaders, academics and environmentalists, at the Queen Elizabeth II Conference Centre, London, followed a series of workshops held in March and the consultation document "Climate change: our national programme for  $CO_2$  emissions" published at the end of last year ("Climate for change", *Safe Energy 93*).

Speaking at the meeting, Michael Howard MP, the then energy secretary, reiterated the government's view that voluntary partnership with the public and industry, imposed on the standing charge element of bills have added to the outrage over the move. Opposition has come from pensioners groups, a wide range of charities, churches, social workers and consumer groups.

Reminiscent of the now defunct poll tax, opposition to the tax is particularly strong in Scotland where larger fuel bills - because of colder temperatures, higher wind speeds and poorer housing stock - will mean a higher level of taxation. The leader of the Scottish Liberal Democrats, Jim Wallace MP, has estimated that VAT will cost the average British household £130 a year but that for Scotland the figure will be around £180. Alex Salmond MP, Scottish National Party leader, points out that, with insulation standards at the level of Sweden's in the 1940s, 750,000 Scottish households already cannot afford to heat their homes properly. Even Scottish Tories are worried by the tax with the Scottish Association of Conservative Councillors pressing for the plan to be dropped.

In contrast to the wide-spread opposition to the VAT proposals, Friends of the Earth (England and Wales) and the Association for the Conservation of Energy have welcomed the move to taxing fuel use as a way of encouraging energy efficiency, though they recognise the need to protect those on low incomes.

announced a review of the future of five laboritories, including Warren Springs, but he had already secretly commissioned a report on Warren Springs without even consulting Michael Howard, the then environment secretary. The review, by PA Consulting, recommended closure of the laboratories with half the scientists being sacked and the rest transferred to AEA Technology at Harwell. Following news of the report and Heseltine's intention to axe the laboratories, it also emerged that PA Consulting had been in direct competition with Warren Springs for a number of research contracts.

All this follows rumours of closure last year which the government denied, promising staff a £25 million purpose-built

relying on economic instruments and education, was more efficient than regulation.

However, many delegates believed that more action was needed, particularly in the transport sector. Measures proposed included: investment in public transport; fuel efficiency standards; lower speed limits; and an integrated transport policy.

Despite the government's own forecast of a 69% to 113% increase in road traffic by 2025, Howard told the conference that stiffer transport measures were unnecessary to meet the UK's obligations in cutting emissions. Howard's interpretation of the Rio Earth Summit commitment to *stabilisation* of  $CO_2$ emissions at 1990 levels by 2000 was that they were likely to rise again thereafter. This is contrary to the widely held view that stabilisation must be the first step to long-term reductions in  $CO_2$ .

#### Fossil free future?

A major new study on global energy and climate change by Greenpeace claims that world fossil fuel use could be halved within 40 years.

Comprehensive measures on energy efficiency and the introduction of a range of renewable energy sources could also see an end to nuclear power by 2010 and the complete phase-out of fossil fuels over the next century.

Based on analysis by the Stockholm Environment Institute, Boston, the study calls for major improvements in energy efficiency in the transport, buildings and electricity sectors. Average energy efficiency over the next 40 years could increase almost four-fold for cars (to 93 miles per US gallon), by a factor of three for appliances, and double in power generation.

Through research and development support and other policy changes including pollution taxes, the study believes a range of renewable technologies could be economically competitive in the next 10 to 20 years.

\* "Fossil fuels in a changing climate", Greenpeace International, 1993. (From Greenpeace, Canonbury Villas, London N1 2PN, £5 inc p&p.) Full technical report — "Towards a fossil free energy future: the next energy transition".

replacement facility at Welwyn Garden City.

Although Warren Springs actually ran at a profit, closure will save the Department of Trade and Industry the bulk of the estimated £33 million cost of a move to new laboritories (though some £7m is already irretrievably committed) and allow sale of the existing site to Glaxo.

Around 100 of the scientists are expected to be transfered to the UK Atomic Energy Authority's Harwell and Culham sites in Oxfordshire to create what Heseltine has billed as a National Centre for Environmental Technology. It will, of course also boost the value of AEA Technology in advance of an expected sell-off.

#### US energy tax turmoil

HAVING passed through both Congress (twice) and the Senate, President Clinton's energy tax proposal ("Clinton taxes fuel", *Safe Energy 94*) has finally come unstuck.

A series of exemptions and loopholes, made to ease progress, left the tax seriously undermined, and when the plans reached the Senate finance committee in June, opposition led by Democrat Senator David Boren finally forced the Clinton administration to admit defeat.

The search is now on for some alternative and suggestions include a transport fuel levy, a general energy tax based on value or a far reaching consumption tax.

# **SAFE ENERGY**

#### Coal saga

SINCE Michael Heseltine's white paper on coal in March, British Coal (BC) has been adjusting to the new circumstances. If BC can find a market for additional coal output, a government subsidy is on offer, but the future of the twelve reprieved pits remains bleak.

Negotiations between BC and the big two generators — National Power (NP) and PowerGen (PG) — have proved difficult. BC have offered to sell at 90p-95p a gigajoule, less than two-thirds the price of existing contracts but, citing high stockpiles and a spot price in Rotterdam of 86p, the generators are driving a hard bargain. National Power has decided not to sign any deal before the autumn, while PowerGen is believed to be adopting an even tougher stance. This will mean an extra one million tonnes of coal a month piling up at BC's mines.

Meanwhile, the High Court has given approval for BC to shut the 10 pits whose immediate closure had been ruled unlawful last December. Two of those pits, Cotgrave and Silverhill, along with the mothballed Easington and 'near exhausted' Bolsover, have been offered by BC for sale to the private sector. In all BC has immediate plans to dispose of 20 pits, 18 from the original 31 earmarked for closure last October.

