

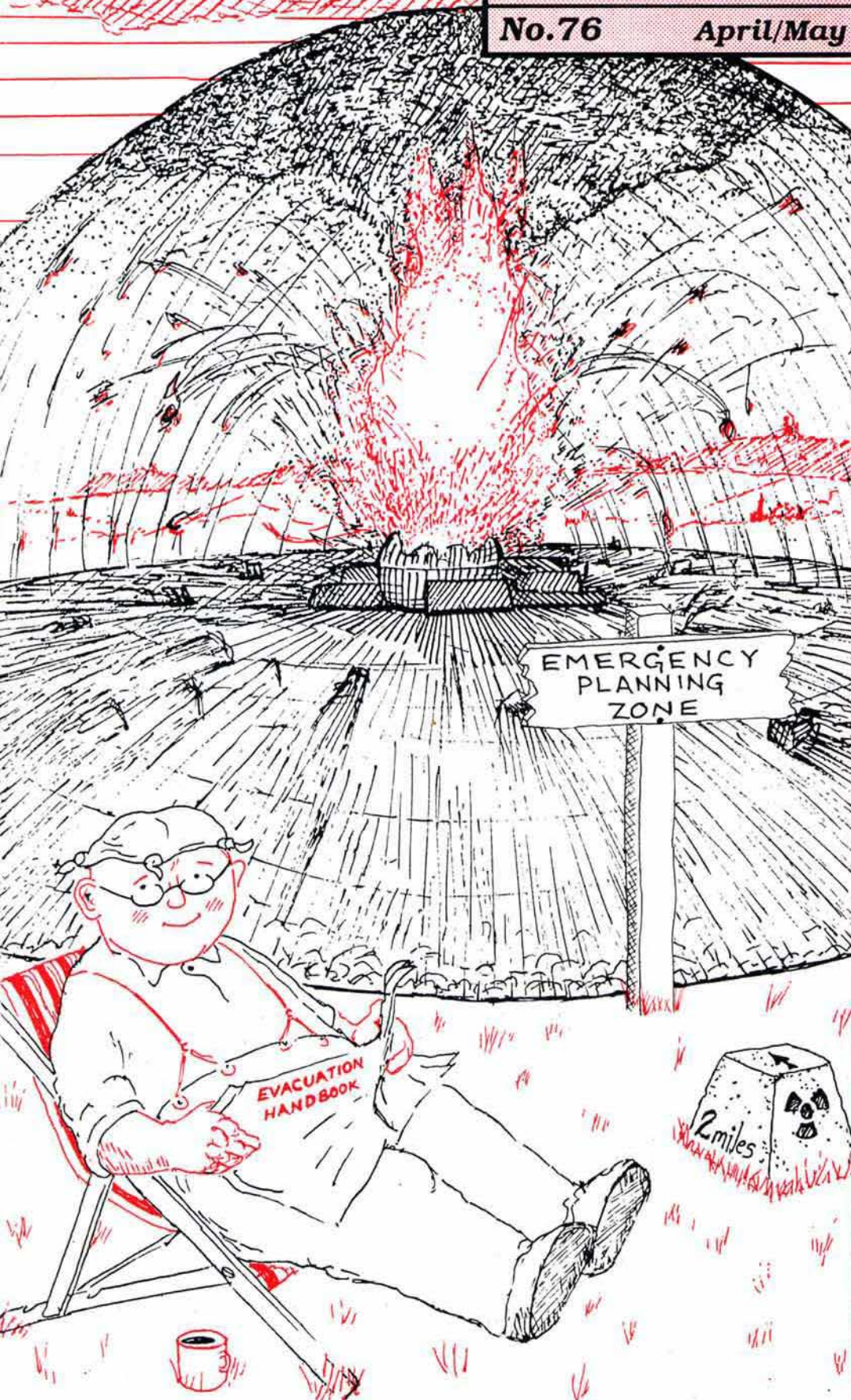
THE SAFE ENERGY JOURNAL

SCRAM

No.76

April/May '90

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**Low level
radiation:
how low can
you get?**

**The Twilight
Zone**

**Energy grows
on trees**

**Reprocessing:
the hidden
costs**

**ICRP: no clear
reaction**

**Unlocking
the fuel cell's
potential**

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AS "Clean, cheap, safe and reliable" echoes quietly around the corridors of nuclear power, Professor Martin Gardner has exorcised the last vestiges of the nuclear industry's mantra.

It was a black day for the industry when Gardner published his findings, that men exposed to levels of radiation at Sellafield, well below the statutory guidelines, have an unacceptably high chance of fathering children with leukaemia. The gang of four has finally been shattered.

Yet some in the industry, mesmerised by the illusion of glories past, are not willing to face the inevitable truth. Radiation, very low levels of radiation, cause cancer. They were heard to greet the Gardner report with incantations that it meant all blame was contained within the plant, and that routine external emissions had been exonerated. Clutching at straws.

Instead of bringing down exposure limits, which would inevitably increase the costs of Sellafield's activities, and quite probably close it down, more studies have been ordered.

Study begets study begets study..... What begets action?

STEPHEN SALTER, designer of the Duck wave power device, has received official confirmation that the Department of Energy miscalculated the estimated cost of electricity from Ducks. Somehow, they found it unlikely that it would be able to generate below 8p a unit. Their new figures show that the actual cost would be 3.8p at 1982 prices. The Government pulled the plug on wave in 1982.

Now they are saying that it will still not be economic because the privatised regime demands a much higher pay back rate. No account is being made of its, or any other renewables, non-polluting nature. Infact they are actively being degraded. How, we wonder, can the 'true greens', those defenders of the earth, the Tory Government, balance what they say with what they do?

They plan to write off the £1.4bn debt of Scottish Nuclear, and are putting up £2.5bn to cover the liabilities of Nuclear Electric. The entire e.s.i. is being forced to subsidise the nuclear industry, at an estimated cost of £1.15bn per annum for the next 8 years. As a final slap in the face for the taxpayer, and proponents of renewable energies, Chancellor Major is allowing oil companies a "100% allowance against corporation tax" on the future cost of closing down offshore oil and gas fields.

They would generate more electricity and less pollution if they burnt the money, in pound notes, directly.

The **SCRAM 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 (SCRAM)**. Views expressed in articles appearing in this journal are not necessarily those of SCRAM.

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

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Editors:
News - Pete Roche
Safe Energy - Mike Townsley
Layout - Graham Stein

Cover drawing:
Dennis Martin

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After much pressure, the two materials testing reactors at Harwell, DIDO and PLUTO were closed on 31 March. **Paul Mobbs** argues that the reasons for this decision are more than just financial, and have implications for the rest of the nuclear industry.



The PLUTO materials testing reactor at Harwell

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Nuclear knockout

THE European Commission has ruled that the so-called 'nuclear levy' can last only until 1998, and will be restricted to existing nuclear stations and Sizewell B.

By limiting the levy in this way, the Commission has probably ruled out any new nuclear construction for the foreseeable future. Friends of the Earth described the ruling as a "knockout blow" to the industry.

John Wakeham, the Energy Secretary, set the nuclear levy at 10.6%, midway between the 12% demanded by the Treasury and the 8% lobbied for by the Public Electricity Supply (PES) Companies (ex Area Boards). The PESs will be obliged to buy 8,500MW of expensive nuclear-generated electricity, and 50MW of renewable electricity - the 10.6% levy on fossil-generated power is intended to compensate them.

Wakeham originally intended to phase out the levy, and expected a minimum 33% drop by 1998, due to efficiency improvements in the nuclear industry. This increased efficiency was to come from extending the life of some of Nuclear Electric's (NE) Magnox reactors, and by increased investment in the AGRs, to make them work properly - a thoroughly unconvincing strategy.

The Magnox stations are currently undergoing long-term safety reviews (LTSRs). To continue operating, they have to receive a licence from the Nuclear Installations Inspectorate (NII). Berkeley has already been

shut down because the investment needed to bring it up to NII standards was too high for the CEGB to stomach. Hunterston A, Britain's most efficient Magnox station has closed because "rising costs for reprocessing Magnox fuel have made Magnox uneconomic".

The AGRs were designed to re-load fuel while still running at normal efficiency. This has never been achieved, and is the main reason why their performance has been so disastrous. In order to re-fuel, the reactors have to reduce their power to only 20 or 30%.

The 'nuclear levy' is worth £1.15bn per year over the next 8 years to Nuclear Electric. They could be in for some serious difficulties when the subsidy comes to an end in 1998. The obvious solution is to abandon Sizewell B, and close some of the more inefficient AGRs (ie Dungeness B, Hartlepool and Heysham A), rather than increasing investment, which would just be a case of throwing good money after bad.

Other subsidies, which the Brussels Commissioners approved, include a £2.5bn guarantee to cover present and future costs of decommissioning existing nuclear power

Column 1 Station	Column 2 Licensee's LTSR completion dates	Column 3 Possible next LTSR (note 2)
Calderhall (1956)	1982; 1989	1996
Chapelcross (1959)	1982; 1989	1996
Berkeley (1962)	Closed 1989	—
Bradwell (1962)	1987	1992
Dungeness A (1965)	1990	1995
Hinkley Point A (1965)	1990	1995
Hunterston A (1964)	Closing in 1990	—
Oldbury (1967)	1991	1997
Sizewell A (1966)	1991	1996
Trawsfynydd (1965)	1990	1995
Wylfa (1971)	1991	2001

Notes:

1. () = Date of commissioning.
2. If licensees wish to extend the station's operation beyond the date shown in column 3, then a further LTSR would have to be completed by the licensee and considered by the Health and Safety Executive's Nuclear Installations Inspectorate (NII) by that date.

stations, and a £1.4bn debt write off for Scottish Nuclear.

Meanwhile, details of contracts between Scottish Nuclear and the two Scottish generators, Scottish Power and Scottish Hydro-Electric have yet to emerge. The generators are planning to take all of the output of Hunterston B and Torness, despite the high price of nuclear electricity. They obviously expect to buy the electricity at a good deal less than the stated 3.47p average unit cost of producing it in 1988-89. The bit of the industry staying in state hands will effectively be providing a subsidy to private investors. □

NIREX waste flaws

A SERIES of worrying gaps in Nirex's plans for deep disposal of radioactive waste have been exposed by the International Atomic Energy Agency (IAEA). In a review of the UK's programme, which confirms much of the work of anti-dumping groups, Nirex's timetable for the safety assessment and their competence are called into question.

Last June, a panel of six scientists, closely involved with the nuclear industry worldwide, examined plans for a deep repository at Sellafield or Dounreay, at the request of NIREX. They list factors which "could well become major obstacles" to the credibility of the safety assessment. These include chemical composition, gas generation, energy release and organic content.

Nirex research work is said to give "little information on phenomena which might disturb the physical and/or chemical integrity" of the concrete to be used as one of the barriers between the waste and the biosphere.

Large volumes of methane and carbon dioxide will be produced as organic material decomposes. Unless adequate venting is provided, high pressures could cause surrounding rock to crack. However, providing an escape route for the gas is incompatible with the need to make the repository impermeable to water. The panel suggest an "acceptable compromise" needs to be found.

"No account", say the scientists, has been taken of the corrosive effects of salty groundwater on the packaging used to con-

tain the waste. This highlights a "more general weakness" which is the "lack of field data". Nor has account "been taken of the possible occurrence of major shear or fraction zones", which could speed the release of radioactivity. Nirex are also criticised for not considering how the "geosphere pathways will evolve with time due to the presence of ... a massive concreted repository."

They recommend the production of a report to examine certain areas including; package technology, transportation technology, handling and emplacement methods, backfilling methods around canisters, sealing of caverns, shaft construction and cavern excavation. This contradicts Nirex's claim that all this is "proven technology".

In conclusion the panel does say that Nirex is off to an "admirable start", but appears to doubt whether the Nirex timetable can be met: "as soon as possible a strategic plan should be formulated to show how all the related elements for the Performance Assessment will be obtained in sufficient detail and at the appropriate time to ensure sufficient information will be available at the projected time for license application."

They stress that "care should be taken to obtain maximum information during the initial characterisation of the 2 sites" ie before a final choice of site is made. One abandoned hole at Sellafield (yet to be redrilled) and a pending planning application at Dounreay is hardly an auspicious start. □

Irradiating the books

THE latest statistics from the Department of Energy (DoE) demonstrate how the electricity boards have tried to manipulate their output, to make nuclear power look healthy in, the period leading to the end of their financial years. This was before the Government pulled the rug from under them, by withdrawing nuclear power from the privatisation package.

In March 1989 *Energy Trends*, an official bulletin of statistics issued by DoE, reported that nuclear electricity generated in the three months November to January was up by 45.6%, at 17.76 terawatt-hours. This was headline news in the *Financial Times*.

This year, in the same period, even with Torness contributing, nuclear output was down 5.8% and stood at 16.73 TWh.

The electricity boards plainly avoided shutdowns for maintenance and repairs and ran their nuclear plant flat out so that the figures they would present in their annual reports, for the year ending 31 March, would look good. They were still hoping to sell the nuclear stations.

Immediately after, production fell sharply, as they carried out repair and maintenance work. Now the bills are starting to come in - but it is the taxpayers and consumers rather than the shareholders who will have to meet them. □

Risk estimates rise

CHANGING radiation dose limits have left the Radioactive Substances Act 1960, "in urgent need of fresh review and revision" according to a new report from the Scottish Universities Research & Reactor Centre (SURRC).

Concern over an excess of leukaemias in North Humberside around the Capper Pass ore smelter led the East Yorkshire Health Authority to ask SURRC, in 1988, to conduct a review of available information on releases of radionuclides from the factory.

The radionuclides concerned are indigenous constituents of the feedstocks used in the smelter. The 1960 regulations only cover ores if any individual radionuclide is present in the raw material with a specific activity of greater than 15 Bq/g (or if the total activity

present exceeds 100 Bq/g). However, a 1984 reassessment by the NRPB concluded that ores with an activity of only 0.3 Bq/g of thorium or 1 Bq/g of uranium could expose workers to radiation doses which are ten times the present dose limit for the public (0.5mSv/yr).

"Inadequate attention has been paid throughout to the ALARA principle", say SURRC, "had this philosophy been applied actively throughout the plant's history, the consequences of the growing obsolescence of the statutory laws, limits and regulations would have been potentially less significant."

The entire range of operations at Capper Pass, therefore, require a radiological safety assessment. Similar requirements are likely to apply at other smelting, chemical and power generating industries. The recent findings of the 'Gardner Report' mean that a detailed examination of the health records of Capper Pass workers and their families is

also necessary.

Concern on Humberside has mostly focused on releases of Polonium-210 (Po-210) from the stack. However, the NRPB's 1984 report suggested that a range of radionuclides may be important. SURRC say there is a distinct possibility that radionuclides are released other than through the main stack. Environmental monitoring has been biased towards air sampling for Po-210, whereas wind dispersal could have contaminated food crops with Po and other radionuclides. A detailed survey of air, dusts and vegetation outside the plant is called for.

Although the study team say they cannot attribute the excess cancers to the operations at the plant, they stress that "technologically enhanced natural radioactivity has the equivalent potential for damage, per unit of activity, to the manmade radioactive products of the nuclear industry". □

HMIP changes for Sellafield

HER MAJESTY'S Inspectorate of Pollution (HMIP) have modified the authorisation certificates which permit radioactive discharges from Sellafield, but they have failed to take account of the changes and improvements in technology and greater understanding of the detrimental effects of radiation. The new authorisations, which came into force on 1 January this year, after a 6 month consultation period, allow the world's highest level of alpha discharges, which would be illegal anywhere else.

For alpha-emitting radionuclides, the new annual limit is 10TBq. This compares with a limit of 1.7TBq/yr at Cap La Hague, the French reprocessing plant. Even the National Radiological Protection Board (NRPB) recommended in 1983 that the annual limit should be less than 7.4TBq. The old authorisation level was 14TBq/yr.

For beta-emitters the annual limit is 500TBq (excluding Tritium), compared

with the old limit of 950TBq.

Frank Cook MP, Vice Chair of the Parliamentary Alternative Energy Group, says the "authorisation of continuing radioactive discharges to the marine and atmospheric environments [is] totally inappropriate" and believes that HMIP should restructure the means by which all radioactive discharges are regulated in the UK.

The current system is flawed in three respects:-

(1) The authorisation framework for radioactive discharges is based on legislation and practices which include conflicting requirements. The Nuclear Installations Act 1985 requires nuclear plant operators to prevent any health injury, while the authorisation certificates permit discharges which implicitly result in such injury.

(2) HMIP does not consider the cumulative contribution of radioactive materials already present in the environment, nor discharges from nearby nuclear plant.

(3) The Government recently committed itself to apply the Best Available Technology (BAT) principle which requires the

whole process to be scrutinised to identify possible modifications to the plant which would reduce or eliminate radioactive discharges to the marine environment. The HMIP make no reference to the implementation of BAT and have based the new authorisations on the current operational characteristics of Sellafield, and consider only how the radioactive 'arising' are to be treated once they have been generated. Thus the new authorisation certificates are not in accordance with the Government's stated radioactive waste management strategy.

Frank Cook concludes "the present system, whereby radioactive discharges from nuclear plant in the UK are permitted, does not satisfactorily protect people and the environment from detrimental effects". The virtually static authorisation certificate limits should be replaced by an improving target. The Government's commitment "to apply best available technology can only be satisfied if the nuclear industry and the authorising departments recognise the need to drastically modify the means by which radioactive discharges are regulated". □

Plutonium Flights

PLUTONIUM Flights from Prestwick Airport in Strathclyde to Japan could be back on the agenda following revelations by the US Nuclear Control Institute of plans to downgrade American regulations governing the design of the flasks used to transport plutonium by air.