With the government committed to privatisation of British Coal, there is strong pressure for the core pits to be sold intact. BC's directors and the mining unions have argued against a pit-by-pit sell-off. But Hanson, the UK-American conglomerate, is pressing the government to allow it to bid for selected collieries. It was Hanson which, during a crucial phase in the troubled privatisation of the electricity industry, were reported to be interested in buying PowerGen. Though this eventually came to nothing, it attracted a number of other bidders and revived the sell-off. The full story of Hanson's curious role in that privatisation will probably never be revealed. 

#### **Desulphurisation moves**

reassessment of the merits of flue Agas desulphurisation (FGD) is being made by the large power generators following new authorisation limits issued by Her Majesty's Inspectorate of Pollution (HMIP) this spring. The new regulations, aimed at further reducing acid rain, set limits for individual power stations - more stringent in more environmentally sensitive areas — and reassert an earlier requirement that all fossil fuel plant must, by 30 April 2001, have the same standards for sulphur dioxide  $(SO_2)$  and oxides of nitrogen (NOx) emissions as apply to new stations.

At the moment, only two coal-fired stations in England and Wales are retrofitting FGD: Ratcliffe, PowerGen's 2GW power station in Nottinghamshire, where FGD is due to be commissioned shortly, and National Power's massive 4GW Drax station in North Yorkshire. Both will use the limestone/gypsum method of FGD.

Drax, Europe's largest coal-fired power station, should have FGD in place and commissioned in one of its six units by September this year. The whole plant is due to be equipped, at a cost of  $\pounds700$  million, by 1996.

The European Community Large Combustion Plant Directive will require the UK to achieve reductions from 1980 levels of 60% in SO<sub>2</sub> emissions by 2003 and 30% in NOx by 1998.

Beyond their present FGD plans, both National Power and PowerGen are considering whether replacing existing coal stations with either combined cycle gas turbines or new clean-coal stations makes better economic sense than retrofitting existing plant. A stopgap measure being considered to meet the targets is to run present stations less intensively.

■ An alternative to limestone FGD is being planned by Scottish Power for its Longannet power station in Fife.

Scottish Power plans to use a seawater scrubbing method which will almost half the estimated £350m to £400m cost of limestone/gypsum FGD. It is expected that an application for planning permission will be made by 1994. In addition, new fuel burners, to reduce NOx emissions, are due to be fitted at a cost of £24m in time to meet the 1998 deadline, but these will cut emissions by only 35% to 40% compared with a reduction of up to 90% which could be achieved with flue gas cleaning.

#### **Market confusion**

T is becoming increasingly obvious that the electricity market created by the government at privatisation of the industry is far from a level playing field and that operation within it is no real test of efficiency or cost.

Possible manipulation of the electricity pool price has once again come under the scrutiny of the electricity regulator Professor Stephen Littlechild. The threat to National Power (NP) and PowerGen (PG) of a referral to the Monopolies and Mergers Commission was raised by Littlechild following large increases in the spot price of electricity during April.

Two formal investigations into the role of the big two generators in the pool price have already been undertaken by Offer (the Office of Electricity Regulation) in the past two years. The pricing system operated in the pool means that the price paid to generators rises rapidly as predicted demand approaches offered capacity. The potential, therefore, for NP and PG to dominate the market and manipulate the pool price has been a continuing concern. Littlechild is also looking at ways of reforming the pool from its present structure where generators bid to supply electricity, which he has described as "half a market". The regulator would like to see suppliers and users being able to bid to buy electricity on a day to day basis. Littlechild envisages that eventually trading will take place "days, months or even years" in advance.

■ Just a few months ago, with the dash for gas, predictions were being made of a large overcapacity of generating plant in the UK. However, in its fourth annual guess at the future — or seven year statement (SYS) — since privatisation, the National Grid Company (NGC) has increased its forecast of demand and reduced its prediction of new capacity. Under one scenario put forward by the NGC overcapacity would actually fall to 18% by 1999, below the 20% 'minimum desirable margin'.

Since last year's SYS, 3,075MW of existing capacity has been earmarked for complete or partial closure and six gas-fired projects totalling 3,524MW have been abandoned. The demand forecast has been adjusted from an increase of 1.1% a year to 1.6%.

Extensive system reinforcement between north and south has been foreshadowed by the NGC which envisages up to 10GW of power having to be transferred from generating plant in the north of England and Scotland to feed growing demand in London and the south-east.

A recent House of Lords' report\* has strongly backed liberalisation of the European energy industry and the creation of a single market.

The Select Committee on the European Communities believes that appropriate regulatory regimes could mean that "liberalisation need not jeopardise environmental protection or energy conservation."

While recognising that the quest for a single market "will increase the risk in some investments in infrastructure", the committee argues that subsidy could be provided for uneconomic but socially desirable projects.

\* "Structure of the single market for energy", Select Committee on the European Communities (HL Paper 56); HMSO, February 1993.

#### Glasgow's better houses

**F**UEL poverty is being addressed in a comprehensive way by Glasgow District Council with its award winning Action for Warm Homes programme. The council's ultimate aim is to provide energy efficient housing in all its 125,000 properties.