The strict US standards for regulating the air transport of plutonium would virtually rule out BNFL's plans to fly up to 45 tonnes of plutonium to Japan (SCRAM 75). Draft regulations prepared by the International Atomic Energy Agency (IAEA), however, fall far short of US standards and the US Department of Energy has been lobbying the Nuclear Regulatory Commission (NRC) to adopt these considerably weaker standards. Such a move would bring the air transport of plutonium back within the realms of feasibility.

Rather than require a flask not to rupture or release its contents in a "worst-case" plane

crash, at 630 mph, or in the "crash and explosion of a high-flying aircraft", at 288 mph, the IAEA has proposed that a cask be able to survive an impact at 190 mph. A series of tests on Plutonium Air Transport flasks in the US showed that current designs could not survive an impact caused by being propelled at 288 mph into an unyielding target. The flask's inner container broke through its protective outer shield which would have left it vulnerable to blast and fire in a real accident.

The Nuclear Control Institute point out that, not only will the new IAEA standards increase pressure on the US to downgrade their regulations, but they will have dangerous consequences for air shipments of plutonium within Europe. A 1988 report by the UK Advisory Committee on the Safe Transport of Radioactive Materials (ACTRAM) estimated that there will be 15 flights per year, after the Thermal Oxide Reprocessing Plant at Sellafield opens, from the UK to the Continent, each carrying about 100kg of

plutonium dioxide. These flights will proceed using flasks, which despite meeting IAEA standards, might not survive a severe crash: "This amount of plutonium, if dispersed in a severe crash over a densely populated area, represents potentially millions of cancer deaths."

■ Meanwhile BNFL in collaboration with the UK Atomic Energy Authority are to build a pilot mixed oxide (MOX) fuel manufacturing plant at Sellafield.

Christopher Harding, BNFL Chair, told the House of Commons Energy Committee last December, that the company would "strongly support" the idea of the Japanese receiving their recovered uranium and plutonium in the form of MOX fuel, because "it would be additional business for BNFL". □

Contact: Campaign Against Plutonium Transport: Secretary Brian Nisbet, 1a Seabank Road, Ayr, KA7 1JE.

Plutonium challenge

MONEY will not be provided by the Bush Administration in the next financial, beginning 1 October, to build the Special Isotope Separation (SIS) project at the Idaho National Engineering Laboratory. The plant, which would use advanced lasers to purify plutonium for bombs, was once the centre-piece of the US Department of Energy's (DOE) plan to rebuild its deteriorating nuclear weapons industry. The project may now be abandoned.

Serious questions about safety and environmental hazards associated with the nuclear weapons industry have arisen over the past few years (*SCRAM 70*), and presented the DOE with some expensive choices about the industry's future. The cost of a full clean-up programme has been put at \$110 billion, by the DOE.

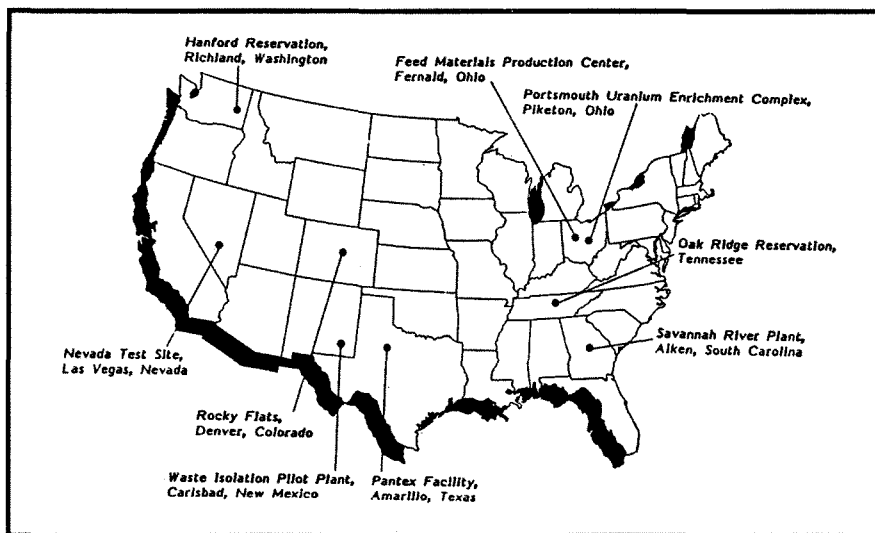
Eight disarmament and environmental groups met in Washington in November 1987 to discuss ways to use the trouble in the weapons complex to reduce the size of the nation's nuclear arsenal. The result was the "Plutonium Challenge" declaration which urged the US Government to begin a two year moratorium on plutonium production and to negotiate with the Soviet Union a bilateral, verifiable, production cut-off of both plutonium and highly enriched uranium. The campaign has two themes: that weapons production creates nuclear waste and environmental hazards, and spending millions to build

two new tritium production plants (\$6.8 billion) and the SIS (\$1.2 billion) would strain the federal budget, when the budget deficit already threatens to engulf the money available to clean up the existing mess.

The campaign was surprisingly successful in gaining support in Congress for the International Plutonium Control Act, last year. The Act is still being discussed in Congress; even if it only succeeds in creating a White House 'task force' to study weapons' material production cut-offs and verification of bilateral cuts, it will be the first time the subject has been discussed in Congress since 1975, and it has now become an important issue on the

congressional agenda. Gorbachev has already proposed a bilateral agreement on the "controlled cessation of the production of all weapons-grade fissionable materials", and the Administration are now being forced to explain their objections to the idea.

Speaking after the withdrawal of funding for the SIS plant, Dan Reicher, a lawyer for the Natural Resources Defense Council (one of the 8 groups) said: "It's the first of many dominoes that will fall in the nuclear weapons production complex. This bodes well for a United States-Soviet agreement to halt plutonium production completely. That's the next step in all this." □



Some of the US sites of serious radioactive contamination

Post Chernobyl blues

THE Soviet Union's nuclear programme has virtually collapsed since the Chernobyl disaster, mostly as a result of growing public opposition. There is growing suspicion that the Government are keeping the true death toll figures secret: anecdotal evidence suggests an alarming increase in health disorders.

Twelve nuclear power stations, either operating, under construction or at design stage have been cancelled or closed down, since the disaster. One of the reactors at the Rivno station in Western Ukraine, commissioned in 1979, has been shut down inexplicably, and is to be decommissioned. It has been rumoured that its foundations have sunk into the ground as a result of a lowered water table. Other stations in the process of construction face local referenda, and are also likely to be cancelled.

In March 1986, one month before Chernobyl, the Soviet Union had a nuclear capacity of 28,000MW providing 10.8% of electricity output. The Government had hoped to double this output by the end of 1990, but in January this year, nuclear capacity was only 34,400MW. □

GDR near-meltdown.

TWO Soviet-designed PWR reactors at Greifswald in East Germany have been shut down. The 440MW reactors (VVER-440s) were ordered to close after a safety analysis of the reactor pressure vessels, by the West German Association for Reactor Safety (GRS).

The closure follows revelations, earlier this year, about a series of incidents at the station, including a near-meltdown in 1986. Although the East Germans describe the closure as temporary, it is generally assumed that the reactors will never open again.

The safety analysis has generated worldwide interest. There are 8 VVER-440 units operating in the Soviet Union, 8 in Czechoslovakia and 4 each in East Germany, Bulgaria and Hungary. Two units are operating in Finland, but with Western control systems, and further units are due to come on line in Cuba and Poland.

The Communist Government had been planning an 8,000MW expansion in nuclear capacity by the end of the century, but most of the new political parties have called for an end to nuclear construction.

■ Work has been suspended on two VVER-1000 reactors, Temelin 3 & 4, in Czechoslovakia, pending a decision on whether to abandon construction, or to incorporate Western technology. The Bulgarian Government have also suspended work on two VVER-1000 reactors under construction at Belene, after 40,000 people in the nearby town of Svishtov went on strike to protest against the project. Opponents claim the site is unsuitable because the soil is sandy and in an area of seismic activity. □

Kalkar legal battle

THE fate of the fast breeder reactor at Kalkar could become clearer on 22 May, when the German Federal Constitutional Court announces its verdict on a two year legal battle between the Federal Government and the State Government of North Rhine Westfalen (NRW).

The NRW Government have been refusing to comply with a Federal Directive not to commission a safety report on the possible consequences of the Chernobyl disaster for the fast breeder. The NRW Government intended to make the licence, for the loading of fuel elements, dependent on the results of such a study. □

French farce

FACED with growing local opposition, the French Prime Minister, Michel Rocard, has called a halt to test drilling at the four potential underground sites for storing highly radioactive waste "for at least 12 months". Rocard explained that he was stopping work "so as to restore a normal situation as soon as possible and bring back the calm necessary for a dialogue and mutual comprehension". ANDRA, the waste management agency, has been ordered to suspend work on the sites at Bourg-d'Ire in the Maine-et-Loire, Bourg en Bresse in the Ain, at Neuvy-Bouin in the Deux-Sevres and at Sisonne in the Ainse.

Rocard called for a rethink of the waste management programme during the year's moratorium by "independent persons of recognized competence in association with elected officials and representatives of all interested parties".

The sites have witnessed emotional and sometimes violent protests since ANDRA began test drilling under police protection last December. One protest march drew 15,000 people to Angers in Maine-et-Loire.

ANDRA had expected to be ready in late 1991 to select one site for construction of an 'in-situ verification laboratory' (ISVL). The laboratory is meant to study conditions for emplacing high-level and alpha-bearing wastes, with a decision on whether to transform it into an actual repository scheduled for the end of the century and operation to begin by 2010.

The moratorium runs counter to the recommendations of a study commissioned by the Government on the future of the French nuclear industry. The report, prepared by Philippe Rouvillois, now chair of the Commission a l'Energie Atomique (CEA), recommended that sites for underground storage of waste should be found and used swiftly "to avoid any build-up of public opinion against the choice".

The Rouvillois report was leaked to the press at the beginning of March, by the radical-left union federation, CFDT. Launching a new campaign on France's

power policy, the union said the Government's action in keeping the document secret since May 1989 showed contempt for the public, parliament and the unions within the nuclear industry. They have called for on-site storage facilities to be more than doubled, and huge dry storage sites to be prepared so that a real choice can be made about whether to continue reprocessing.

The report's authors note that the end products of reprocessing - uranium and plutonium - are now being amassed at a rate which outstrips demand. Now that the introduction of fast breeder technology has been postponed, some of the plutonium could be mixed with uranium to make mixed oxide (MOX) fuel, but no decision has been taken to build a new MOX fuel plant, because it is not considered economic. In any case, it would not be feasible to use all the surplus plutonium in MOX fuel, so Electricité de France (EdF) would still be left with a substantial amount of unused plutonium by the end of the century. Storage costs are high, and the quality of the plutonium deteriorates after it has been stored for a while, making it no longer suitable for MOX fuel.

The French Government is now seriously considering shelving the whole waste disposal problem until more sophisticated reprocessing techniques have been discovered. According to Environment Minister, Brice Lalonde, the decision to store highly radioactive waste underground was taken when fast reactors were still expected to replace conventional nuclear plants. Lalonde says, because this is no longer the case, it is possible to leave waste in its original state and wait for the radioactivity to decline. At the same time a more advanced reprocessing technique could be developed which would permit a finer separation of radioactive elements.

■ The decision not to privatise nuclear power in the UK has been a blow to EdF, says the Financial Times magazine *Power in Europe (PiE)*. The utility is convinced that nuclear power is the most economic choice for power generation, but according to *PiE*, the UK decision "has reopened the debate on nuclear costs, not least in the EC [European Community]

Commission. It has cast doubt on the fairness of EdF's electricity prices."

It has also highlighted the problem of decommissioning. EdF may come under pressure to give more details on the methods and costs of decommissioning. Which could prove to be embarrassing because, after several decades of running a nuclear programme decommissioning, planning and research are still in their infancy.

Following the UK's decision, EdF are believed to be worried about their continued political future in France. The chance of a revival of orders in other European countries appears slim, and it is unlikely that EdF can continue building reactors in isolation.

■ Pierre Tanguy, chief inspector for nuclear safety at EdF, has estimated the risk of a serious accident at a French nuclear power station as being "several per cent" over the next 20 years. Tanguy has also highlighted two disturbing incidents over the past 12 months at the Gravelines nuclear complex, only 30 miles from the Kent coast. One of the reactors had a narrow escape when operators failed to re-fit the proper bolts on three safety valves after a test conducted in 1988. This was not discovered until 15 months later. Had an accident occurred, during that time, the valves would not have functioned properly. Last April a control rod got stuck, this should not have happened, according to Tanguy, as the same thing happened at another French reactor some months before.

■ The French President, Francois Mitterand, cleared the way for the sale of a 900MW reactor to Pakistan, on a recent state visit to the country. Fears that Pakistan was on the verge of acquiring nuclear weapons prompted France, under Western pressure, to cancel an order for a nuclear reprocessing plant in 1978. Compensation for France's failure to complete the plant still has to be worked out.

Mitterand stressed that any equipment sold to Pakistan under the new deal would be subject to International Atomic Energy Agency safeguards, despite the fact that neither country is a signatory to the nuclear non-proliferation treaty. □



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Dr Alice Stewart, the epidemiologist who first alerted the world to the dangers of low level radiation, is now planning to study the health of 300,000 workers, past and present, in the US nuclear industry. MIKE TOWNSLEY reports on her work, which goes beyond Gardner.

Low level radiation: how low can you get?

INFORMATION stored on the world's largest data bank concerning the health of nuclear industry workers (see SCRAM 75) is to be handed over to researchers at Birmingham University by the US Department of Energy.

The data bank containing detailed information on 300,000 nuclear employees, going back to the 1940s, has been the subject of a long and complicated court action, lasting over three years, brought by the Three Mile Island Public Health Fund (TMIPHF) under the US Freedom of Information Act. Now, the Department of Energy has agreed to ending the case by settlement, rather than face the consequences of a messy litigation. All that remains to be done is to work out the fine details of that settlement. Dr Johnathan Berger, Executive Secretary of the Board of Scientific Advisors to the TMIPHF, believes they are "getting there. This is the first time I have been optimistic in the last two and a half years."

Verification

When the data is finally released it will be sent to Dr Alice Stewart at Birmingham University, who will conduct a \$1 million analysis on behalf of TMIPHF. "Our gloomiest expectation is that we would be able to produce something fairly concrete in a year", estimates Stewart. She believes that such a large sample size will allow her to verify the results of a previous study she conducted on workers in the US nuclear industry. That study was concluded in 1978 and showed that the risk estimates set by the International Commission on Radiological Protection were between 10 and 30 times too low. The current ICRP estimate allows workers up to 50mSv of exposure to low level radiation per year.

The study into the health of workers at Hanford - the main US reprocessing plant and source of plutonium for the nation's nuclear weapons - was sponsored by the US Government, and

headed by Professor Thomas Mancuso of Pittsburgh University. Mancuso had been working on it since 1964, funded by the Atomic Energy Commission (AEC), and was nearing completion when he brought in Alice Stewart and George Kneale, a UK statistician, to help interpret his results. The team found that even at very low levels of radiation there was a definite increase in cancers; they concluded that 6% of cancer deaths in Hanford workers were radiation induced.

This news, not surprisingly, was disputed by the international nuclear community. The Energy Research and Development Administration (ERDA, the successor to AEC), who received a courtesy pre-publication copy of the report, began discrediting the team even before publication. Copies of a critique were hurriedly dispatched around the world. Stewart comments that AEC were "brought in to whitewash the industry, then we turned up to cause trouble". They were not given copies of the critique, but had to apply for them under the Freedom of Information Act. Berger adds: "I think you can say, without a doubt, there are two principles in radiation risks. One, the closer you are to the source then the greater your risk. Two, the closer you are to publishing positive findings, as a researcher, the greater your risk also."

Re-analysis

Mancuso's funding was stopped, he was told, because of his imminent retirement, yet he was only 62 and eligible to work for another 8 years. The project went to another laboratory to be headed by one of Mancuso's fiercest critics, Dr Sidney Marks, a former employee of ERDA. Marks was joined by Dr Ethel Gilbert in the re-analysis of the Hanford data. They found the incidence of two cancer types significantly increased, amongst the workers, but concluded that this might be due to exposure to toxic chemicals rather than radiation in the workplace. Gilbert received an award from the American Statistical Society, in 1980, for her Hanford work.

Alice Stewart is not new to challenging the wisdom of the ICRP. In 1956 she disproved the theory that there is a threshold for low level radiation, below which it has no effect. Whilst working at Oxford University's Institute of Medicine she took part in one of the world's largest studies of Children's Health, the Oxford Child Health Survey, and observed that children whose mothers had received pelvic x-rays during pregnancy were more likely to get cancer.

This was the first proof that low levels of radiation could cause cancer. It led, 20 years later, to the establishment of the 'ten day rule', which stated that if a woman was going to have a pelvic x-ray then it should only be done within ten days of her last menstrual period.

Money before health?

However, in the mid 1980s, the ICRP surprised everyone by repealing the 10 day rule, the only reason for which appears to be financial - it was interfering with the efficient running of hospital x-ray departments. Instead x-ray departments were expected to ask women whether they were pregnant. Women, especially those with irregular periods, do not always know they are pregnant. Most x-ray departments in the UK have decided to ignore the ICRP and continue to operate the rule.

Much criticism has been heaped upon the ICRP over the years. Since the late 1920s, when it was set up, its suggested exposure limit for people working in the industry plummeted from 730mSv to 50mSv, in 1958. It is an august body which has been condemned as a "Gentleman's Club", no woman has ever been a member. Its members are mostly drawn from the nuclear industry and its regulatory bodies, and from sections of the medical profession which use ionising radiation. ICRP publication 9, in 1966, stated that the 50mSv limit was retained because the "Commission believes that this level provides reasonable latitude for the expansion of atomic energy in the foreseeable future." Clearly

a political decision and not one based on scientific evidence.

Risk estimates are in the main derived from data relating to the atomic bombings of Hiroshima and Nagasaki by the USA during the second world war. The ICRP along with most other bodies concerned with the health effects of radiation, including the World Health Organisation, regard it as providing the best sample from which to calculate risk estimates because 76,000 survivors have been closely monitored for the last 45 years. Yet, rather than long term exposure to low level radiation, as is generally the case in the nuclear industry, the bombings gave rise to relatively high doses of radiation over a short period of time. Stewart believes that the data "can be misleading", and thinks that simply working backwards from the high doses dispensed by the bombings to give low level exposure risks is not good enough. "It is high time somebody came out and said why not take the simplest solution, instead of the most complicated", argues Stewart. That means an independent study of the health of workers in the nuclear industry, such as the one carried out on Hanford.

In fact, the risk estimates stemming from the A-bomb data have been recently revised (SCRAM 75). The exact amounts of radioactivity released during the bombings were not known until 1976, when the US finally declassified the details of the bombs they dropped upon Nagasaki and Hiroshima.

Indeed the A-bomb data is often used against studies when the nuclear

industry do not agree with the conclusions. The recent Gardner report is such a case. Valerie Beral, Director of the Imperial Cancer Research Fund's Cancer Epidemiology Unit, wrote in the issue of the British Medical Journal which contained the Gardner report: "The explanation offered by Gardner et al is not, however, without its problems. The only other relevant human data available are on the 7,400 children of Japanese men who survived the atomic bomb explosions, and these show no hint of increased risk of leukaemia in the offspring."

Sterile argument

Average exposure to radiation was 4 times higher for the Japanese men than the Sellafield workers. It is implied that four times the dose would be more likely to induce leukaemia. However, Stewart points out that "only 20% of these [Japanese] children were actually born before 1948. Of those born before February 1948 we are only interested in those who were conceived between August 1945 and May of the following year." Gardner found that the children of workers who received doses of 10mSv in the 6 months before conception faced a 6-8 fold increase in the risk of developing leukaemia.

Stewart continues: "When you consider that the effect of 4 times the Sellafield dose would include temporary sterility and impotence, one can't imagine that any would fall in this category at all. It is simply irrelevant to say there is nothing in the Japanese data."

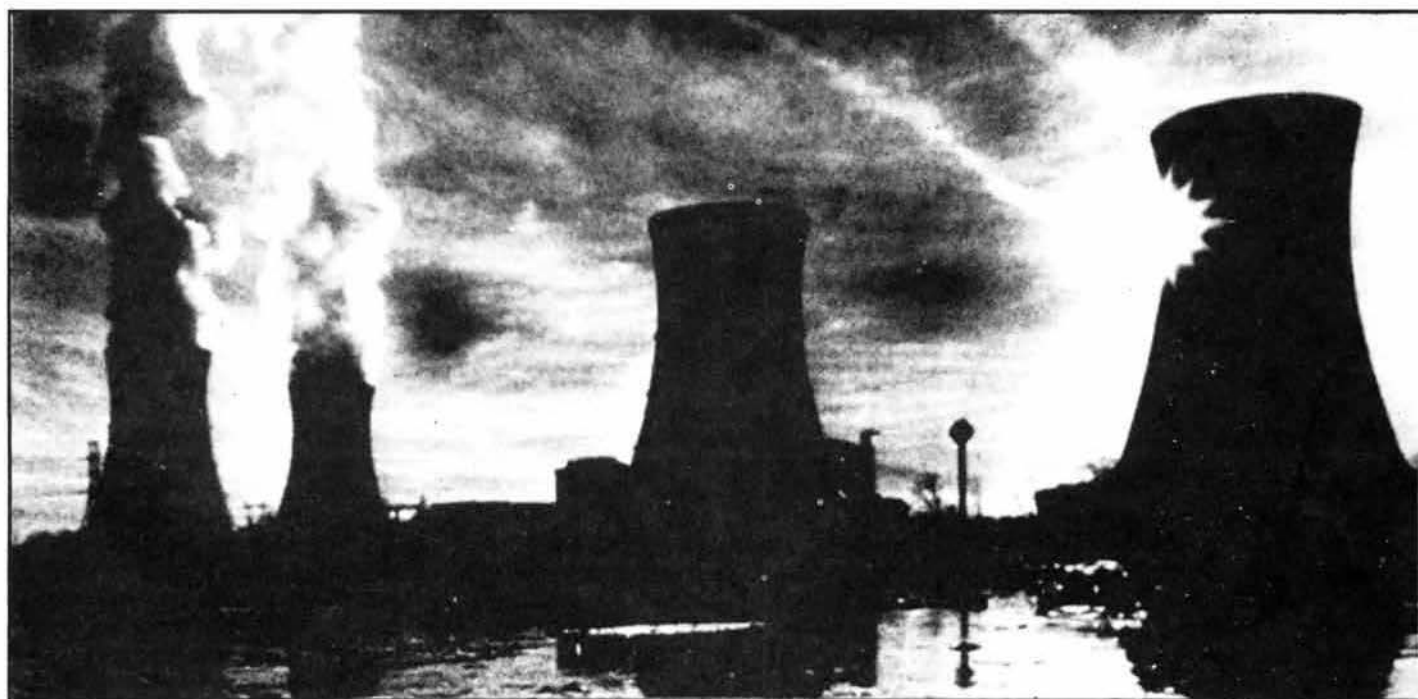
One response by BNFL to Gardner is to suggest that high risk areas of the plant

should not be staffed by men likely to have families, but by people who have already had their families. But, the Hanford survey showed a marked increase in the risk of getting cancer with age. "It is a 'Catch 22' situation", says Stewart, "if you send the younger men in they are not going to get cancer but their children are, and if you put older men in they are not going to have any children but they are the ones likely to get cancer."

Stewart is also wary of any suggestion from the nuclear industry that the Gardner report clears emissions from Sellafield from playing a part in the high incidence of cancer in the area: "They have got to look for reasons to derive some comfort and to deflect peoples attention away from what has happened. I only hope nobody is going to be foolish enough to believe them." She would like to see the scope of studies extended to include an examination of all cancers in the area, and also other birth defects, such as brain damage and miscarriages.

The industry's and government's reluctance to admit the real risk of radiation has very little to do with people's lives: if, as now seems inevitable, low-level radiation is more dangerous than we have been told, and it can be proven, the compensation bill will be staggering.


Only through properly funded large scale studies can the radiation riddle be solved. But, for such studies to engender public confidence, they cannot be overseen by organisations which have so much to lose, they must be conducted by independent scientists. □



The Three Mile Island plant, Pennsylvania USA

The Twilight Zone

The Department of Energy were attacked at a local authority conference on nuclear power station emergency planning for dragging their feet over implementing improvements to emergency plans. Almost four years after Chernobyl there has been very little progress. The conference, held in Manchester, at the beginning of March, highlighted serious flaws in current emergency arrangements, and the need for urgent steps to resolve outstanding shortcomings and deficiencies. PETE ROCHE was at the conference.



FOLLOWING Chernobyl the Department of Energy (DoEn) set up the Nuclear Emergency Planning Liaison Group (NEPLG) to "identify, recognise and find solutions to common problems and decide upon how issues should be taken forward." The group is attended by representatives from the nuclear industry, the Nuclear Installations Inspectorate (NII), the National Radiological Protection Board (NRPB), the Department of Health, Home Office, Cabinet Office, the Association of Chief Police Officers (ACPO), and the County Emergency Planning Officer Society (CEPO). Its meetings are chaired by DoEn.

The *Nuclear Power: Planning for Emergencies* conference was organised by the National Steering Committee (NSC) of the Nuclear Free Local Authorities, at which Fred Barker, their Principal Planning and Research Officer, denounced NEPLG as "no more than a talking shop". So far they have discussed arrangements for issuing public warnings; the extent of emergency planning zones; the implementation of countermeasures and; the extendibility of plans, but have made no concrete recommendations.

Public warnings

Current UK practice for alerting the public relies on door-to-door visits by police, police public address systems on patrol cars, and broadcasts on TV and radio. The effectiveness of such warning mechanisms was called into question at the Hinkley Inquiry, in evidence presented by the Consortium of Opposing Local Authorities (COLA). Dr Alan Jones, CEPO for Somerset County Council, expressed a number of reservations about the current system, even for the 'Reference Accident', which is defined by the CEBG as "the worst accident which could conceivably happen". For more serious accidents, where a large number of people might have to be evacuated, such concerns are heightened.

The use of sirens to alert members of the public to go indoors and await advice was discussed at the conference. Sirens are used extensively in other countries, and at other hazardous premises in the UK. Martin Baggenstos, Head of Emergency Preparedness and Planning

at Switzerland's Nuclear Safety Inspectorate explained how the Swiss public would be alerted by sirens. Radio broadcasts would then inform people of what further action should be taken.

Fred Smith, Assistant Chief Constable in Cleveland, pointed out that there are 15 potentially hazardous sites in the immediate vicinity of Hartlepool nuclear power station. The public would find it impossible to distinguish which siren was sounding in the event of an emergency. He suggested using "a combination of all methods".

At NEPLG's first meeting it was agreed that the use of sirens needed further investigation, as a result the NII have recently begun research into the use of sirens. The DoEn's representative at the Hinkley Inquiry, Mr Hampton, said his department was not against the use of sirens in principal, and the CEBG are considering the "benefits and disbenefits of using rapid alerting systems".

Potassium iodate tablets

During a nuclear site emergency potassium iodate tablets are administered to prevent the thyroid gland taking up radioactive iodine. Stocks are currently held by the emergency services for use by their personnel, and at power station gatehouses for collection by the police for distribution to the public in the emergency planning zone. Current planning envisages that the tablets would be issued at the same time as warning the public or on evacuation. COLA criticised this system, at the Hinkley Inquiry, for causing delays to the warning process. Malcolm Fergusson of Earth Resources Research (ERR), who gave evidence for COLA on international emergency planning arrangements, believes that "the predistribution of tablets should now be more actively considered".

At its meeting on 25 May last year, NEPLG considered a DoEn paper on potassium iodate tablets, which points out that certain police forces have questioned arrangements for distribution within the planning zone and expresses reservations about going beyond the zone: "Distribution beyond the detailed planning zone might require a larger number of people than would be available in the early stages of an accident". Their dilemma is that predistribution

would "heighten public concern about the danger of a nuclear accident". NEPLG have agreed to produce a framework of guidance on potassium iodate tablets, but there is no sign of progress yet.

Sheltering

Malcolm Fergusson believes that evacuation is "inappropriate in many situations ... it is easy to envisage situations in which evacuation would be worse than useless, particularly if countermeasures were needed over a wide area." He wants sheltering to be given more prominence as a countermeasure: "It can be implemented more rapidly, is simpler to operate, and actually facilitates a subsequent evacuation if that is needed."

Internationally sheltering is taken far more seriously as a countermeasure. Martin Baggenstos told the conference of the primacy of sheltering in Switzerland where 80% of the population are provided with civil defence shelters. However, sheltering does not appear to have been given any detailed consideration by NEPLG.

The Size of Zones

British planning zones, which vary from 1km to 3.5km, have been widely condemned because of their very limited extent. In the majority of Organisation for Economic Cooperation and Development (OECD) countries a 10km radius has been adopted for detailed planning.

The emergency planning zone is confined to the area within which a response would be necessary in the event of a Reference Accident, which

Malcolm Fergusson described as "very minor indeed".

Research commissioned by the NSC from ERR showed that, even in accident scenarios only marginally worse than the Reference Accident, evacuation could be required out to 5km, and sheltering and the use of potassium iodate tablets out to 10km. The NSC has recommended that British practice be brought into line with the widely accepted 10km detailed emergency planning zone. In addition it recommends a secondary zone of 25km for the rapid implementation of less elaborate countermeasures, such as sheltering. Phil Harris and John McVicar, Regional Emergency Planning Officers for Lothian and Strathclyde respectively, were both speakers at the conference, and both support the proposal that "plans should include the provision for evacuation and distribution of potassium iodate tablets to persons within a 10km downwind radius of the source of release."

Extendibility

Sir Frank Layfield, in his report on the Sizewell Inquiry, recommended that the extent of the area covered by emergency plans should be thoroughly reviewed. He concluded: "to provide sufficient public confidence, plans should err on the side of being too extensive." Yet, since the 1987, report no specific arrangements have been made for accidents more serious than the Reference Accident, on the grounds that existing plans are sufficiently flexible to be extended easily to cover a wider area. Malcolm Fergusson argues that "there is little or no evidence of specific provision for the extension of current plans, and sometimes quite the reverse."

Fred Smith said that in the event of an emergency at Hartlepool, the 14 people within the 1km emergency planning zone could be warned by telephone to self-evacuate. However, if evacuation has to be extended to a 3km zone, as a result of an accident more severe than the Reference Accident, part of a town of 4,500 people with 1,500 cars and several hundred school pupils would have to be included. Obviously extending the zone in the case of Hartlepool would not be easy.

Similarly at Heysham, where there are no houses within the emergency planning zone, Malcolm Fergusson says "it is difficult to see how countermeasures could be 'extended' from a base of zero, all the more so at a site with the major towns of Heysham, Morecambe and Lancaster, all within five miles."

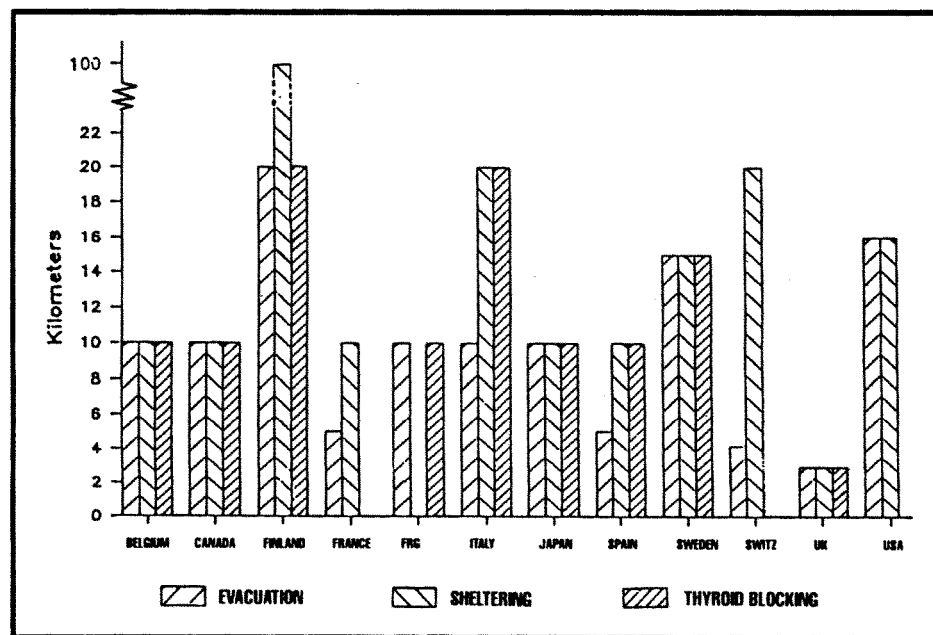
Dr Alan Jones, when talking about the assertions of the extendibility of plans to the Hinkley Inquiry, said "in the absence of a scenario based approach to emergency planning, which considers a range of possible accidents, this assertion is weak and cannot be relied upon with any confidence."

The issue of extendibility is finally being addressed - the NII are expected to produce a paper on the subject soon.

COLA's concluding submission to the Hinkley Inquiry, was that "After more than three years, the post-Chernobyl review of DoEn has revealed no main conclusions and the DoEn has no current plans to issue any guidance." According to Fred Barker this "is clearly unacceptable and steps need to be taken to resolve the situation".

The conference ended up on an optimistic note, with Jamie Wooley, Senior Solicitor for Sheffield City Council, telling delegates that the Health and Safety Executive (HSE) are drawing up legislation to impose a statutory duty on relevant local authorities to produce off-site emergency plans. The anticipated consultation procedure, expected this summer, will give local authorities the opportunity to address current shortcomings in emergency planning, and impress upon the HSE and the Government the urgent need to resolve the deficiencies in current arrangements and to develop 'best practice' for nuclear site emergency planning. □

Nuclear Power: Planning for Emergencies - Conference Presentations available from the Nuclear Policy Unit, Town Hall, Manchester, M60 2LA. (£25 for NFZs and voluntary groups, £35 for others.)



Planning zones in countries with a nuclear programme

Electricity from short-rotation energy forestry looks like an increasingly economic proposition. Willow and poplar trees grown on surplus farmland could supply well over 10 per cent of the UK's current energy consumption, writes DAVE TOKE*.

Energy grows on trees

A COMBINATION of 200 year old engine technology and trees grown for energy purposes could produce up to a quarter of our current electricity requirements, at commercial prices, from farms.

If pressure mounts to cut back on fossil fuel burning in order to counteract global warming then energy forestry and other biomass and renewable energy sources will become more attractive as energy options, especially as they are becoming increasingly cheaper, rather more plentiful and certainly more ecologically acceptable than nuclear power. Energy forestry alone could provide more power than is derived from nuclear power in the UK.

Energy crops do not add to global warming since the burning of the vegetation only returns as much carbon to the atmosphere as the plants have absorbed during growth.

Burning trees only adds to global warming when trees are not replanted, as is happening with the tropical rainforests. Growing trees, rather than say cereals, will have the added advantage of storing and trapping carbon while the trees are growing.

In fact, burning biomass waste such as forestry wastes, industrial or domestic refuse, farm and animal wastes or even sewage does not, in general, add to global warming. Forestry wastes, for example, would otherwise degenerate to give off carbon dioxide, as with refuse which also tends to produce large amounts of methane, an even more potent greenhouse gas.

Biocrops are already used, to a small extent, to produce energy. Since the 1960s people have been developing technologies for converting plant material into biogas using anaerobic digestion techniques, and while there is a gradually increasing application and perfection of the technology, it has mostly been for waste rather than

specially grown crops, which would produce energy at 4-5 times the current price of oil.