Scottish Power and British Gas Scotland have been approached to help finance a scheme to provide insulation and efficient central heating to tenants at reduced cost. In exchange for funding the project, the utilities would have a guaranteed customer base in an increasingly deregulated market. If they

Humberside study

**R**ENEWABLE sources could be providing 10% of Humberside's

energy needs by the year 2000 according

to a recent eight-month study. The

report,\* by Environmental Resources

Limited (ERL) was commissioned by

Humberside County Council ("Humberside renewables", Safe Energy

90) and identifies over 20 action points for

The potential for wind power is already

beginning to be realised, with several projects,

including a wind farm, proposed for the

Holderness area, where the Borough Council is preparing a planning framework to guide the

siting of schemes. Amongst other renewable

sources considered are domestic and

In welcoming the report, Cllr Margaret

agricultural wastes and geothermal energy.

the council to encourage renewables.

Council

Humberside

refuse to back the scheme, other utilities may be approached by the council.

More than half Glasgow's housing stock does not have adequate central heating or insulation; Energy Action Scotland estimates that in Scotland as a whole 750,000 homes suffer from fuel poverty. Action for Warm Homes has shown the causal links between poverty; inability to afford adequate warmth; the incidence of condensation, dampness and mould; and ill-health. The programme also offers energy audits and rating, energy and fuel debt counselling, and demonstration energy saving projects.

One demonstration project will involve the refurbishment of early post-war

Crampton, Chair of the Environment Sub-Committee, described the study as "a major step forward in trying to ensure that our society's demands do not overload the environment."

The project director, Ray Tomkins of ERL, commented: "For each of the technologies investigated, the primary factor has been the amount of energy which could be economically exploited. Our favoured technologies not only offer Humberside cleaner energy but they can help in tackling other issues facing the county such as waste management, the future of the farming industry and the need to contribute towards national targets for reducing carbon dioxide levels."

\* "Renewable energy in Humberside part 2: practical next steps", from Director of Technical Services, County Hall, Beverley HU17 9XA, £15.

Solar chimney

novel solar power device, shaped A novel solar power user, is being like a cooling tower, is being developed at the Israeli technology institute. The project, headed by Professor Dan Zaslavsky, dean of agricultural engineering, aims to use salt water and the heat of the desert to generate electricity and produce fresh water.

The concept is remarkably simple, but involves a massive tapering chimney 300 metres in diameter and 1,000 metres high. Salt water pumped to the top of the tower would be sprayed down on air which, heated by the sun, would be rising up the chimney having been drawn in at the base. The air, rapidly cooled by the water, would drop back down the chimney and turn electricity generating turbines. The water would be desalinated by evaporation and filtration.

The project, which was an Israeli state secret until accidentally disclosed by foreign minister Shimon Peres last autumn, has obvious potential for desert areas. Zaslavsky believes that his towers could provide 45 times present world energy consumption, and he estimates that the cost could be as low as two or three US ٠ cents per kilowatt-hour.

#### Energy saving trussed

WNER-occupiers installing energy central heating may qualify for a £200 grant thanks to the Energy Saving Trust and British Gas. However, just £1 million has been allocated to the scheme, which is enough for less than one per cent of potential applicants.

More than one million gas-fired central heating boilers are installed in British homes each year, but less than half a per cent are of the most energy efficient type, this compares with 40 per cent in the Netherlands. Though condensing boilers are ten per cent more

#### Dounreay goes green

**R**ESULTS are expected soon from a wave power survey carried out by AEA Technology at Dounreay. The study, being undertaken in conjunction with Applied Research and Technology (ART), aims to determine the potential for the ART Osprey offshore wave energy device.

AEA's support of wave power follows research on wind power in Caithness and Sutherland, including plans for a tenements in the city, with the aim of reducing heating bills for tenants to below ten per cent of their disposable income -£4 a week for single people up to £12 for large families.

The world's largest demonstration of transparent insulation material for buildings — a student residents' building at Strathclyde University — has proved a great success. The building, opened in November 1989, can maintain a temperature of 23°C throughout a Glasgow winter purely through energy efficiency and passive solar gain. With a payback time put at 12 years, there is worldwide interest in this European Community funded project. O

#### Mersey barrage ebbs

**P**LANS for a Mersey barrage have been shelved following government refusal to help with further funding of the project.

After 11 years of feasibility studies and over £8m, the Mersey Barrage Company a consortium of construction, engineering and other companies - failed to secure advance payments under the Non Fossil Fuel Obligation to contribute to the £1.4bn, 700MW development.

The general manager of the barrage company, James McCormack of Tarmac Construction commented: "In years to come environmental issues will assume greater political significance. The next general election could be a watershed for future policy. We would hope there will eventually be the political will to proceed." 

efficient than the most efficient of conventional boilers (and 30 per cent more efficient than older boilers) they cost around £400 more to buy and install.

The Trust's newly appointed chief executive Dr Eoin Lees, formerly head of the Energy Technology Support Unit at Harwell, commented on the limited scope of the scheme: "I hope we do run out of money in a few months - then we can go back and say the scheme is popular and ask for more."

The Trust is hoping to have a total annual budget of around £400m, half from the electricity utilities and half from British Gas. 

Details of the boiler scheme are available from British Gas on 0345 581158.

demonstration wind farm at Hill of Forss, and is part of a diversification programme to compensate for the 1994 closure of the fast breeder reactor.

A £100,000 study into the potential for tidal power around the coasts of Orkney and Shetland has been organised by the islands councils. With funding from the European Community, the work will be undertaken by the International Centre for Island Technology, Stromness.

# **SAFE ENERGY**

#### Waste burning urged

A call for waste incineration has come from the Royal Commission on Environmental Pollution in a report\* published in May. Arguing that the environmental impact of incineration is preferable to the alternative of landfill, the Commission recommends financial incentives to encourage a move to incineration, especially for electricity generation.

The report comes when the future of waste incineration as part of the Non Fossil Fuel Obligation (NFFO) in England and Wales is being questioned. Opponents see electricity from waste taking funding from genuinely renewable energy sources, and environmental groups including Greenpeace and Friends of the Earth. are also concerned about the environmental impact of incineration.