The Brazilians have a great deal of experience in growing sugar cane and cassava and fermenting the vegetable matter to derive ethanol to power cars. Although this has helped Brazil save precious foreign exchange that would otherwise be spent on imported oil, the alcohol-as-fuel strategy is still extremely expensive. Moreover, a third of the UK would have to be planted with biocrops to derive only 10 per cent of current levels of motor fuel. To add to the problems, monocultural biocrops have often been criticised by environmentalists for the large quantities of pesticides that have been needed to ward off disease, and the heavy use of artificial fertilisers.

By contrast, short-rotation energy forestry seems not only more economically viable but also less environmentally damaging.

Economically viable

Bernard Wilkins, of the Wood Energy Development Group, says that a million hectares of fast growing willow trees will produce 7 million tonnes of coal equivalent (MTCE) every year, while Steve Newman, of the Open University, believes a million hectares of poplar trees would produce 10 MTCE a year.

Wilkins argues that farmers could already make more money from growing trees and generating electricity for the grid than from growing cereals. He says that even without subsidies farmers should make 10 to 20% more from energy forestry than from growing wheat, as the costs of generators are no higher than other farm equipment, like combine harvesters.

Not everyone accepts Wilkins' figures. However, it seems that electricity from trees would be very competitive with fossil fuels if the market was structured to take account of the reduction in carbon dioxide

emissions that would result from the substitution of biomass for fossil fuels.

The trees need not be used to produce electricity, they could be used to provide district heating or even process heat for industry. One advantage of farmers producing electricity from harvested trees and selling the power to the grid is that the cost of storing and transporting the trees would be removed. The biomass generators would also produce heat which would dry the wood in preparation for burning and provide heat for farms and local buildings. The use of biomass for combined heat and power generation is likely to increase.

Environmental effects

Growing trees for energy should not involve major environmental costs (apart from changes in agricultural land use) provided the industry is properly regulated. The willow or poplar trees would be grown by planting many different varieties at the same time, avoiding the need for pesticides used to stop the spread of disease among monoculture crops. They would be 'coppiced', or cut down, after about five years of growth. The trees would offer a richer habitat for wildlife than the cereals that they would probably be replacing. Natural fertilisers could be used and the wood ash from the generators could be recycled as fertiliser.

The small level of 'acid rain' producing emissions from the generators could easily be scrubbed; more efficient types of generators could even reduce the need to do this. Compared to coal there are negligible quantities of sulphur in wood. Nitrogen oxide emissions produced during combustion reactions with the nitrogen in the air can be removed either by using generators which burn at relatively low temperature or by passing the flue gases through an alkaline medium, or by a combination of the two. Steve Newman points out that the only 'appropriate technology'

currently available for producing electricity from wood are steam engine driven turbines, which do not come in sizes less than 500kW or 1MW. This would suit large farms, but small farmers would have to club together for the process to be commercially viable. Smaller engines were available until the 1920s, when they went out of fashion. Nevertheless, if government policy favoured energy forestry, engineering firms would be encouraged to bring small engines of around 50kW to 100kW onto the market.

Graham Rice of Reading University's Engineering Department has been involved in developing Stirling external combustion engines which, he believes, would be especially suitable for generating power from biomass. Stirling engines were invented 200 years ago and would be very useful because they keep the combustion process separate from the engine, allowing pollutants in exhaust gases to be easily removed.

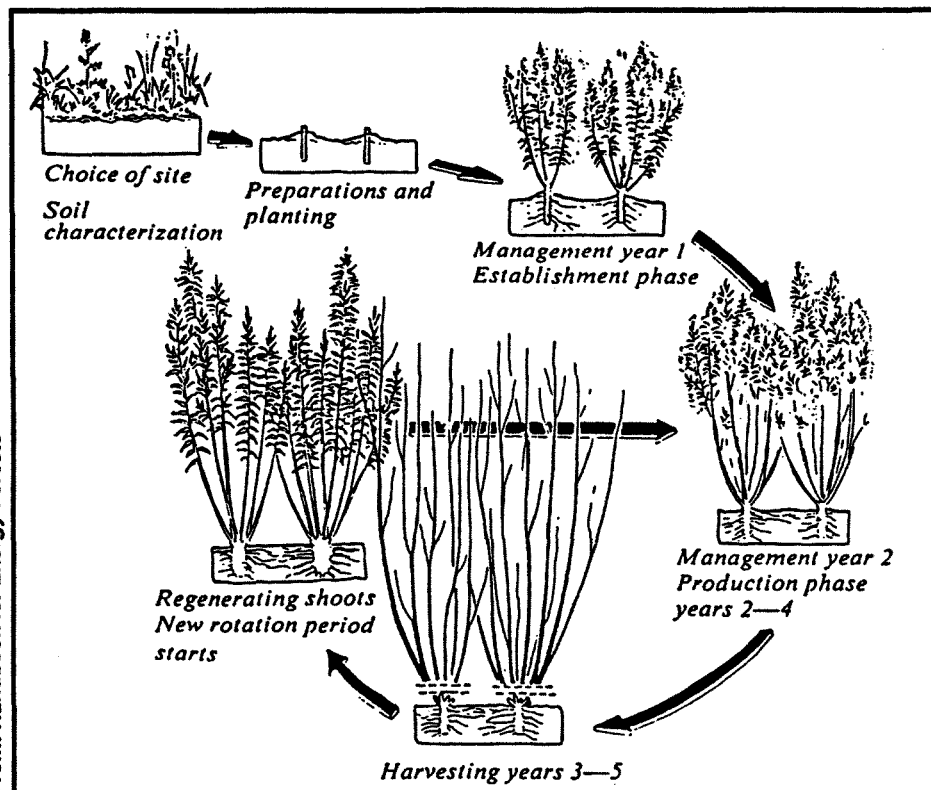
Surplus farmland

In assessing the available land for energy forestry, official estimates are of one million hectares of surplus farm-land in the UK: unofficial estimates are three or four times higher. If around two million hectares were planted with, say, fast growing poplar trees then the resource could provide about the same amount of energy as was produced by nuclear power in 1988.

Department of Energy studies suggest that a further 20 MTCE of energy could be derived from biomass wastes, thus putting the total biomass energy potential in the UK at well over 10 per cent of current UK primary energy consumption, which stands at around 340 MTCE.

Energy efficiency experts, like David Olivier, suggest that with the right measures energy consumption could be cut by almost half without slowing down economic growth. Thus biomass could be providing over 20 per cent of the UK's energy requirements by around the year 2025.

If, as many Scandinavian energy analysts believe, electricity efficiency improvements can reduce electricity consumption by half along with big increases in services, then biomass together with other commercially deployable renewable energy sources



Stages in development of an energy forest

like wind, micro hydro and tidal power, could be providing two thirds of electricity demand by around 2025; at a rather cheaper financial and environmental cost than nuclear power. Further development of renewable sources like geothermal, wave and solar power should enable the UK to eventually produce all its electricity from renewable sources.

Policy changes

Of course this will only happen if renewable energy rather than nuclear or fossil fuel energy sources are given preferential treatment. Five changes in government policy would benefit the development of energy forestry.

First, independent, small electricity producers must be given fair rates for their power. As is done to a greater or lesser extent in the USA, they should be paid on the basis of the long term avoided cost principle. This means that new entrants into the market who bear high capital costs are paid rates which take account of these costs. Otherwise they would be undercut by established power stations.

Second, farmers should have to pay only nominal local rates for the land used for electricity generation.

Third, farmers ought to be given capital grants to help them buy generating equipment.

Fourth, instead of giving incentives, through the Common Agricultural Policy's land set-aside scheme (designed to reduce food over-production), for farmers to grow nothing, incentives should be given to farmers to grow trees for energy purposes.

Fifth, a major education campaign needs to be launched to persuade farmers to grow trees for energy.

Some conservationists might be tempted to argue that surplus farmland ought to be left to grow wild. I disagree with this view. We must look at our activities in terms of global ecological priorities as well as local ones. In an energy efficient economy the opportunity cost of not using surplus farmland for energy forestry could be either more fossil fuel burning, and thus global warming, or more nuclear power with all its consequences.

Given that we can never completely exorcise human environmental impact and given that we need energy from somewhere, using surplus farmland for energy forestry seems a small price to pay for the contribution to global ecological sustainability. □

* Dave Tuke is author of *Green Energy*, soon to be published by Greenprint/SERA, and is the Energy Group Convenor of SERA (Socialist Environment and Resources Association).

As nuclear waste piles up, BNFL continue to import spent fuel seemingly blind to the consequences. DAVID LOWRY, visiting research fellow at the Open University's Energy and Environment Unit, charts the history of THORP's 'factual meltdown'.

Reprocessing: the hidden costs

AT THE time of peak enthusiasm for nuclear energy, in the autumn of 1974, barely a year after the first oil crisis, the head of the Nuclear Installations Inspectorate (NII), E C 'Bill' Williams, made a blunt admission to the science editor of the *Financial Times*: the price for Britain building a lucrative business in the nuclear fuel services, he said, was that the country would become "the dumping place for the world's nuclear waste".

Within a year the political fight over Windscale had begun in earnest. Friends of the Earth (FoE) and Cumbrian local groups organised protest meetings. The *Daily Mirror* ran the now celebrated front page banner headline "Plan to Make Britain World's Nuclear Dustbin" with a scare story inside to match, in October 1975; and followed this a month later with a half page headline "Sign Here for Japan's Nuclear Junk".

Such populist reporting helped create a fierce political controversy over Windscale, focusing upon plans for Europe's biggest construction project - the Thermal Oxide Reprocessing Plant (THORP). The furore ensured that a public inquiry was held, as Labour's Energy Minister, Tony Benn, and Environment Secretary, Peter Shore, passed the buck back and forward, over which department should be responsible.

Return to sender

In the end Benn won, shuffling responsibility to the Department of Environment (DoE), but only after he had been forced to announce, at the end of 1975, that it was the Government's intention to ensure that all reprocessing contracts signed from then on, for foreign spent fuel, had built in 'return to sender' clauses for nuclear waste. This set the context for the current controversy over UK nuclear waste policy, especially from reprocessing wastes.

The Windscale Inquiry, held over 100 days between June and November 1977, did not clarify the matter of

waste management. For much of the Inquiry the focus was upon plutonium and the proliferation problem. These concerns came in the wake of the 1976 Royal Commission on Environmental Pollution report on *Nuclear Power and the Environment*, which warned both of the dangers of the 'plutonium economy' (civil liberties restrictions, terrorism and transport risks) and of going ahead with a large nuclear programme without an adequately planned nuclear waste management strategy.

By the time the Windscale Inquiry began Britain had already imported spent fuel, from Magnox stations sold to Japan and Italy in the 1950s, which was being reprocessed along with UK origin Magnox spent fuel. In addition, spent thermal oxide (PWR) fuel had been imported from Sweden, which was being stored with the long term aim of it being reprocessed. No 'return to sender' clauses for waste arisings were built into these contracts.

Belligerent

British Nuclear Fuels Ltd (BNFL) put a belligerent pro-reprocessing case to the Inquiry. From a capital investment of nearly £300m (in 1976/77 prices), BNFL would gain orders for at least £600m in overseas reprocessing contracts. Effectively these would cover the investment and provide a substantial foreign currency profit for the Treasury. That, at least, was the projection. But, as with many nuclear industry projections, things have not quite worked out that way.

Last year in a letter to the *Guardian*, 25 November, BNFL conceded that the present day investment cost of THORP is nearly £1,900m. This was described as "a real increase in present values of £250m, to take into account more exacting seismic requirements than originally planned plus some reassessed decommissioning costs." The letter concluded that reprocessing was the only waste management alternative to 'direct disposal'.

Three issues now demand attention, in the debate over the future of Sellafield and the role of THORP. Firstly, the issue of radiation risk following the Gardner report. This is discussed elsewhere [in this Journal]. Secondly, the prospect of increased volumes of spent fuel being imported from the Federal Republic of Germany, following the cancellation last summer of the Wackersdorf project in Bavaria. Although a joint declaration was agreed, 25 July 1989, between the British and West German Governments to provide the framework for increased import contracts, subsequently the nuclear industry press, *Nuclear Fuel* and *Nucleonics Week*, have indicated widespread disagreement between West German power utilities over whether exporting their spent fuel is a good idea at all.

Concerns were raised over both the economic benefits, the increased safety hazard in transport and discharges, and West German environmentalists have campaigned strongly, in the aftermath of the 1987/88 Transnuclear bribery and corruption scandal, arguing that the whole policy of exports of nuclear materials should be halted.

The third issue is the problem of the long term management of radioactive waste arising from foreign fuel imported for reprocessing.

Condemnation

In April, last year, the House of Commons Energy Committee report on BNFL produced a damning condemnation of their commitment to contracting imports of spent fuel without due consideration of the waste management consequences. "Britain stuck with Nuclear Nightmare" the *Daily Mirror* glowered; the *Daily Mail* with higher front page profile, declared it a "Nuclear Waste Scandal". These concerns were picked up by the Energy Committee members in their cross-examination of BNFL's management, last December.

The Government's response to the Energy Committee's 1989 criticisms, published in December last year, is to blindly state it is their intention that the 'return to sender' clauses will be put into effect. BNFL in response, more candidly, concluded that large volumes of low and intermediate level waste (LLW and ILW) will remain in the UK.

The present plan, admitted in a parliamentary reply to Liberal Democrat MP, Malcolm Bruce, 28 February, is the same as that first divulged to Labour MP, Austin Mitchell, 2 May 1986, when he was part of the successful campaign to halt Nirex's search for a nuclear waste 'disposal' site in four areas of England. In short, the plan is to 'return to sender' the same curie content of waste, in the form of a small volume of high-level waste (HLW). As HLW comprises only around 3% of total volume of nuclear wastes, this plan would dump the LLW and ILW from foreign contracts upon an already beleaguered Nirex.

The political reality for the proponents of THORP, therefore, is that they will have to persuade the local populace of whatever location is finally chosen by the government, on Nirex recommendations, for LLW and ILW disposal, that they are not recipients of foreign radioactive rubbish, even though the facts show they will be. Nor is this the only unre-

solved future radioactive waste problem.

Another MP, Plaid Cymru's Ieuan Wyn Jones, whose Anglesey (Ynys Mon) constituency has been rumoured to be one of Nirex's reserve options for its disposal site, was told in a parliamentary reply, 8 March, that LLW "is currently stored at Harwell as part of the commercial activities of AEA Technology". The DoE Minister, David Trippier, stated that the storage "is not subject to regulation by this Department", and that any question of the costs of this operation were the responsibility of the UKAEA.

Waste inventory

Jones was chipping away at an economic iceberg, initially pursued in a series of parliamentary probes by Malcolm Bruce, who had picked up on a concern aired by FoE over whether adequate plans exist for the safe management of radioactive waste arising from non-nuclear power and non-military operations (ie. medical research and industry radioactive residues). It transpires from replies, 28 February, to Malcolm Bruce that the DoE have no central records of these LLWs - and appear to pass responsibility to Her Majesty's Inspectorate of Pollution, who are known to be severely understaffed. The DoE have, however, announced in reply to Ieuan Wyn Jones, 8 March,

that the most up-to-date (1989) UK radioactive waste inventory will be published in June.

The final outstanding question on radioactive waste burdens is the decommissioning nightmare. For decades politicians and the public alike have been assured that nuclear power was cheap, mainly because after the heavy capital investment in plant, the fuel cycle was very economical. Some doubters disagreed, but were ignored. When the Government decided to privatise the electricity industry, and insisted nuclear was to be sold off as part of the package, Ministers still appeared to believe, despite detailed argument to the contrary, that nuclear power would be an attractive option.

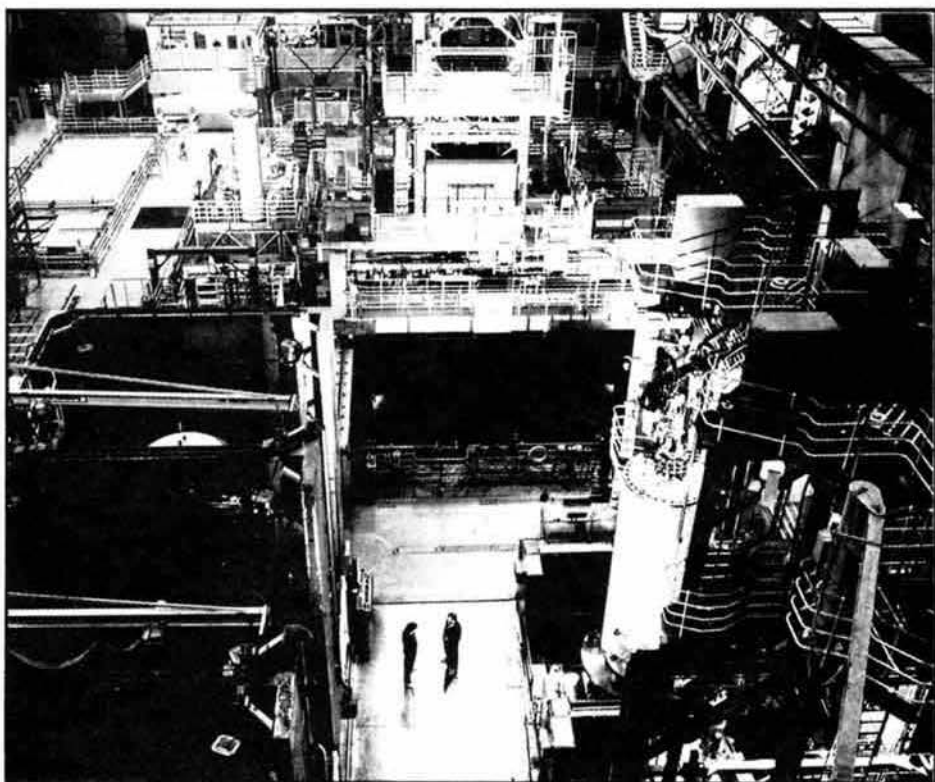
Fuel cost audit

The City demanded a fuel cost audit of the electricity supply industry, to enable them to advise on the sell-off price, so the Government issued a range of consultancy contracts to ensure this evaluation of assets (and liabilities) was properly canvassed. Labour Energy Spokesperson, Frank Dobson, secured a full list of these contracts in a parliamentary reply, 5 February, this year.

His Labour colleague, Paul Flynn MP, pursued the matter of the contract issued to the Nuclear Services Group (NSG) listed as having conducted the decommissioning survey, 15 February. Flynn asked when the contract had been issued to NSG and when they reported. The answer, 10 April 1989 and 16 May 1989: "The cost and content of the report are commercially confidential" said the Department of Energy.

We may, fairly, make this conclusion: it took NSG consultants barely 5 weeks to research and review BNFL's decommissioning costs and produce a report which led directly to nuclear power being deemed too much of a liability to sell off in the privatisation programme. One short, five week, study proved the critics right, after they had been lambasted, lampooned and dismissed as ignorant outsiders by Government Ministers and nuclear industry spokespeople alike.

The dirty back-end of the nuclear industry is an expensive business - official! So what will be the real price of THORP? Over to you NSG? □



Sellafield's THORP spent fuel receipt and storage area

ICRP: no clear reaction

The International Commission on Radiological Protection (ICRP) have issued new recommendations outlining dose limits for radiation workers and the public. The recommendations were circulated during the week following the publication of the Gardner report, which suggested that occupational exposure of the father is linked to childhood leukaemia. On this basis alone they are already out of date and in urgent need of revision. However, PATRICK GREEN, Friends of the Earth's Radiation Campaigner, explains that even without Gardner, the recommendations are a cause for concern.

THREE years after the National Radiological Protection Board (NRPB) acknowledged that radiation was more dangerous than previously thought, the ICRP have responded by issuing new recommendations. Instead of following the NRPB's lead, the ICRP have again failed to propose a reduction in the dose limits for radiation workers and members of the public.

The new recommendations are not final, because the Commission have taken the unusual step of issuing them for consultation. The Commission are meeting in June and are expected to publish the final version in the spring of 1991. At the time of writing, it is not entirely clear who is on the consultation circulation list. Within the UK, the document (which is around 220 pages long) has been circulated by the NRPB. FoE was sent a copy, but pressure groups in other countries were not. Consequently, it seems that the consultation process will be more complete in the UK than elsewhere. This will undoubtedly and justifiably give rise to allegations that the ICRP are only paying lip service to the consultation process and are not really interested in comments, or in amending the recommendations.

Radiological protection?

Under their old recommendations the ICRP have three main radiological protection principles: (1) all exposures have to produce a net positive benefit, ie. the exposure must be justified; (2) the exposure must be kept as low as reasonably achievable (ALARA) and (3) the exposure must be within the dose limits set by the Commission. In practice, regulatory authorities have been primarily concerned with the last two principles, with particular emphasis on ALARA. The justification of exposures has been ignored.

ALARA

In the past the Commission have rejected the need for a reduction in the dose limits, arguing that the ALARA principle was sufficient to bring exposure down to well beneath the dose limits. Arguments such as this have ignored the fact that some groups of workers - uranium, and other hard rock miners, reactor maintenance workers,

reprocessing workers some industrial radiographers, etc - consistently receive higher than average exposures, often close to or at the dose limit. ALARA has not brought their exposure, and hence their risk, down.

Fatal cancer risks

The ICRP now accept, in terms of fatal cancer risks (of individuals as opposed to their children), that radiation is four to five times more dangerous than previously thought. This acknowledgement is a complete vindication of FoE and other organisations' position. However, the US National Academy of Sciences has recently suggested that the risks are actually 6-8 times higher than the ICRP's 1977 estimate. (This was the FoE position at the Hinkley Inquiry.)

They have totally failed to act on this information. If anyone was worried that the Commission's recommendations were more concerned with the requirements of industry than the need to protect health, a careful reading of the new recommendations should leave no doubts as to where their sympathies lie.

Very little has changed. It would be reasonable to assume that if the ICRP consider radiation to be four to five times more dangerous than previously thought, then the dose limits would be reduced by a corresponding amount. This would be the absolute minimum step to maintain the same level of safety as was intended by the old recommendations. An improvement in safety would demand a greater reduction.

Here, the Commission have again failed to recommend a meaningful reduction in the dose limits. Three years ago the NRPB recommended that workers should not receive more than 15mSv per year. The ICRP now considers an annual limit too inflexible and argue that limits should be spread over a five year period. The current limit is 50mSv per year. The ICRP are now saying that in any year workers can still receive this dose (even though the risk associated with such a dose is four times higher than previously considered to be acceptable), but in a period of five years they propose a limit of 100mSv, or an average of 20mSv in a year.

For members of the public they suggest that over a five year period an average

of 1mSv should apply. Currently the NRPB recommend a site specific limit of 0.5mSv and accepted, at the Hinkley Inquiry, that this may be reduced to 0.2mSv. (FoE's position in 1987).

Acceptable risks

In order to justify their recommendations the ICRP have rewritten their acceptable risk philosophy. In effect this amounts to moving the goalposts. They support the occupational dose limits by comparing the annual risk of death due to cancer with fatal accident rates in industry, claiming that radiation work, on average, was similar to working in industries with high standards of safety.

This means of comparison no longer produces the required answers. FoE demonstrated at the Hinkley Inquiry that radiation work at the existing limits is now on a par with working in some of the most dangerous industries. Even the Commission no longer accepts such comparisons as valid. It has introduced a number of new parameters that give them an excuse for doing very little. The most insidious of which concerns the number of days of life lost. On this basis the number of days of life lost from a radiation induced fatal cancer is compared to the number of days of life lost from a fatal accident. The latter tend to occur on average at age 40, whereas cancers tend to occur at around age 60. On this basis they judge fatal cancers less important than fatal accidents.

The Commission believe that on average 13 years of life will be lost from a radiation induced cancer (regardless of whether the dose was 10mSv or 50mSv). This argument can only be described as totally repugnant. It reduces the pain and suffering experienced by cancer victims and their families to mere estimates of time lost. This is not acceptable.

Implications of Gardner

As a result of the publication of the Gardner report, the Commission's recommendations are already out of date. Gardner identified two groups of workers who faced the highest risk of having a child which developed leukaemia: those who had received lifetime doses in excess of 100mSv (equivalent to the ICRP's new five year limit); or those who received a dose of 10mSv or over in the six months prior to conception. For both groups there is a six fold increase in risk, amounting to a 1 in 300 chance that a child would develop leukaemia. A risk of this magnitude is totally unacceptable.

It is also important to recognise that exposure below these levels is not safe. Any level of radiation will produce a

corresponding level of risk. This basic assumption is not changed by Gardner, if anything it is strengthened, because the levels of exposure linked to genetic damage are not generally considered to be large.

However, Gardner does not discuss a mechanism by which the damage occurs and does not speculate on a dose response model. Nevertheless, it is reasonable to assume that lower exposure will still carry some risk. A fact which Gardner's own statistics support, but seems to have been over-looked by the media.

Gardner's report poses a major challenge to the ICRP, the nuclear industry and its regulators. For over 30 years these bodies have claimed that there is no evidence linking radiation with genetic damage in the human population, for example, none was seen in the survivors of Hiroshima and Nagasaki. Consequently, estimates of genetic risk have been largely based upon animal data.



Ignoring, for the moment, whether Gardner's findings could have been predicted earlier, had anyone bothered to look (which will be the subject of my article in SCRAM 77), one should ask what the Commission are planning to do in response. Will the recommendations be rewritten? Predictably, they are claiming the recommendations will be sufficient to protect workers. John Dunster, the former NRPB director believes the new recommendations will ensure that "almost no workers" will be exposed to the high risk levels identified by Gardner. Significantly he does not say "no workers".

Justification of exposure

It is not only on the question of dose limits that the Commission have failed to take meaningful action. A prerequisite of any acceptable risk philosophy must be that no level can

be considered acceptable if the source of exposure is not justified and no benefits are produced. Justification has been the ICRP's primary principle since 1977, yet no one has seen fit to use it in practice. Unlike the ALARA principle which has been the subject of endless discussions, conferences and reports, virtually nothing has been said or written about justification. The ICRP, industry and its regulators continually dodge the issue by applying the argument that if something exists then it must be justified.

The new recommendations do not elaborate on the concept of justification, except to state that the justification of a practice goes far beyond the scope of radiological protection. However, they do accept that the justification of a practice does require "that the net benefit be positive". The ICRP do not discuss who should be responsible for defining what is a net positive benefit.

Furthermore the Commission fail to state what should happen when a practice has been shown to be unjustified. Common sense dictates that if there is no justification then the risks resulting cannot be tolerated and the practice should cease.

What should be done?

So what needs doing? It is quite clear that a long term objective must be to completely rethink existing radiological protection standards. Justification must be a central part of any such system. Whatever one thinks of particular sources of radiation, and some cannot be considered justified (particularly those concerned with the nuclear fuel cycle), action must taken now to ensure that workers are not exposed to levels which put their children at unacceptably high risk.

At present around 260,000 people are exposed to radiation in the course of their work. A recent report by the Scottish Universities Reactor Research Centre suggests that many more are unknowingly exposed. The potential problems for industry are therefore enormous.

There must be an immediate reduction in the dose limits for workers to 10mSv per year, with a further reduction to 5mSv within, at most, five years. These limits do not represent safe levels of exposure, but the absolute maximum acceptable. It must also be recognised that it will probably be necessary to revise them in future. □

European Community (EC) funding and a Department of Energy (DoE) study could herald the revival of UK fuel cell technology. Fuel cells, potentially far more efficient than conventional electricity generation, were invented in Britain 150 years ago, writes GRAHAM STEIN, but have received little attention here since the 1960s.

Unlocking the fuel cell's potential

CONVENTIONAL electricity generation uses heat to power a mechanical device (usually a steam turbine) to turn a dynamo. The 'heat cycle' (conversion of heat energy to mechanical energy) in such systems, has a limited maximum efficiency - the 'Carnot efficiency' - of around 40%. Fuel cells, like batteries, generate electricity directly by chemical reaction and are not 'Carnot limited'.

The principle was first demonstrated in 1839 by William Grove, a multi-talented lawyer. He successfully produced electricity by bubbling hydrogen and oxygen over two platinum electrodes in an acidic solution. Attempts by Victorian engineers to use this principle for fuels such as coal-gas faced many problems, including slow reaction rates and short cell life. With the invention of the dynamo towards the end of the nineteenth century, fuel cell research lapsed.

Revived interest

Interest was renewed in the 1950s by the work of Dr F T Bacon, at Cambridge University, and the development of a 6kW high pressure hydrogen-oxygen cell, with an alkaline electrolyte between nickel electrodes. In the early 1960s, Energy Conversion Ltd, a consortium including BP, planned to develop the fuel cell commercially. Other British researchers included Shell Chemicals, the UKAEA and the CEBG. But, by the end of the decade, with no commercial success and large investment required, British interest waned.

The most developed fuel cell is the Alkaline Fuel Cell (AFC), based on Bacon's design. It was used in the Gemini and Apollo space craft, Skylab and now the Space Shuttle. Fed by cylinders of pure oxygen and hydrogen, it provides electrical power for the space craft, and the only by-products of the reaction are heat and drinkable water. In terrestrial applications air can replace pure oxygen, but poor tolerance of carbon monoxide and carbon dioxide in the gas supply makes the AFC

unsuitable for hydrocarbon fuel. Its advantages include low working temperature, 60-200°C, allowing immediate start up, and low production costs. AFCs could be used for small scale power generation, for example emergency supply; transport, possibly in conjunction with batteries; and because of its low infra-red emission and quietness, for military communications 'in the field'.

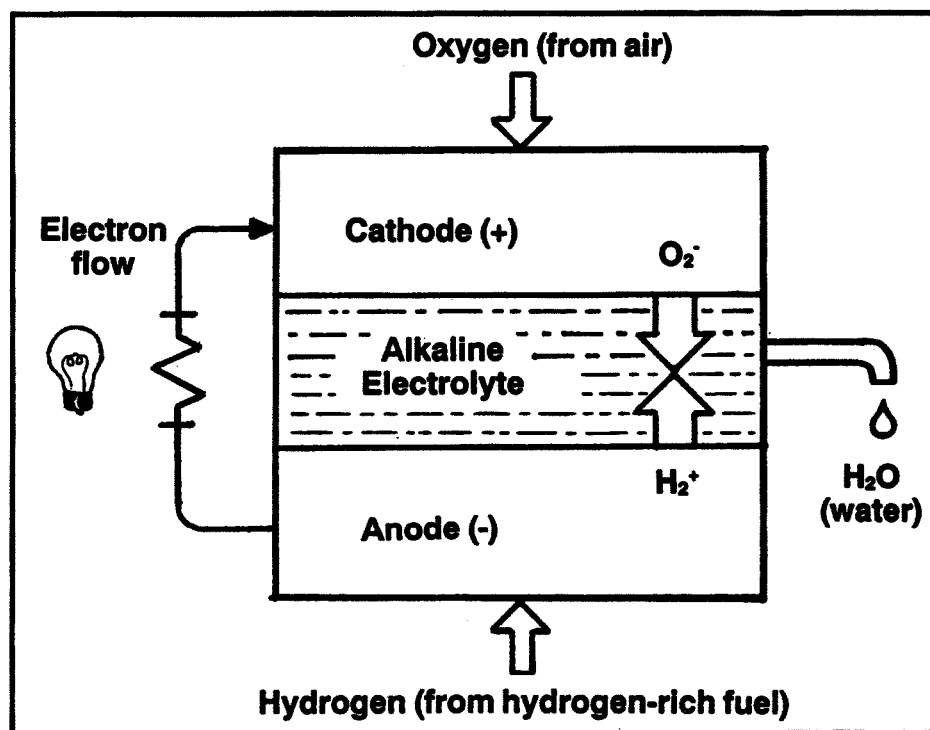
The second successfully developed cell, the Phosphoric Acid Fuel Cell (PAFC), uses an acidic rather than alkaline electrolyte. It is tolerant of carbon dioxide and has a limited tolerance of carbon monoxide and sulphur, allowing it to run on light hydrocarbon fuel converted into hydrogen and carbon dioxide (CO₂). Two 4.5MW pilot plants were built in the early 1980's: one in New York and the other in Tokyo. The New York plant was never operated because of delays - reportedly administrative hitches and environmental objections - which took it beyond its 'shelf-life'. The Japanese plant did generate electricity, though on reduced power because of a

heat-exchanger problem. Cells from the unused New York plant were shipped to Japan and successfully tested.

In the mid '80s the US Gas Research Institute conducted a project with 45 self contained 40kW fuel cell power units. They were installed at sites in N. America and Japan to provide electricity for equipment ranging from a telephone exchange to a laundry. Electrical efficiencies of around 40% were achieved, and because of their operating temperature of around 200°C a further 40% of the input energy was utilised, in the form of waste heat. More demonstration PAFC plants are being built in the USA, Europe and Japan, the largest, an 11MW plant, is being built by the Tokyo Electric Power Co.

Second generation

Though currently the most advanced, PAFCs may ultimately be superseded by 'second generation' designs, which have the potential for higher electrical efficiency. One such cell the Molten Carbonate Fuel Cell (MCFC) draws heavily on PAFC technology, but



The basic alkaline fuel cell

operates at much higher temperatures (around 650- 700°C). It is uniquely tolerant of oxides of carbon in the fuel gas, (even carbon monoxide has fuel value), and therefore well suited to operation with all hydrocarbon and coal-based inputs - the most efficient being liquid petroleum gas. Because of the high operating temperature the exhaust gas can be used in a steam turbine, to give an overall electrical efficiency of up to 65%. Pilot plants may be built in the near future.

A more distant prospect, but potentially the most promising is the Solid Oxide Fuel Cell (SOFC). This type offers a high power density, fuel versatility, expected very long cell lifetime and electrical efficiency (including steam cycle) of about 65%. The main design problem is the need for a high operating temperature of about 1000°C (though scientific advances could reduce this requirement) which leads to problems in finding materials for cell construction. The solid electrolyte has led to variations in design from the traditional flat plate electrode, with research into several different cell constructions, from hollow cylinders to honeycombs.

Researchers at Westinghouse in the USA and two Japanese companies have already produced and tested SOFC systems rated at 3kW. Westinghouse, who use tubular fuel cells, are currently working on a scaled up version of 25kW which is due to go on trial in Japan later this year.

European boost

A major boost to European research, which lags behind the USA and Japan, has come from the European Commission with the injection of £4.3m into a programme to develop cells for industrial use. Under the Joule programme (Joint Opportunities for Unconventional or Long-term Energy Supply), two teams of European researchers will receive funding over the next three years. They aim to have a functioning 1kW SOFC with potential as a cost-effective mass-produced industrial power source by 1992. Spearheading the respective projects are Siemens in West Germany and the German arm of Asea Brown Boveri (ABB). GEC and Imperial College in London are involved with Siemens, and ABB's partners include British Gas and ICI.

Professor Brian Steele, head of the Imperial College group, says there is no competition between the two teams, which have taken different approaches to achieving the same goal. He forecasts, however, that the substantial investment which will be needed to bring the

technology to fruition may well result in a joint venture between the teams. There is no technical reason why the Westinghouse system could not be scaled up to produce hundreds of kilowatts, but Professor Steele says that other SOFC researchers doubt whether the system will ever be commercially viable.

The ABB group have chosen a system with a similar structure to the Westinghouse cell, but with a rectangular design aimed at ease of manufacture. The Siemens team, however, have opted for a planar design which researchers hope will enable easy and cheap mass production. Imperial are working on a 100W system and aim to have it running by the end of this year, hopefully to be scaled up to 1kW for 1992.