The Commission believes that with new standards on emissions to air from combustion set by HM Inspectorate of Pollution (HMIP) applying to all new plant and to existing plant by December 1996, incineration offers the best environmental option. A four-stage procedure for dealing with waste is proposed: wherever possible avoid creating wastes; where wastes are unavoidable, recycle them if possible; where wastes cannot be recycled in the form of materials, recover energy from them; when the foregoing options have been exhausted, utilise the best practicable environmental option to dispose of wastes.

In arguing against landfill, the report highlights the emissions of methane — a powerful greenhouse gas — even where methane collection is undertaken, and contamination of ground and surface water from landfill sites. It also cites the environmental advantage of using waste for electricity generation to replace the burning of fossil fuels.

Unlike many other European countries which burn around 30% to 40% of their domestic refuse, Britain incinerates only around 7%. Of the 29 waste incineration plants in Britain, most are expected to close in the next four years as the new HMIP standards come into force.

With the present cost of incineration put at £15 to £30 a tonne compared to landfill costs of £5 to £30, the Commission wants to see a levy applied to all waste deposited in landfill sites to encourage incineration.

Although the report calls for strict controls and monitoring of emissions, there is concern from environmental groups that emissions, especially of dioxins and heavy metals, could be a health risk. The Commission's not been shown to be acutely or chronically toxic to humans in the concentrations likely to have been produced by emissions from incineration plants." But it recommends that the implications of further evidence be kept under continuing surveillance by the Chief Medical Officers. Recognising that on the precautionary principle exposure to heavy metals should be reduced, the report says that methods of reducing heavy metals from the domestic waste feedstock, such as recycling batteries, should be studied.

assessment of dioxins is that "they have

The subsidy of electricity from waste, as with the present NFFO, is supported by the Commission. With a new Renewables Order expected later this year and similar schemes planned for Scotland and Northern Ireland, the continued inclusion of incineration at the expense of genuine renewables has been criticised by some pro-renewables groups.

A further environmental concern, expressed by Greenpeace, is that a policy of encouraging incineration will be at the expense of the best environmental option: minimising the production of waste.

\* "Incineration of Waste", Royal Commission on Environmental Pollution, seventh report; HMSO, May 1993.

#### Tyre power

THE future of a tyre burning power station planned for East Kilbride is likely to rest with an environmental impact assessment. The 6MW plant, which would burn around 20,000 tonnes of waste tyres a year, has been granted planning permission by Labour-controlled East Kilbride District Council but is opposed by the local Labour MP, Adam Ingram, and the local Labour Party.

The environmental impact assessment

#### Wood gas

GASIFICATION of wood for electricity generation is to be tested in two Scandinavian trials. A demonstration plant in Sweden and a test rig in Finland will aim to fulfil the promise of high temperature conversion of biomass to gas for use in turbines.

While gasification of wood is not a problem, the gas at 900°C contains various tar compounds, alkaline metals and dust which foul the turbines.

The two Scandinavian projects, at £25 million each, have independently developed 'hot gas cleaning' filtering technology where the gases are cooled to 400°C when the alkaline metals and other contaminants can be filtered out.

The Swedish plant at Värnamo, run

was called for by the chair of the European Parliament Environment Committee, Ken Collins, who also happens to be Euro MP for Strathclyde East and an East Kilbride resident. Concerns over emissions from the plant are due in part to its proposed location near a hospital and residential areas.

The plants developer, Elm Energy, the UK subsidiary of a US power generator, is already building a 30MW plant in Wolverhampton and is dismayed by the opposition, arguing that emissions will be well within pollution limits.

This does not satisfy opponents like Dr Henry Gray, an East Kilbride resident and

jointly by Sydkraft and Ahlstrom, will use combined cycle technology using waste heat from the gas turbines to power conventional steam turbines. In addition, waste heat from the steam turbines will be used for district heating, giving a total output of 15MW. Currently being run on diesel fuel, the plant's hot gas filtering will be in place this summer and the gas turbines are due to generate electricity from wood in the autumn.

Like the Swedish plant, the test rig in Finland will be combined cycle and produce around 15MW. Its developers, Tampella Power and Sweden's state electricity company Vattenfall, had originally planned to build a 40MW station in Sweden but scaled down their plans. The first stage to test the gas-cleaning system — started in early March. specialist in respiratory diseases at Glasgow Royal Infirmary, who is worried about the unknown effects of heavy metals and the emissions of sulphur dioxide which could be harmful to asthmatics and others with respiratory problems.

Another concern is over the monitoring of emissions, though the council argues that planning consent involves stringent conditions including a land-line link from the plant to the council's environmental health department for monitoring.

The result of the environmental impact assessment is expected by late summer.

Environmental benefits of wood gasification over coal burning include no net carbon dioxide emissions (from sustainable forestry), lower nitrogen emissions, no sulphur emissions and an ash residue which can be used as a fertiliser. The potential benefits of such a system are well understood in Scandinavia where forests are a major resource and acid rain a serious problem.

Wood gasification could be particularly attractive in Sweden which is committed to closing its nuclear power stations (50% of its electricity generation), has restrictions on hydro development and plans to cut carbon dioxide emissions.

The Swedish project could be the forerunner of a \$30 million UN Global Environment Facility programme which plans a gasification plant in Brazil.

## **LETTERS**

#### **VAT confusion**

Dear Safe Energy

Some environmentalists were caught out and welcomed the UK budget proposal to impose VAT at 17.5% tax on energy. Friends of the Earth (FoE) declared that "taxing energy is taxing pollution and FoE welcomes the Chancellor's new commitment to this principle" (17 March, Budget briefing "VAT on fuel and power").