The Siemens team are lagging behind Japanese researchers who have already produced a 1kW planar design SOFC, but Professor Steele believes the Japanese are only a year or two ahead and says "If Europe gets its act together we can compete, but we'll have to move quickly."

It is likely that SOFC's first commercial application will be in combined heat and power (CHP) with ratings from 100kW to several megawatts, but the technology is not yet sufficiently developed to predict if it could be scaled up to the range of large scale power generation.

Environmental effects

There have been many claims to fuel cells being a clean power source, this should not be overstated, especially in the light of recent awareness of the problems of global warming. They do not belch out smoke and soot, and operate quietly making them useful for in city applications such as CHP. Also, they do not give off acid-rain-causing oxides of nitrogen. Cells running on fossil fuels will emit the same amount of CO₂ as conventional heat engines, but their increased efficiency means lower fuel consumption/CO₂ emission, for the same amount of electricity generated.

The problem of CO₂ emissions is only avoided when hydrogen rather than a fossil fuel is used. Even then, it has to be remembered that hydrogen is not a primary fuel source, and if the hydrogen has been produced directly or indirectly from a fossil fuel source then there is no reduction in emissions.

In the short to medium term fuel cells could have a useful environmental role in using fossil fuels more efficiently. Combined with alternative energy sources they offer the possibility of 'clean' electricity.

With their low maintenance requirement, fuel cells would be well suited for remote communications such as transmitters, beacons and weather stations. In transport everything from wheelchairs and milk floats to cars, buses and even ships could utilise fuel cells, making them up to twice as efficient. The development of medium scale local generation (and CHP) may well follow. Amongst the possible benefits of local electricity generation is that piping hydrogen or hydrocarbon gas is far more efficient than electricity transmission. The replacement of large power stations with equivalent fuel cell plants is less certain technically, and it is doubtful, in any case, if such a system would be more beneficial than dispersed generation.

Combining fuel cell technology with alternative power sources creates an attractive prospect. Alternative power sources, with their intermittent supply, could be used to produce hydrogen from water. The hydrogen could then be stored and piped, in the same way as natural gas, then used by local fuel cell plants to generate electricity (as efficiently at part load as full load) with the 'waste heat' being used for district heating, the only other product of the process being water.

If the technology can be developed, its future may well come down to a matter of cost. Current projections are vague, but sufficiently promising to encourage further work; and if talk of 'green taxes' was to become more than just talk, the financial argument would shift considerably to the benefit of fuel cells.

The Energy Technology Support Unit (ETSU) on behalf of the DoE are reassessing the prospects for fuel cell technology in the UK, with a study (a follow up to reports published in 1983⁽¹⁾ and '87⁽²⁾) due out later this year. Whether this report will see fuel cells as a technology worth investing in, and if it does, whether any research and development funding will follow, remains to be seen. British ideas being taken up by other countries, while Britain lags behind through lack of money, is an all too familiar tale, but it's not too late for Britain to get back into fuel cell development. Hopefully, for once, the DoE will get it right. □

References

- (1) *Fuel Cells: an appraisal of current research and future prospects* by K F Langley. ETSU R12, HMSO, June 1983.
- (2) *Fuel Cells: an update* by D G Lovering & E W Lees. ETSU-N-104, June 1987.

The sudden and unexpected closure of both materials testing reactors at Harwell are for reasons other than just financial, argues PAUL MOBBS Director of Banbury Environmental Research, and has implications for the rest of the nuclear industry.

The Disneyworld reactors

AFTER much pressure, the two materials testing reactors at UKAEA Harwell were closed on 31 March this year. According to the Harwell management the reason for the closure of these reactors is purely a matter of economics, not safety: they are being economical with the truth.

DIDO and PLUTO, the materials testing reactors at Harwell, were built in 1956 and '57 respectively. They are almost identical, and are very similar to the one which was opened at Dounreay in 1958. They were heavy water moderated and cooled, operating at atmospheric pressure and at around 70°C. The original design power was 10MW (thermal), but over a long period this was slowly upgraded to a final level of 25MW. The fuel rods were made of composite aluminium and 93% enriched U₂₃₅.

Safety at the site was not regulated by the Nuclear Installations Inspectorate. Due to the exemption the UKAEA possessed under the Atomic Energy Acts, safety of all nuclear plant was regulated from within the AEA itself by a safety committee comprising mainly Harwell employees and employed consultants. Over a period of time this led to a slow deterioration in the condition of these reactors.

During the 1970s the reactors had little

investment to keep them up to standard. Operator doses were very high, with quite often more than 30-40 people a year exceeding a dose of 15mSv, and some coming close to, or exceeding, the legal limit of 50mSv. Many proposals for improving safety and reducing operator doses were made, but were dropped due to lack of funds.

The history of these reactors is one of short-cuts and under-investment in safety systems.

Reactor Experiments

The reactors have a single set of control rods for the primary control and shut-down. A smaller set was used to vary activity to a fine degree, but this secondary set could not reduce neutron activity enough to effectively shut down the reactor. As they were built before the Windscale fire in 1957, no emergency secondary shutdown system was fitted. Even after the Windscale accident no working system was ever fitted.

High pressure, high temperature experiments have been conducted in the core of both reactors. Considering that they were not constructed as pressure vessels, and did not have a backup emergency shutdown system, the consequences of one of these pressurised loops failing could have been very serious. But again, the production and approval of safety cases for each of these

experiments was regulated internally, and so many of the experiments did not have to meet the engineering standards required elsewhere in the nuclear industry.

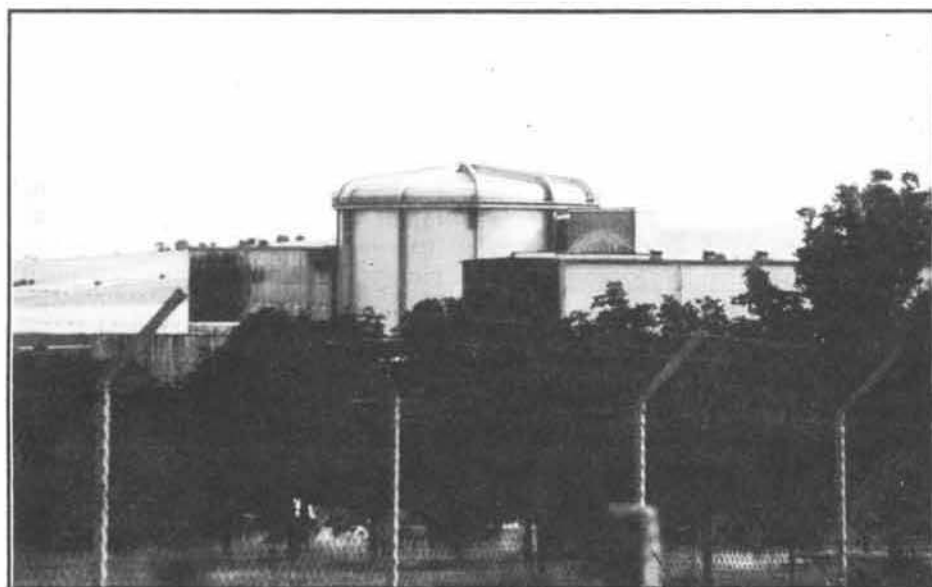
The two experiments which gave the greatest cause for concern were two experimental loops used for testing reactor fuel rods. One, known as the DIDO water loop, was used to test Polaris submarine fuel rods by simulating the high pressure/temperature conditions inside the submarine reactor. It was calculated that there was enough energy within this experiment to cause serious damage to the core should the loop ever fail. Even so, no backup shut-down system was fitted to the reactor to ensure its safety should an accident ever happen with the experiment.

The PAT loop

The other experiment, the PAT loop deserves a more detailed explanation. The Harwell reactors have done a major part of the experimental work for Britain's nuclear power industry over many years. DIDO was used mostly for water reactor research, mainly for submarine power plants. PLUTO was used, in the main, for gas cooled reactor research.

Towards the end of the '70s it was decided that in order to increase the economic potential of the Advanced Gas-cooled Reactor (AGR) a series of experiments would be carried out to test if the core temperature could be raised significantly to increase the average output load. A wide range of experiments were conducted, but the major part of these were to involve the testing of AGR fuel assemblies in the PLUTO reactor. A special experiment called the PLUTO AGR Test (PAT) was designed and fitted to the PLUTO reactor. It was a large highly pressurised experiment which required over one third of the available core space.

For at least six years the AEA tried to get the safety case for this experiment approved. Because of the nature of the experiment the Nuclear Installations Inspectorate (NII) had to give their approval, but despite the best efforts of Harwell, the CEB and the UKAEA's Safety and Reliability Directorate, and



DIDO materials testing reactor at Harwell

many millions of pounds, the safety of the experiment could not be proved.

In the December 1988 issue of their magazine *ATOM*, the UKAEA outlined in detail the set of experiments which were to be carried out in the PAT loop. These experiments it said would run "for several years". However in February 1989 the UKAEA announced that the PLUTO reactor would close in 12 months. The PAT loop was not mentioned, it was merely closing for economic reasons. In fact what happened was that the CEBG had withdrawn from the venture because Harwell could not guarantee that the experiment would get its safety case approved and run.

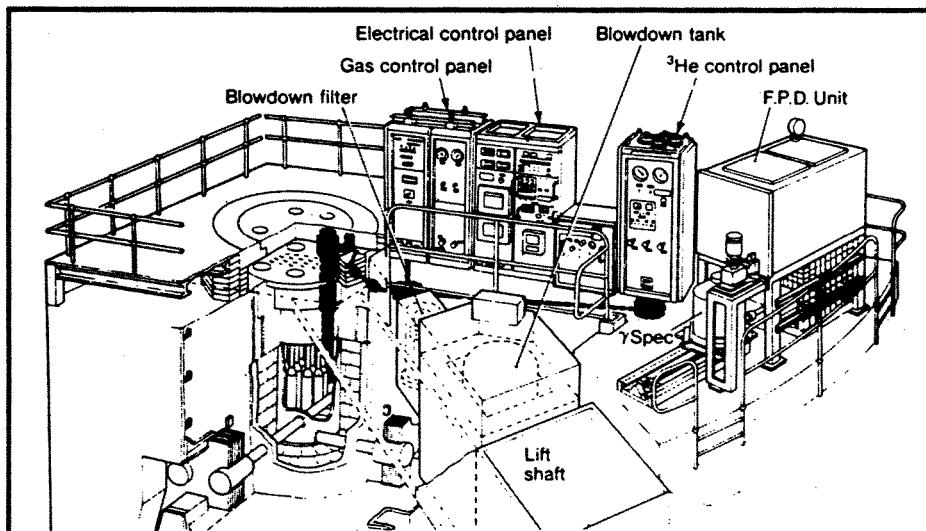
This now leaves the AGR programme in limbo. At present the reactors are running very uneconomically. Without testing of the fuel rods under the proposed increased core temperature, any modifications to the reactors will have to rely on computer models and limited irradiation experiments. Nuclear Electric, on the basis of their computer models, may go ahead at a future date and try some warming experiments (such as those at Trawsfynydd and Chernobyl) to see what results they get.

Reactor Safety

In January this year, *ATOM* carried an article on the safety of the Harwell reactors, stressing that after a safety audit by the NII, the reactors were safe - this is not the case.

The NII safety audit was conducted after the Department of Energy finally succumbed to pressure from ex-employees, not least of which was the former head of reactor design and research at Harwell. Its terms of reference covered not only the reactors, but also the experiments which operated within them. This audit was carried out from December '87 to January '88. The results of this survey, despite the fact that it was initiated by public pressure, have never been published.

The actual situation is as follows. The reactors were built with a design life of 25 years - even so, after 34 and 33 years respectively DIDO and PLUTO were still running. Due to wear and corrosion the drain lines on both reactors from the reactor vessel have suffered a number of pinhole leaks - in the event of the reactor pressurising, for example if an experiment ruptured, they almost certainly could have burst. For at least fifteen years the connections to the biological shield cooling coils leaked and saturated the concrete of the biological shield with water - this



A PLUTO installation in PLUTO

caused cracking of the shield in DIDO, and by the AEA's own admission an unknown amount of corrosion of the reactor vessel. The reactors were the only ones in the country to have the control room sited in the same room as the reactor - quite often operators had to evacuate the control room when airborne activity became too high. I could go on, but space doesn't permit it.

Closure

In February 1989, the AEA announced that PLUTO would close in March 1990, but DIDO would continue to operate for a number of years. In February this year, totally without warning, they announced that both reactors would close on 31 March. This came shortly after the publication of a report, originally prepared for the Commons Select Committee on Energy, on the state of the reactors and associated plant at Harwell. Again, this closure was said to be due to "economic and not safety considerations".

The reason given for the closure is being economical with the truth. The NII would not approve the safety case for the reactors in their current condition. Also, the safety case for experiments such as the DIDO Water Loop were highly suspect given the fact that the NII would not approve the PAT loop. It was estimated by the Harwell Reactor Research Division in 1985 that £18 million would be needed to bring the reactors up to standard. Therefore their only course of action was to shut DIDO as well.

Decommissioning

The closure of these reactors is not the end of the story. The Dounreay testing reactor was closed before it reached the end of its design life (it is suspected that it got too 'hot' to work inside). It was decommissioned to stage 1 - the

removal of the control rods. No attempt to seal the core of the reactor was made. This is exactly what they are proposing to do with the Harwell reactors. The fuel rods will be removed and the core of the reactor will not be sealed in concrete. This is not a particularly awesome task with a reactor this size - in fact it is very simple. The AEA just don't want the hassle and expense.

Another problem is the removal of the 25 fuel rods from each reactor. The fuel pond at Harwell is quite small, and there are doubts whether it could accommodate 50 fuel rods safely. It is possible that after closure the majority of the fuel rods may be left inside the reactors for six to twelve months to allow them to cool sufficiently for transport. The spent fuel rods will then be driven, as they have been for many years, over 800 miles, by road to Dounreay for reprocessing.

It is a great relief that the Harwell materials testing reactors have closed - it should have been done some time ago, but because of the Atomic Energy Authority's exemption from the normal standards practised within the nuclear industry they were kept running. The trust put in the AEA by the Atomic Energy Acts have been abused, both in the maintenance of the reactor plant and in the exposure of the employees to excessively high levels of radiation. That a serious incident has not occurred already within these reactors is purely a matter of luck. They are closed, but there is much more to come. □

The full report on reactor safety and other issues, produced by Banbury Environmental Research for the Commons Select Committee on Energy, is available, price £6, from Banbury Environmental Research, PO Box 59, Banbury, Oxon OX16 8HF.

NFF Off

RENEWABLE energy sources have once again fallen prey to the nuclear industry: the European Commission's decision that contracts set under the Non Fossil Fuel Obligation (NFFO) of the Government's energy privatisation must be limited to 8 years has cast many renewable energy projects into financial limbo.

The NFFO was originally established by the Government to protect the nuclear industry from the ravages of economic competition, but following cries of "foul" from proponents of renewable energy it was altered to account for 50MW of renewable power by 1992 and 600MW by the year 2000. *Wind Power Monthly (WPM)* reveals that about 2,000MW of renewable energy projects were submitted to the Department of Energy for inclusion in the NFFO, before the cut-off date at the end of last year. This comes in the form of 300 individual proposals, the largest of which is for a 700MW barrage across the Mersey. James McCormack, the project's General Manager, is dismayed by the news: "We cannot survive under 8 year contracts." He says his project requires a minimum contract of 20 years.

The British Wind Energy Association, upon hearing rumours of the impending 8 year sentence, sent the DoEn a communique arguing that 8 year contracts "would undermine all attempts at successfully exploiting wind energy in Britain in

the short term". It continued Britain is "missing an invaluable opportunity to develop an environmentally benign energy source".

The remainder of the 2,000MW of renewable proposals is believed to be composed of: 500MW wind; 50MW a barrage across the Conway; 25MW of micro-hydro and; a host of waste incineration and landfill gas schemes. Most of the proposers of which agree that gaining the necessary financial backing will be impossible under the new restriction.

Another key factor in the viability of renewable energy power proposals is the price which the area boards pay for their electricity. That price will be set by the DoEn which has chosen a seemingly arbitrary figure of 6p/kWh as the upper limit. However, *WPM* report that some say "only those closer to 5p/kWh stand any real chance of selection". This is certainly below what the nuclear industry will require in the privatised regime.

The DoEn are now said to be working around the clock, trying to produce an eleventh hour package to salvage something from the nightmare that the Government's dream of an electric free-market has become.

■ In Scotland there is no NFFO and whilst private producers of electricity will not fall foul of the 8 year limitation little comfort can be taken there.

Scotland has an abundance of electricity so independents can only export via the interconnector to England. However, this is

owned jointly by Scottish Power and Scottish Hydro Electric who are currently offering independents a mere 1.88p/kWh. Neil Wright, director of Edinburgh Hydro Systems, believes that the structure of the privatised electricity industry will mean the cancellation of 50 or 60 proposed independent power projects. He explains: "unlike the English, north of the border we are going to be stuck with vertically integrated monopolies which can fix the price regime to suit themselves. We also miss on the NFFO which is encouraging the use of green power down south."

"Not only will Scotland's hydro producers be selling to the grid at a fraction of the price obtainable elsewhere in the UK - 1.88p compared with up to 6p - they will also have to carry substantially increased standing charges." Adding "the cost of back-up provision for independents, who occasionally need to buy in from the grid, was increased by 230% last year".

Lesley Potts of the Association of Independent Electricity Producers says: "The tragedy is that Scotland should be leading the world in renewable technology with the resources we have." She believes that "if Scottish independents could at least be given cost price access to interconnecting capacity and offered priority over fossil-fuel power, we could begin to make some headway."