However, the VAT falls on renewable energy too. It falls less on petrol and diesel because of the large excise duty. It falls equally on the end-use price of fossil fuels and electricity. But, while the VAT on off-peak electricity will be similar to solid fuels, the carbon dioxide emitted will be two or three times higher from electricity, as the efficiency after generation and transmission is only about 30% from steamraising plant. Evidently, taxing energy is far different from taxing pollution.

In principle, raising the price encourages economy in

energy. But energy price elasticity is low, and the primary switch would be between fuels, rather than to energy-saving investment. The psychological impact, resulting from all the fuss over the new tax and the 'signal' that energy prices would increase, may well have the greatest effect in encouraging energy saving and energy efficiency investment.

The call from MPs (and FoE) for "full compensation" to poorer households hit by the tax is of course unachievable. Costs depend on the local climate, on position in a terrace or block of flats and on personal need. Some people would gain and some would lose from any uprating of pensions and benefits. Moreover, if you would use market mechanisms to encourage energy saving, you can't exempt the seven million households living in 'fuel poverty'. Their compensation has to be in kind - insulation improvements, efficient boilers, low-energy lighting, etc.

Funding such a programme was always the intention of the European Community (EC) carbon/energy tax, which was to be 'fiscally neutral'. So a crucial fault of the Chancellor's tax is that no earmarked energy-saving fund is created, to be drawn on for the multi-billion pound investment needed.

A second crucial fault is that a carbon/energy tax needs to be imposed far upstream, on industry generally and on the fuel-producing industries in particular, for they are quite profligate in use of energy and in emitting greenhouse gases. About 7% of oil taken by refineries is consumed in refining, while another 4% in equivalent gas is used or flared on oil-producing rigs. Quantities of methane and VOC (volatile organic compounds) with strong greenhouse effects are also emitted in oil production and use. Natural gas and coal production also generate significant emissions of methane and carbon dioxide.

In the USA the fuelproducers' lobby have argued successfully for their carbon tax to be further downstream, post-production and processing, so as not to penalise marginally economic extraction. This issue has yet to be resolved for the EC's carbon/energy tax, so environmentalists should be warned.

Moreover, accepting VAT as a substitute for a carbon/energy tax is politically naive — as it may scupper the whole proposal. Despite agreeing to the EC UK proposal, the government is now saying that ministers are "not convinced" of the need for such a tax. Instead of the USA, it appears that the UK will now be the major stumbling block to taxing carbon dioxide (CO2), let alone a combination of  $CO_2$ , radioactivity, methane and VOCs that would better reflect the pollution from energy production.

Yours sincerely

Max Wallis School of Mathematics University of Wales Senghennydd Road Cardiff CF2 4AG

#### **Clinton concern**

Dear Safe Energy

As always, we greatly appreciate getting Safe Energy, but we must protest at your portrayal of Bill Clinton. In the view of hundreds or organisations in the US, Clinton is as bad as Bush or Reagan.

Particularly on nuclear policy, he's pushing for extended testing of nuclear warheads and a massive landslide of nuclear waste dumping activity.

Also, his agriculture department is pressing for the irradiation of the nation's beef supply, which will require 500-1000 irradiator facilities at food distribution points, each containing 10-20 million curies of Cs-137 extracted from spent fuel. This amounts to a back-door approach to reprocessing, and following the Cs will be Sr-90 for radioisotope power generators whose use we revealed last September and October, and Pu-239.

A couple of weeks ago, David Broder, one of the senior editors of the Washington Post, wrote in a column that the bottom line from the first 100 Clinton days is that a new elite has been formed and a social policy (health care, North American Free Trade Association, jobs programmes) has been shaped to fit this elite.

A powerful component of this elite is the US nuclear industry, which is sweeping across Europe and the former Soviet Union with its globalised activities.

Best wishes

Kemp Houck Atoms & Waste 310 Domer Street #1 Takoma Park Maryland, MD 20912 USA

# SCRAM REPORTS

£3.50
£5.00
£1.00
£2.50
£3.50
£2.00
£3.00
£3.00

These reports are available from SCRAM 11 Forth Street, Edinburgh EH1 3LE.

Please add 10% for p&p (20% for overseas)

## REVIEWS

#### World inventory of plutonium and highly enriched uranium 1992; by David Albright, Frans Berkhout and William Walker.

Stockholm International Peace Research Institute and Oxford University Press; 1993, 246pp, £25(hb).

When the Soviet Union collapsed and the cold war thawed many breathed a sigh of relief, perceiving an end to the threat of mutually assured destruction (MAD) promised by the nuclear arms race.

The break up of the Soviet Union "has made it possible for the international community to achieve arms control agreements that were previously almost inconceivable. The years 1991-92 have brought about a genuine breakthrough in this respect. As many other problems recede with the end of the cold war, problems of controlling fissionable material are coming to the fore," observes the Director of the Stockholm International Peace Research Institute, for which the work for this timely book was carried out.

Plutonium and highly enriched uranium (HEU) are essential ingredients in nuclear weapons, first produced in the 1940s by the USA and then the USSR when they embarked upon their nuclear weapons programmes. Since then large quantities have been produced by many countries. The nuclear weapons states have acquired extensive stocks of HEU in order to manufacture warheads and to fuel submarine reactors. HEU is also used in civil research reactors. Many tonnes of plutonium have also been produced for nuclear weapons but by far the largest amounts have arisen from the irradiation of uranium in civil power reactors.