It is hoped that the position of Scottish independents will improve following the assurance from Ian Lang, the Scottish Office Minister responsible for energy, that consideration is being given to the inclusion of a condition in the licences of the Boards which will force them to offer more generous terms for use of the interconnector. □

Liberal Democrats on energy

IN THE UK the annual fuel bill is about £39bn, despite this, say the Liberal Democrats in their Federal Green Paper No. 12 *, "no British government has ever articulated one single overall energy policy". This is exactly what they seek to present.

Their approach is commendable: "Liberal Democrats believe that an energy policy must ... take account of the consequences of energy use."

The Liberal Democrats argue that the environmental costs of energy "are real, are increasing, and must be paid - either by environmental destruction or as the direct costs of corrective action - by every society and every individual on the planet."

They call for "A global 'carbon budget', with targets for reduction of CO₂ emissions for the UK of 30% by 2005, and 75% by 2050." Action must also be taken on acid rain emissions: "reduce sulphur emissions by 60% by 1995, as proposed by the European Community". Nitrogen oxide (NO_x) emissions, another player in the acid rain tragedy, "are more harmful than those of sulphur dioxide, as they help to make ozone [in the troposphere], which damages both trees and lungs". Appropriate "targets

should be set at a European Community (EC) level for the reduction of NO_x emissions". However, the EC have already called for NO_x targets: 20 and 36% of 1980 levels by 1993 and 1998 respectively. This, it is worth noting, is far from satisfactory as most scientists are calling for a reduction of 75%.

Such reductions would be achieved through the use of "the market mechanism ... primarily through the use of taxation, subsidy and tradable 'emission ceiling licences', to ensure that the polluter pays the full cost of the pollution associated with the energy usage." Fuel use would be taxed according to emissions.

All UK nuclear power stations would be shut down "at the latest by the year 2020, and earlier if this can be achieved without incurring additional environmental costs." Work would be stopped on the Sizewell B PWR. On nuclear waste, they support the "creation of a deep underground depository for lower level nuclear wastes". They want a scheme which, unlike that proposed by NIREX, would allow retrieval. High level waste would be stored on site "until such time as a method for safe disposal can be established". That, presumably, would be millions of years into the future when all the radioactivity contained therein had decayed? Intermediate level wastes magically disappear from their inventory: if only the

real world were that convenient.

Energy efficiency plays a central role in their policy, the section dedicated to it is by far the best researched. The main point of which is the "Adoption of the target of 4% per annum fall in the energy ration, to be achieved through a wide variety of energy conservation measures."

They also propose to "establish a Renewable Energy Office and a renewable Energy Applications Committee within the Department of Energy", which would oversee "an increase in research, development and demonstration (RD&D) expenditure on renewable energy", and the "construction of a Severn Barrage". RD&D into nuclear power would be reduced.

The Green Paper calls for the establishment of "a powerful Environmental Protection Agency, and a new Department of Environmental Protection with a seat in the Cabinet".

The central philosophy of their plans is excellent, but the paper would have benefited from more detailed research and more precise composition. It is, however, an excellent place to start, and deserves to be read by all interested in the energy debate. □

* *Energy and the Living World*. Hebden Royd, The Birchcliffe Centre, Hebden Bridge, West Yorkshire HX7 8DG, £3.50.

Anywhere the wind blows

WINDFARMS "can represent symbols of wise resource use, responsible energy policy and environmental stewardship rather than merely another form of visual pollution", say FoE*; however, they warn, "there is growing concern that the environmental impact of wind energy is being prejudged in a way which might hinder its full development".

Public response to windfarms is a "key factor" in their extended use in the UK electricity supply industry, according to the report. Written by Marcus Rand of the Energy & Environment Unit of the Open University, it seeks to dispel some of the myths that have grown around the industry and to set out methodologies to maximise the development of the industry in an environmentally acceptable manner.

Site choice is very important, insensitive planning could destroy the whole industry. They note that, unfortunately most of the best areas for wind energy are those which have been designated, over the last

40 years, for their landscape and conservation value. However, between 10 and 20% of the UK's electricity could be generated from wind without encroaching on protected areas.

The CEB's proposal last year to build an 8MW windfarm on Langdon Common, in the North Pennines, is examined in an appendix. It is a classic example of how not to develop wind power. It was held by many as no more than a spoiling operation. Langdon Common is a Site of Special Scientific Interest (SSSI), and Area of Outstanding Natural Beauty (AONB) and a Special Protection Area (SPA) all neatly contained within a National Park. The application met with strong opposition from the Countryside Commission, the Royal Society for the Protection of Birds and the Council for the Protection of Rural England, and has since been dropped. However, PowerGen and National Power, who have jointly taken over the project, are now considering another site which is still in the North Pennines AONB.

The Nature Conservancy Council argue: "We have no first hand experience of windfarm developments, and our point

would be that until that knowledge is available they shouldn't attempt developments on known sites with high ecological interest." FoE "strongly endorse this position", and call for the establishment of a development framework excludes designated areas "before conflicts become so intense that they limit the exploitation of wind energy in other more environmentally acceptable areas".

Other potentially damaging aspects of developing the UK wind resource, such as noise and visual pollution are also examined in the report, none of which are found to be insurmountable. It is suggested that some sort of Community involvement will ease progress, "by far the most effective means to ensure local support for developments is to allow local communities to plan, invest and operate their own windfarms".

What is clear from this study is that given the proper encouragement and sensitive handling, clean, cheap and renewable wind energy could make a sizeable contribution to electricity supply in the UK. □

* **Developing Wind Energy for the UK**, by Marcus Rand, FoE 1990, 30pp, £3.00.

Cornwall wind gets the go-ahead

CORNWALL District Council have reversed their decision, taken at the end of last year, to refuse planning permission for a 3MW wind farm at Delabole, in North Cornwall.

Originally Peter Edwards' application was rejected (SCRAM 75) because of fears that the wind farm would generate excessive amounts of noise. However, he appealed against the decision and requested that those who would be judging his appeal visit an operating wind farm in Denmark.

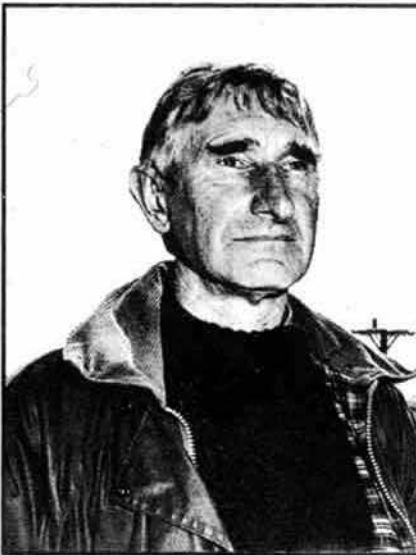
No council member had any first hand experience of an operating wind farm, and after the visit they voted unanimously to give the scheme the go-ahead.

Edwards, a farmer, will now install 10

82ft Wind Energy Group turbines, costing around £2.5 million, and export electricity to the grid at 6p/kWh, slightly less than the cost of nuclear power. He estimates that the pay back period will be around 14 years.

Edwards is optimistic about the future of wind power in Cornwall: "In theory at least we could use the wind and water round here to produce all of Cornwall's energy. If this works then I expect lots more wind farms in Cornwall."

Given that this was the first such application in the UK and that a negative decision would have set a dangerous precedent affecting the whole UK industry, proponents of wind power will now be breathing a sigh of relief. □



Peter Edwards

Fusion blows hot and cold

SCIENTISTS who monitored the fabled Pons and Fleischmann cold fusion apparatus (SCRAM 71), at Utah State University, for five weeks have dismissed the idea of test tube power.

Professor Michael Salamon comments: "You cannot have normal fusion. I don't believe this phenomenon is real, although I hope I am wrong because it would be the greatest thing for mankind."

Originally he wanted to co-write a scientific paper with Stanley Pons, but Pons refused to cooperate. So the team trained some of the most sophisticated equipment in the world on the apparatus to look for tell-tale sign of fusion - neutrons and

gamma rays. They also checked for the increases in temperature claimed by Pons and Fleischmann at their infamous press conference, 23 March, last year. Salamon's equipment is capable of registering energy production down to a millionth of a millionth of a Watt. No energy production was measured.

However, during the five week experiment a bolt of lightning struck the university, causing a power failure. Pons, not one to miss an opportunity, claimed that "significant" amounts of heat were produced by the apparatus whilst the measuring equipment was off-line. Salamon comments "I don't think there is a ghost of a chance for cold fusion."

Following last years claims the state of Utah set up a National Cold Fusion In-

stitute, however, no one at the institute was available for comment.

■ Meanwhile, the US National Academy of Sciences has advised that a programme to develop more 'conventional' fusion technologies should remain in the hands of the Pentagon, because of its usefulness in testing and developing nuclear bombs.

In an interim report a panel on behalf of the Academy said that civil applications inertial confinement fusion must be dropped in favour of the military potential.

It seems even in these days of arms limitation talks that the quest for limitless destructive power takes precedent over providing 'clean, cheap and reliable' (sic) nuclear power. □

Bobbing back?

A REPORT, on the Salter's Duck wave power device, which was published last year by the Department of Energy's (DoE) Energy Technology Support Unit (ETSU) has been withdrawn from all scientific libraries in the UK and Ireland, because it contains serious inaccuracies, resulting in the doubling of estimated costs for wave energy.

Written by YARD, a Glasgow based engineering consultancy, it estimated the unit cost of electricity from the Duck to be 9.8p. However, this has now been amended to 5.2p/kWh (1986 prices) at the instruction of ETSU. YARD used a load factor for the device of 20% at the request of ETSU because "the main report of consultants [Rendel Palmer and Triton (RPT)] to the wave energy programme in June 1983 did not include a figure for the availability for the Duck system for offshore wave energy."

ETSU have now ordered a new report to be published using a load factor for the device of 38% which gives the unit price

of 5.2p, copies of which will be sent out to the libraries who have been instructed to "destroy your older copies".

Professor Stephen Salter, of Edinburgh University, designer of the Duck is "grateful to those who saw to it that the mistake has now been corrected. I think there is now hope of progress." He does, however, wonder why YARD were given the 20% figure when Dr Roy Taylor, of ETSU - the man responsible and the one who ordered the report to be removed - said in 1985 that the load factor for the Duck was 38%.

The UK wave power programme was axed in 1982/83 after the DoE judged that there was only "a low probability of any design achieving an energy cost below 8p in May 1982 prices". The new figures show that at that time the estimated price from the Duck should have been 3.8p, under half of the required amount.

The DoE, as one would expect, refused to answer specific questions as to why YARD were given the wrong figure and whether or not the new data implied that funding for the Duck was wrongly axed but kept repeating "The YARD study was intended to develop methodologies for

costing renewable sources of energy ... This contains a simple review of previous renewable energy costings studies on tidal, wind, geothermal and wave energy. This report does not contain any new work on these technologies."

This is just the latest altercation over the decision to stop funding wave energy research. The most serious of which was made by Gordon Senior, a consultant engineer, to the House of Lords Select Committee on the European Community who were examining renewable energies, in 1988. He told them that his report on Salter's Duck had been altered after he had submitted it to RPT: "Most of the text of the report was as I had drafted, but the key conclusions had indeed been changed and even reversed. It was and still is my considered opinion that some of the conclusions in the report on the Duck device as submitted to the DoE cast unfair doubts on its long term viability."

Given that the DoE are currently conducting a reassessment of wave power it is difficult to see how under the welter of new information that they can possibly fail to reinstate the wave power programme. □

Norwegian wave

PLANs to develop the Oscillating Water Column (OWC) wave power device have been shelved by Norway's Kvaerner heavy engineering group because it will be "too long" before wave power becomes "a profitable commercial product".

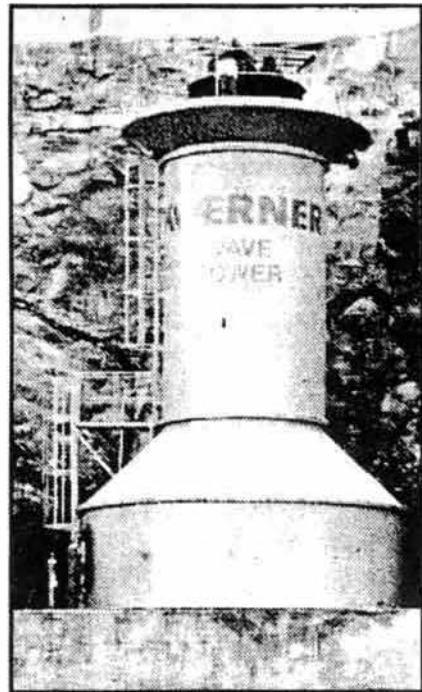
Kvaerner had successfully demonstrated the viability of the device at Toftehallen but at the end of 1988 it was torn from the cliff it was bolted to by freak weather conditions. The £700,000 plant was sent crashing into the sea below. Odd Sandoey of Kvaerner commented at the time: "We are very disappointed, but this shows how powerful the sea can be." It has now been salvaged, repaired and mothballed.

A second blow to their plans came with the cancelling of their plans to build an OWC on the island of Tonga, in the Pacific. The estimated cost of which have trebled, and attempts to measure the power of the waves incident on the island

have failed to yield sufficient data. The data that was collected indicated that wave frequencies could be around 20-30% below the minimum necessary. The Tonga project was to have been a 'shop window' demonstrating the commercial viability of the OWC.

Kvaerner have spent about Nkr 60m (£5.6m) on the development programme so far. They believe further work still is required to boost the efficiency of the device to make it competitive with plant burning coal and oil. Ole Jacob Haaland, Kvaerner's Managing Director, believes the additional research needed would cost "at least Nkr25m (£2.3m)".

There is one glimmer of hope for proponents of wave energy: Kvaerner are considering transferring wave operations to Kvaerner Boving, a UK subsidiary based in Kent who are a hydro power engineering and marketing company. If the transfer goes ahead a new prototype might be built somewhere in Scotland, probably in north west Scotland, says Haaland. □



OWC at Toftehallen

Energy efficient California

A PLAN put forward by a coalition of Californian power companies, consumer groups and environmentalists could significantly increase the state's energy efficiency and yield more than \$1.5 billion.

The "Energy Efficiency Blueprint for California" has the backing of 15 agencies including, the California Energy Commission, Pacific Gas & Electric Co., Southern California Edison (who buy

most of the world's grid connected wind power) and the Natural Resources Defence Council. The result of concern over the quality of the state's air, it calls for an annual investment over the next two years of \$500 million which will result in annual savings of over \$1.5 billion.

Pacific Gas & Electric, the largest US utility, propose to offer rebates of up to \$100 to domestic consumers who purchase energy efficient fridges and air conditioners, \$15,000 to commercial customers for using more efficient equipment and \$300,000 for large building

plants using the latest energy saving technology.

The utilities would profit from investing less capital in new power plants and would need to import much less power.

The California Public Utilities Commission is expected to establish several test studies to examine the viability of the plan.

Ralph Cavanagh of the Natural Resources Defence Council says: "These are major departures from current policy. They will set extremely important national precedents if they happen." □

Acid House

GOVERNMENT assurances that 12,000MW of existing coal-fired power stations will be fitted with flue gas desulphurisation (FGD) plant in order to meet the European Community (EC) Directive on sulphur dioxide (SO₂) emissions have been dumped.

Last November the Prime Minister told the United Nations General Assembly that "we already have a £2 billion programme of improvements to reduce acid rain emissions from our power stations". Now, however, the power companies have been given leave to abandon £800 million of the programme leaving 4,000MW of coal capacity 'unscrubbed' and a considerable shortfall in the Government's commitment to the EC directive. This presumably is intended to improve their portfolios for privatisation.

The Government maintain that they are committed to the Directive, which is binding on all member states of the EEC.

Speaking in London, in the middle of March, at the Better Environment Awards for Industry, Mrs Thatcher cited FGD as an example of solving one problem but creating another. She was referring to the limestone/gypsum (LG) process. She said that enormous "lorry loads" of limestone have to be driven to power stations for use in FGD, adding "we don't yet know what to do with the gypsum created by the process". Oddly, when FGD was first mooted she was entirely in favour of the LG process, claiming that the gypsum could be used for plaster board. Environment groups, including SCRAM, dis-

agreed (SCRAM 61 & 62), arguing that the gypsum was not of a high enough grade. Yet, when FGD was popular at No 10 the LG method looked likely to be fitted to all 14,000MW of the offending coal-fired plant.

There is an alternative technique - the Wellman Lord system. This is the preferred option of environment groups. It requires one twelfth of the limestone used in the LG process and produces marketable by-products, one of which is sulphuric acid. Britain currently imports about 90% of the sulphuric acid used in industry at a cost of around £57 million.

The generators will now meet the quota, Energy Secretary, John Wakeham, told the National Economic Development Council this month, partly by switching to low-sulphur fuels, such as natural gas.

They will also have to rely on imported low-sulphur coal which will come, in the main, from South Africa. They will buy-in 10 million tonnes (mt) which will replace the 10mt reduction in the British Coal contract with the old CEEB. This may sweeten the industry for selling, and benefit shareholders, but will cost the country dearly. Power in Europe, the Financial Times Business Information newsletter (PiE), calculate that in the short term this will cause a balance of payments deficit of £300m. But, in the longer term, by 1998, the imports will need to be upped to 32mt. "The balance of payments costs could leap to over £1 billion", according to PiE.

This would close Britain's deep mines. A 10mt import would close at least 10 collieries, sterilising about 200mt of coal reserves. "If 32mt is imported", argue PiE,

"then 640mt of high quality reserves would be thrown away."

It would devastate British Coal, who have recently warned that cutting back the FGD programme would make thousands of miners redundant. PiE again: "The economic costs of closing only 10 mines and making 10,000 miners redundant would also be huge, well in excess of £400 million the first year and over £300 million per year subsequently."

It still remains uncertain whether the new Government plans will in fact meet the European standards, and some commentators believe that our fellow Community members - many of which have agreed to cutting their SO₂ emissions by more than the 60% reluctantly accepted by Britain - will now call on the European Commission to judge Britain out of order.