As nuclear production in both civil and military domains expanded, and as technologies diffused, knowledge of the scale and whereabouts of plutonium and HEU inventories became increasingly important in the decades following World War II. "Today", say the authors, "there are four contexts in which this knowledge, or the lack of it, has assumed great significance."

•The first is that of regional proliferation — the attempts by some countries to acquire materials for their fledgling nuclear weapons programmes, as illustrated by the recent controversy surrounding Iraq and North Korea's clandestine activities. This has demonstrated the urgent need to keep close track of nuclear materials and technology flows.

- The second context is that of disarmament in both the Confederation of Independent States and the USA. This is expected to lead to the eventual dismantling of vast quantities of warheads and the extraction of large amounts of plutonium and HEU. Precise inventories are required to control these materials and storage, disposal or recycling is needed to ensure that they do not once again become available for making nuclear weapons.
- The third is that of spent fuel reprocessing which is gaining increasing importance because of the large quantities of plutonium being produced. While most will remain bound in the spent fuel elements the extraction of plutonium is expected to increase dramatically.
- •The fourth concern is the possible development of black markets in fissile materials. Unauthorised trade in plutonium and highly enriched uranium could exacerbate nuclear proliferation and increase the risk of nuclear terrorism.

The knowledge required to fabricate nuclear weapons is readily available in open literature and the equipment can be manufactured with relative ease; only the raw material of nuclear weapons fissile materials — is difficult to produce. It is for these reasons that the authors have taken the vital first step in producing an inventory of these deadly materials.

"Whereas detailed international statistics are published on oil, cotton and potatoes, for example, no equivalent records exist for these critical nuclear materials. This report is an attempt to bring together in one volume what is known and not known about the world's HEU and plutonium inventories."

This is a book for all those who seem to be wallowing in the belief that the end of the cold war meant then end to the threat of MAD. It is an inspiring example of painstaking research, embroidered with little comment, the numbers speak for themselves.

It is intended that the report is updated at regular intervals. Hopefully one day independent researches with the aid of grants from trust funds — the Rockefeller Brothers Fund, the Joseph Rowntree Charitable Trust and the Ploughshares Fund — will no longer have to pull information through the net of international nuclear secrecy in an attempt to "bring an end to much of the secrecy and mystique that has surrounded these materials."

The book is a powerful argument for establishing an international register of fissile materials, and as the authors suggest "such a register should be placed on the agenda in the run-up to the 1995 conference on the Non-Proliferation of Nuclear Weapons."

#### MIKE TOWNSLEY

Climate change policy in the European Community; Pier Vellinga and Michael Grubb (Eds).

The Royal Institute of International Affairs Energy and Environmental Programme; 1993, 67pp, £7.50.

The report of a workshop held by the Royal Institute of International Affairs in October last year, this booklet provides an overview of European Community climate policy and considers possible future developments. The first section provides an excellent summary of international climate change policy and sets the scene for the rest of the report.

Rather than offering a solution to the problems facing the EC and its Member States, the report clearly shows why

the problems exist and the dilemmas involved in reaching a consensus approach.

Frequently mentioned are the pros and cons of an energy/ carbon tax — the "machosymbol of the true environmental believer," as Andrew Warren disparagingly describes it. Warren goes on to outline EC failure to develop other energy effi- ciency measures and laments the decline of the SAVE programme — a message which will be familiar to regular *Safe Energy* readers. The issue of subsidiarity also looms large, and while the EC was a signatory to the UN climate convention, it is dependent on the actions of Member States to meet this commitment. Unless agreement can be reached on an EC energy/carbon tax, which the UK continues to block, the EC can do little more than monitor the progress, or lack of it, being made by Member States.

As examples of the policies being adopted by Member States, there are sections on Germany, the UK and Spain, which show both the differences and the similarities in approach.

Helpfully reproduced as a postscript to the report are key extracts from the 'monitoring proposals' agreed by the EC Environment Ministers' Council on 22-23 March this year (which are significantly modified from earlier drafts available at the time of the workshop). These measures provide for detailed national programmes to be submitted to the European Commission and an annual evaluation of progress in meeting CO<sub>2</sub> emission targets.

While £7.50 seems far too expensive for a mere 67 A5 pages of text, the brevity of the report is a strength. There have been many books on climate change published in recent years (far too many); few have got to the nub of the problem so succinctly. Science and politics make poor bedfellows, and policy making in the real world is a complex business — for subsidiarity read self-interest.

#### **GRAHAM STEIN**

## LITTLE BLACK RABBIT



#### Gummerballs

No sooner had Michael Howard MP, as environment secretary, pronounced that "stabilisation" of CO<sub>2</sub> emissions at 1990 levels by

2000 didn't mean that they couldn't increase again thereafter than he was promoted to Home Secretary.

His successor, John Gummer MP, had been less than two days in office before he was explaining to listeners of Radio 4's Today programme that VAT on fuel was being imposed to protect the ozone layer. His failure to distinguish between global warming and ozone depletion isn't expected to be a hindrance to his career at the environment department.



#### Video nukes

It's not only in Britain that the nuclear industry believes in indoctrinating the young. Science Japan's and Technology Agency has

brought out a set of computer games with titles like Atom World. With exotic locations including the Kingdoms of Alpha and Gamma and exciting weapons like the neutron mirror to bring peace to the world, STA's Nuclear Energy Research Office believes they will make nuclear energy more acceptable to the public.



#### Party time

Regional electricity company Norweb generously sponsored a recent conference at Conservative Central Office in June with all proceeds from the event going to the Conservative Party.

Given all the recent fuss over political donations, Little Black Rabbit trusts that Norweb's annual accounts will clearly identify this expenditure.