■ Meanwhile, The Surface Water Acidification Programme, a five year study into the effects of acid rain, headed by The Royal Society, said that for Welsh streams, "even a 60% reduction [in deposition] would produce significant improvements in stream water chemistry, but even a 90% reduction would not guarantee successful restocking with trout".

The study conclusively demonstrated that acid rain is responsible for the acid lakes and rivers in Galloway, south-west Scotland, and reports that no improvement will be seen until at least a 60% emissions reduction is met. Sir John Mason, the programmes director, believes that without significant reductions soon, the high levels of sulphur in the soils of the Cairngorms may mobilise, tipping the area "over the edge". □

Bush-whacked

BRTAIN, Japan, the US and the Soviet Union are once again blocking progress on the establishment of international targets for carbon dioxide emissions: a move which looks likely to cause 10 European nations to split from the International Panel on Climate Change (IPCC) established under the aegis of the United Nations.

The 10 European countries - Austria, Sweden, Denmark, West Germany, Finland, France, the Netherlands, Norway, Switzerland and Italy - feel that there is now enough evidence for Global warming and plan to begin negotiating their own treaty. Britain & Co want to wait until the IPCC report in August or September before they begin negotiations.

Heintz Schreiber, head of the Austrian delegation to the IPCC, voiced the opinion of the other European nations: "We don't need final scientific proof. We think there is already enough evidence of global warming." It is expected that other nations will join them.

At the meeting of the IPCC in Washing-

ton, at the beginning of February, a petition signed by almost half of the members of the US National Academy of Sciences, was delivered to President Bush calling on him to take a number of specific steps to limit global warming. It opined: "In view of the potential consequences, action ... must be initiated immediately. Only by taking action now can we ensure that future generations will not be put at risk."

Amongst the things the 700 members of the Academy and 49 noble laureates called for were:

- substantial funds for research on energy efficient technologies;
- development on a massive scale of renewable energy technology;
- and a nuclear programme emphasising the protection of public health and resolving the problems of radioactive waste disposal.

Bush told the gathering that he had requested extra funds for 1991 for research into energy efficiency. The reality of which is slightly different: Congress awarded more funds to energy efficiency research than was asked for by Bush to cover 1990, therefore his new request is in fact lower than the budget for 1990. □

Sun rises over Rancho Seco

PROPOSALS to convert the closed Rancho Seco nuclear power station into a giant solar plant are being considered by the Sacramento Municipal Utility District (SMUD), after local residents voted to shut the plant down last June.

Luz International have been invited by SMUD to investigate the possibility of converting Rancho Seco to solar. Luz already operate a 250MW solar plant in California.

Mike Lotker, vice president of business for Luz, believes there is plenty of flat land around the plant suitable for a field of solar collectors and that there is ample sunlight in Sacramento. He estimates that the 2,200 acre site could generate up to 500MW of electricity.

Luz will visit the station site to see if the plant's boilers and cooling system could be customised to be powered by the sun.

Last year three private companies offered to convert Rancho Seco to natural gas firing, but SMUD will await Luz's findings before making a decision. □

**Living in the Shadow:
the story of the people of Sellafield
by Jean McSorley; Pan; 1990, 219pp, £5.99.**

Jean's book could have been dismissed as a collection of rantings and ravings from an anti-nuclear obsessive, had it not appeared at the time it did. Instead, it should be welcomed as a comprehensive indictment of four decades of complacency; mismanagement, deliberate experimentation and misinformation.

Withdrawal of nuclear generation from electricity privatisation, in November last year, following a series of high level leaks, has been described as the economic demise of nuclear power, brought on as much by the officially-recognised escalation of 'back-end' fuel cycle costs - reprocessing, decommissioning and waste management - as by anything else. And, BNFL Sellafield has a major role in these increases.

Then this book was published. Jean focuses on the impact of Sellafield on the health and well-being of the people of

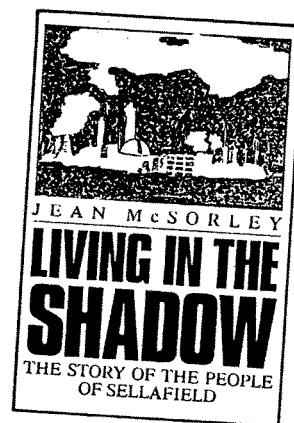
West Cumbria. Much of the text is verbatim accounts of interviews conducted with company managers, trade unionists, and workers, local population and business folk and ordinary people, both local and 'off-comers'. It is profoundly depressing and moving.

Case histories of individuals' illnesses are described. Despite losing loved ones to disease which 'irrational' people naturally associate with the activities at the works, many people remain fiercely loyal to the company. Some, however, are willing to speak out. In particular, the role of the unions on site is criticised - at best they could have been more sympathetic with the bereaved. The immense economic power of BNFL in the county also comes in for a bit of stick, and not just from those you would expect.

Only a week or so after

Jean's book was published, the bottom fell out of the nuclear dream for the second time in three months - the Gardner report linked worker exposure with childhood cancers. The press devoted many column inches to the study, and BNFL blamed their own honesty for the PR blunder. I read *Living in the Shadow* after the study became public, and it seemed to provide much background evidence, however anecdotal, which would have given journalists much meat to add to the bones of Gardner. If this information had been wider known, and accepted, beforehand, then the country would have been better prepared for Gardner's revelation.

I would seriously recommend this book, despite a couple of gripes I have with it: there is no index or (why is this always so?) making referencing very difficult, which is one reason why I have not mentioned specific cases; it has the appearance of being rushed and would have benefited from a more sympathetic overseeing editor; the chapters could have con-



centrated on particular themes, thereby avoiding the disjointed nature of the book.

My most important complaint is that Jean has moved to Australia "for a while"! This will be a sad loss, not only to the UK anti-nuclear movement but also to her many friends and colleagues, in which group I am proud to include myself. I guess everyone deserves a rest! But, if she's as big as pain in the arse in Oz as she has been in West Cumbria I can see the world's supply of uranium drying up quickly!

STEVE MARTIN

**Nuclear Power and the Greenhouse Effect
by D Donaldson, H Tolland and M Grimston.
UK Atomic Energy Authority; 1990, 31pp, Free.**

"Our immediate priority must be to conserve energy, and to set the shape of 21st century power generation by developing the full potential of proven nuclear, hydro, and renewable technology", says John Collier, AEA Technology Chair and Chair designate of Nuclear Electric, in the press release which accompanied the booklet.

It is, as we have come to expect from the nuclear industry, beautifully produced. The approach is relaxed. Indeed 21 pages pass before the words "nuclear power" make their entrance in the text - at which point it begins to slide into fantasy.

The first 21 pages provide as good a résumé of the greenhouse problem. It argues "we cannot afford to wait until we know how severe the problem will be before we take action", touting changes in agricultural practices, the elimination of CFCs and pro-

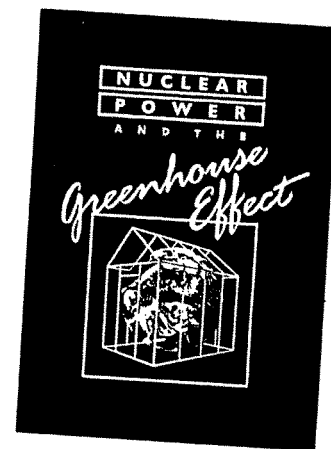
tecting the forests as possible solutions. Global Warming, as the name suggests, is a global problem, and "no one country can solve it alone", developing countries should not, "be expected to accept major restrictions on improving their often very low standards of living".

On the subject of reducing CO₂ emissions from burning fossil fuels it proposes that "the most direct method would be to make more efficient use of the heat produced and so reduce the amount of fuel produced". They coyly add "Other options would be to use fuels which emit little or no CO₂" - nuclear power.

After talking very reasonably about renewables and then dismissing them as being capable of making only "a small contribution to the world's energy needs, particularly in industrialised countries", the sting in this tale is unleashed. The remain-

der of the booklet is devoted to pure fantasy. It argues that half of the world's electricity will need to be generated by nuclear power, and because developing countries could not cope with such a plan, the onus falls upon industrialised nations (including the Soviet bloc) to produce two thirds of their electricity from nuclear. The French nuclear industry is cited as proof that one large nuclear plant could be commissioned every 6 days between now and 2020. This would give a 30% reduction in CO₂ emissions "of what they would have otherwise been".

Conventional nuclear reactors would use up the available economic resource of uranium in 50 years, "however, the next generation of reactor, the 'fast' reactor ... would increase the energy resource of the world's uranium by at least 60 times." It propounds the belief that fast reactors will be available sometime in the first 2 decades of the next century. This is extremely difficult to believe, given that the French are running down plutonium



production at the Super Phenix breeder reactor and the Germans have not yet opened Kalkar. Also the British electricity industry has all but stopped funding breeder research.

All in all, it is an interesting read, and the final 5 pages give a clear indication of just how desperate the nuclear industry is becoming. Write for your free copy today.

Available from Room G118, Building 329, Harwell Laboratory, Oxfordshire, OX11 0RA.

MIKE TOWNSLEY

The Long Road to Greenham: Feminism & Anti-Militarism in Britain since 1820
by Jill Liddington.
Virago; 1989, 341pp, £9.99.

Presumably this book was written with Women's Peace Studies courses in mind. It is fairly readable as history text books go. The scope of the topic, 1820 to 1989, is wide and a multitude of characters are introduced then, in most cases disappear without trace. The work should be in two volumes so the subject could be dealt with more satisfying depth, or the Greenham Common section trimmed, since the material in it, or similar material is available in other contemporary sources. As a history text the last section suffers from the author having been a participant, as opposed to the detached observer she has been

for the last 150 years.

There is a strange unsatisfying hiatus where the years 1940 to 1954 are missed out (as are '64 to '75), apart from a stray reference later to someone's parents having sold peace news during the war.

In places the author lays claim to a more truthful account than previous sources, for example about the origins of CND. Which is great if it is true, but when one deals with events I have knowledge of, her account is flawed. Take '78: "And in Scotland a new alliance held a mass occupation of a proposed reactor site at Torness." In a novel or newspaper article that might

be an acceptable way of telescoping the truth, but if this work is a history text, it is not good enough. The Torness Alliance was formed after the second (1978) Torness event which was organised by SCRAM, an offshoot of Friends of the Earth, which organised a 1976 event at the site. The Torness Alliance then organised the third (1979) occupation.

I found this book very interesting in places where it covered events unknown to me, like the Women's Peace Crusade of 1916/18, but frustrating where it deals with the events I have read of in more detail.

If you are not already familiar with the subject I do not know how you would understand what was going on amid the multitude of initials and notes.

The best thing Jill Liddington did was record the remi-

niscences of two old activists before their deaths, which occurred whilst the book was being written. If you have the slightest need of this history, buy it in the hope that an enlarged and improved second edition might be possible.

I hope the SCRAM office can put some back issues of the Journal in the post since the author only admits to having number 50.

Is 'her story' allowed to forego the rigorous standards expected of History? Was history not as factual as we thought and this author only finds herself on sticky ground because she deals with events we have witnessed?

The comprehensive notes dealing with sources incline me to the opinion that this is a text book or similar academic text work rather than the author's opinion.

LINDA HENDRY

... Letters ... Letters ... Letters ... Letters ...

Wackersdorf: end of saga

Dear SCRAM

I thought you might be interested in this photograph of the building site of the nuclear reprocessing plant at Wackersdorf.

After the project was abandoned in April last year the German firm DWK, which owns the area, has sold the land to four companies for industrial development.

Because the new owners have no need for the high security fence around the site, which was built in 1986 for more than 50 million marks (£17.5 mil-

lion), it is now being pulled down and scrapped.

The people around Wackersdorf who fought against the reprocessing plant for about nine years want to preserve part of the fence as a kind of monument, making people think of the resistance movement and the quarrels and confrontations with the police and with the Bavarian government.

Yours sincerely
Andreas Laemmermann
Anti-WAA-Bureau Schwan-
dorf and Fotogruppe "Strah-
lenfreie Oberpfalz"



Radioactive lightbulbs

Dear Editor

Nuclear Free America (NFA) is pleased to update its letter on radioactive lightbulbs (SCRAM 75) with the following correction:

NFA has learned that not all compact fluorescent lightbulbs (CFLs) contain radioactive material. There is a 'nuclear-free' type of CFL, introduced in the USA just last year by Panasonic and Osram. It contains an integral electronic ballast instead of the radioactive 'glow switch' found in other CFLs.

This 'nuclear-free' technology is more expensive than the glow-starter type (\$20 to \$30 per bulb retail instead of \$10 to \$20), but it also offers excellent energy savings and longer life as compared to standard bulbs. In fact, the electronic type is even more energy efficient than regular CFLs. It also eliminates virtually all of the flicker associated with other kinds of fluorescent lamps.

NFA encourages all distributors and users of CFLs to select this 'electronic' alternative from Panasonic or Osram whenever possible. (Consu-

mers should note that all the US manufacturers of CFLs - GE, GTE Sylvania and Philips - are nuclear weapons contractors.) For more information on nuclear-free CFLs, contact ECO-WORKS, 2326 Pickwick Road, Baltimore MD 21207, (301) 448-1820.

Sincerely
Albert Donnay
Director NFA

■ In addition to some of the CFLs manufactured by Osram and Panasonic, Philips make nuclear-free CFLs. There are two versions of the Philips SL18 bulb; one with magnetic ballast uses tritium, the other uses an integrated electronic ballast and has no radioactive material. In their PL range the 18, 24 and 36 watt bulbs are also nuclear-free, but the lower wattage PL bulbs contain krypton-85.

Clearly great care is needed when purchasing CFLs as manufacturers are understandably reluctant to advertise that some of their products contain radioactive material.

LITTLE BLACK RABBIT

The chaos that has surrounded electricity privatisation has had far reaching effects. Amongst those thrown into a state of confusion were the CEBG's Walter Marshall, Energy Secretary John Wakeham and Donald Miller of the SSEB. A less obvious victim has been the SCRAM subscribers list. Having just processed the change of address of "CEBG (South Western Region)" to "CEBG - National Power Division" a second note arrived, the delivery address was no longer to be "CEBG - National Power Division" but "CEBG - Nuclear Electric Division". With the removal of a SCRAM Journal subscription from the electricity sell-off LBR expects to see a drop in the share price.



Little Black Rabbit reported in SCRAM 75 that the London Electricity Board (LEB) offered Vine Housing Cooperative the chance to pay a quarterly bill at just £105 per month. News of further developments has arrived in a letter from Vine Housing Co-op.

Dear LBR

Well, either the LEB get the SCRAM Journal and are being petty, or it really is a policy change - we are now being offered the once-in-a-lifetime chance of paying a landlord's lighting bill (last 3 quarters: £9, £13, £14) at £100 per month, or they might

allow us to keep paying regularly if we give them £350 up front (which is 7 years worth of electricity!).

So, if the 100 per month is the nuclear tax, perhaps the deposit is paying off all their overdrafts with interest free loans from their customers!

Yours
Mark Baxter,
Vine Housing Co-op



LBR has spent much time since the Chernobyl accident worrying about the resultant contamination of livestock and plants, and concerned about cancer deaths, but he discovered its not all bad news. Burrowing through the nuclear industry journal *British Nuclear Forum* LBR bumped into an article headed "Many trees and plants undamaged by Chernobyl." LBR read on eagerly: "Now that human beings have been evacuated and there is no more hunting locally, there are more waterfowl, foxes, hare, deer and wolves than ever before. Even the rare black stork, an endangered species, has begun to nest in the area." Encouraged by this report, LBR was a much more contented animal for several weeks. Unfortunately, his optimistic outlook vanished overnight with a dream when he awoke in a cold sweat muttering about packs of giant mutant foxes.



The Scottish press recently reported that the Scottish Office are poised to overturn Highland Regional Council's refusal to grant planning permission to the UKAEA to sink two test bores at Dounreay on behalf of Nirex.

The newspapers, of course, didn't carry the full story. LBR was flying north on a plane from Edinburgh and overheard a conversation between several be-suited gentlemen, obviously on their way from St. Andrew's House to Dounreay. It appears that the Scottish Office have already decided to give the nuclear industry the planning permission they need to continue their waste disposal research. However they are delaying the announcement of the decision until a day when the media are already busy on other big news stories - news management being more important than waste management!



A Sverdlovsk factory which used to produce Cruise Missiles now makes chocolate truffles! And at the Soviet Peace Committee's suggestion, metal from missiles scrapped under the INF Treaty is being recycled as coins to be sold to raise money for Soviet and international ecology and peace programmes.

Three ways to promote safe energy

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

1. I would like to subscribe to the **SCRAM Safe Energy Journal**, and I enclose an annual subscription fee of:

- | | |
|--|---|
| <input type="checkbox"/> £12.50 (ordinary) | <input type="checkbox"/> £5 (concession) |
| <input type="checkbox"/> £15 (overseas) | <input type="checkbox"/> £20 (supporting) |
| <input type="checkbox"/> £30 (institutional) | <input type="checkbox"/> £100 (life) |

2. I would like to make a donation to SCRAM and enclose a cheque for:

£10 ☐ £50 ☐ £100 ☐ other £ _____

Name _____

Address _____

Post Code _____

TO: SCRAM, 11 Forth Street Edinburgh EH1 3LE.

3. I would like to help pay SCRAM's wage bill with a regular monthly donation of:

£1 ☐ £5 ☐ £10 ☐ other £ _____

To the Manager: _____

(your Bank)

Address _____

Post Code _____

Please pay on _____ (date) the sum of

_____ (amount) from my account number

_____ to the Royal Bank of Scotland,

142/144 Princess Street, Edinburgh (83-51-00) for the credit

of SCRAM No.2 Account 258597 and make similar

payments monthly until further notice. www.laka.org

Signed _____ Date _____