Which? magazine decided to put to the test the English and Welsh Regional electricity companies' licence obligation

What?

to supply information to customers on energy efficiency. The advice offered to Which? researchers on the companies' special phone lines ranged from vague to downright misleading. The only comfort for the electricity utilities is that British Gas was even worse.



#### Poll into insignificance

In an effort to determine the standard of service the public expects of its electricity companies, Prof. Stephen Littlechild's Office of Electricity

Regulation commissioned a Mori poll.

This revealed such astonishing facts as: "the strongest support for appointments at evenings or weekends is among those who work full-time," and "customers with a low income are more than twice as likely to say that paying for electricity is a major problem."



#### **Image setters**

It was only four years ago that the UK Atomic Energy Authority created a new image for itself as AEA Technology. But under its new

Chair Sir Anthony Cleaver it is now time for another facelift. For the bargain price of just £350,000, image consultants Lloyd Northover have come up with a fresh new title: "AEA". Now all they have to do is spent £500,000 promoting the new name.

#### **Boat** race



Nuclear Electric's celebration of its namesake's success in the British Steel Challenge round-the-world yacht race was more than a little

dampened by the second place yacht. Nuclear Electric's name now stands alongside that of laughing-stock security company Group 4. But with odds of ten to one, let's hope Nuclear Electric had its decommissioning money soundly invested on the winning yacht.

## Two ways to promote safe energy

Fill in the appropriate section(s) together with your name and address and return the form to the address below.

1	I would like to <b>subscribe</b> to the <b>Safe</b> <b>Energy</b> Journal, and I enclose an annual subscription	2 I would like to make a <b>donation</b> to <b>SCRAM</b> and enclose a cheque for:	Dog	
	<ul> <li>☐ £16 (individuals)</li> <li>☐ £8 (concession)</li> <li>☐ £25 (supporting)</li> <li>☐ £100 (life)</li> <li>☐ £40 (organisations)</li> <li>Overseas (£ sterling please): Europe add £2.50; Outwith europe add £6.00.</li> </ul>	□ £10 □ £25 □ £50 □ £100 other £	more to the indu to S	
N	ddress		Sofir	
P T	ost code Phone No o: SCRAM, 11 Forth Street, Edinburgh	EH1 3LE	appe centi	

ou give money nuclear stry than CRAM?



# Scottish Campaign to Resist the Atomic Menace ANNUAL REPORT 1992/93

#### Amongst the highlights of 1993 ...

In a year which saw SCRAM's *Safe Energy* journal reach its 15th birthday, the Earth Summit in Rio was amongst the most important events. Though this historic international meeting failed to live up to the expectations of many, it was a step in the right direction. The activities of the many non-governmental organisations was particularly encouraging, and their continuing work on climate change in particular could be vital.

The nuclear industry persists in claiming green credentials, but it has not had a good year. There was worldwide outrage at the shipping of one tonne of plutonium from France to Japan which left the Japanese reassessing their policy. In the UK, Nirex's plans for an underground repository at Sellafield begin to look more and more like nuclear industry hope trying to overcome scientific experience; and the delayed commissioning of the Thorp reprocessing plant hangs in the balance.

For SCRAM, founded to oppose the Torness nuclear power station, the Public Inquiry in December into Scottish Nuclear's plans for a dry store was of particular significance. Our pragmatic decision not to oppose the scheme did not go unnoticed. Scottish Nuclear cited this as showing what a good idea their proposal was, while our absence was condemned in the press by the local MP, John Home Robertson, and East Lothian District Council.

In fact, having long campaigned for dry storage as an alternative to reprocessing, SCRAM did not have the resources to commit to this lesser of two evils debate, but remains fundamentally opposed to the nuclear waste being created in the first place. We were happy to provide Home Robertson and other registered objectors with information, including our report on dry storage. Home Robertson, on the other hand, was not originally opposed to Torness being built in his constituency. East Lothian District Council gave SCRAM a grant of £100 towards our work for the year.

Following the 1992 General Election, the government abolished Conservative the Department of Energy, and with it the often critical Energy Committee. The idea that widespread privatisation of oil, gas and electricity meant the government could all but wash its hands of energy policy was soon disproved with the coal crisis at the end of '92, which at one time threatened to topple Michael Heseltine from his Presidency at the Department of Trade and Industry. One spin-off from the subsequent review was the bringing forward of the 1994 nuclear review to 1993.

#### Safe Energy

Having reached a landmark of fifteen years continuous publication, *Safe Energy* continues to be well received by a readership which includes concerned individuals, campaigners, politicians, environmentalists, government agencies, the media and the nuclear industry.

SCRAM's main role is dissemination of information, and the journal is our main vehicle. We aim to deal with complex issues in a readable way, and are encouraged that such a broad range of people find it of use.

The economics of the journal have always been marginal, but many glossier environmental magazines have appeared and vanished over the past 15 years. Despite our financial position, it is our intention to maintain the concession subscription and to keep individual rates at as low a level as possible. We are grateful to the many supscribers who include a

www.laka.org Digitized 2017 donation with their subscription, and prefer this approach to setting subscription rates at levels which would prevent interested people from subscribing.

We are aware that many subscribers use the journal as a reference source, but that there has been no index to help with this since issue 60. We have been looking at this and hope to be able to produce a new index in the near future.

Comments on the journal, good or bad, are always welcome as feedback helps us to improve the journal and make sure it is meeting the needs of our readers.

We would like to thank all those who write articles for the journal. It is heartening that authors of such high quality are prepared to contribute to *Safe Energy*. We believe that such unpaid contributions indicate the importance of the journal in reaching key interest groups and individuals.

#### Reports

A number of reports were produced during the year. Reprocessing Dounreay and Dry storage of nuclear waste: an exercise in damage limitation were produced with the support of Glasgow District Council, and Scotland, Japan and the Thermal Oxide Reprocessing Plant was produced for Scottish Nuclear Free Zones. Two volumes on Climate change, Policy, impacts and solutions and the contribution of science to UK policy, were written for SCRAM by Paul Gill and formed the basis of our submission to the Department of Environment's consultation on carbon dioxide emissions. We also made a submission to the Scottish Office on its plans for a Scottish Renewables Obligation.

#### Information

In addition to the *Safe Energy* journal, we provide a range of information to students, politicians, the media and the general public. The level of these inquiries shows that there is a demand for the information we are able to

provide. It is unfortunate that we have been unable to find the resources to produce a new schools pack, a problem compounded by the millions of pounds the nuclear industry has available to spend on advertising. The dependence of schools on biased and unbalanced information from the nuclear industry is a major concern.

#### **Finances**

We were expecting to make a loss in the last financial year of over £6,000, so in that context the loss of £2,000 is good news, but it is essential that our finances improve in the coming years. Breaking even is our first priority, but to secure SCRAM's long-term future, we must also get into the position where staff can be paid reasonable wages.

That our deficit was  $\pounds4,000$  less than budgeted was thanks almost entirely to the generosity of individual supporters; to all those who contributed, be it  $\pounds5$  or  $\pounds500$ , our sincere thanks.

We expect to make a loss of about £2,000 in the financial year 1993/94, but even this is dependent on the continued financial support of individuals. We also hope to increase the number of *Safe Energy* subscribers, and will be trying to secure project funding from trust funds.

#### Staffing

Throughout 1992/93 SCRAM has had just two full-time staff, Mike Townsley and Graham Stein. There has been insufficient money to employ a third member of staff (even at SCRAM's pitiful wage level of £45.50 a week). This has put an additional burden on the staff and left many important tasks undone.

#### Volunteers

We would like to thank all those volunteers who have helped through the year, especially Ken Benjamin for his work in the office, Fearghas McKay for his assistance with our computer system, and Linsay Stevenson for running the SCRAM stall.

## **INCOME AND EXPENDITURE 1992/93** AND BUDGET FOR 1993/94

	1993/94 budget	1992/93	1991/92	1990/91
	£	£	£	£
Income				
Journal subscriptions	7500	6894.27	5990	6519
Donations	8000	9506.73	11848 <sup>(1)</sup>	12732(2)
Projects & contracts	2000	4640.00	800	250
Press cuttings service	1000	910.00	1270	1010
Sales	500	202.55	388	400
Stall	500	507.72	672	
Photocopying	500	1037.97	528	1172
Bank interest	50	103.09	418	1079
Miscellaneous	500	606.36	396	35
Total income	20550	24408.69	22311	23197
Expenditure				
Journal	4250	4037.56	3870	3962
Rent, rates & insurance	2300	2085.72	2475	1878
Heating & lighting	400	354.85	223	381
Telephone & fax	1300	1071.06	1435	1309
Postage	450	419.40	<b>598</b>	746
Office equipment & supplies	2000	1865.44	875	2878
Photocopier	1000	5817.18	4977	4447
Library	1000	1037.64	916	859
Wages <sup>(3)</sup>	4750	4625.14	6818	5819
Expenses	3000	3052.09	3709	2118
Projects & contracts	50	41.13		
Stall	300	554.10	797	
Petty cash	500	407.00	271	254
Bank charges & tax	500	508.01	219	294
Miscellaneous	750	757.30	686	231
Total expenditure	22550	26633.62	27869	25175
	(2000)	(0004.00)	(5550)	(4077)

(1) includes a single donation of £4,000 from a trust fund. (2) includes a single donation of £6,000 from a trust fund.

(3) Wage bill covers 2 or 3 full-time staff on subsistence wages of £45.50 per week.

BALANCE SHEET					
	1993/94 budget	1 <b>992/9</b> 3	1991/92	1990/91	
Assets at start of year	4110	6335	11893	13871	
Profit/(loss) for year	(2000)	(2225)	(5559)	(1977)	
Assets at end of year	2110	4110	6335	11893	

## FINANCIAL APPEAL

The response to last year's financial appeal was tremendous, and the contributions from individual supporters went a long way to meeting our £6,000 budgeted deficit. Though our finances now look healthier, we cannot be complacent about the £2,000 deficit projected for the current financial year.

Raising enough money to break even for the year would avoid eating away our very limited reserves and put us in a better position for receiving project funding in the future.

If you can afford to make a donation, however small, it will contribute to the campaign for a sane, sustainable energy policy.

As we are in the process of reviewing our banking arrangements in order to minimise bank charges, we are unable to accept standing order donations at the moment.

#### I ENCLOSE A DONATION TO SCRAM OF:

£10 / £25 / £50 / £100 / other £\_\_\_\_

Name Address

Post Code

Return to SCRAM, 11 Forth Street, Edinburgh EH1 3LE

#### English and Welsh supporters ...

As you are probably well aware, about 10% of your electricity bill goes to prop up the nuclear industry. Why not match that with a similar donation to SCRAM?

Of course, the more energy efficient you are the less money you give to the nuclear industry and the less you would have to give to SCRAM to match that!

#### ... and Scots

Scottish supporters subsidise Scottish Nuclear in a more subtle way but to an even greater extent so there's no need for Scots to miss out on this.

### MATCH YOUR SUPPORT OF THE NUCLEAR INDUSTRY WITH A DONATION TO SCRAM!

My household's annual electricity bill is about  $\pounds$ As 10% of this goes to prop up the nuclear industry, I would like to make a similar donation to SCRAM.