THE SAFE ENERGY JOURNAL

SCRAM

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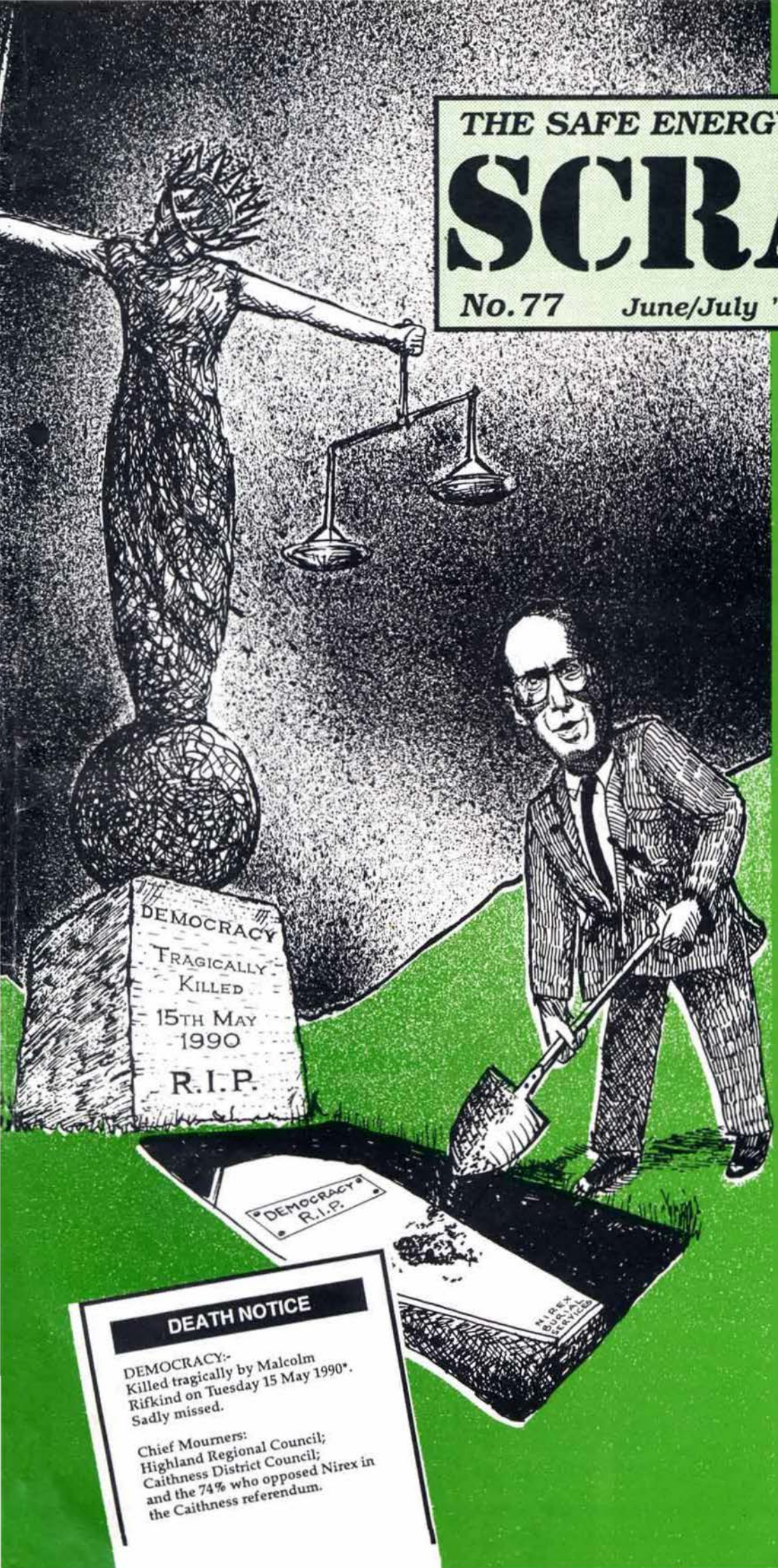

The nuclear tax and you

The legacy of Chernobyl

Decommissioning: the final folly

Towards a hydrogen economy

Radioactive waste dumping

Plus: 4 page pull-out Wind power broadsheet

COMMENT

YOU may remember in the last issue of SCRAM (76) the continued saga of Salter's Duck. Since 1982, when the Government decided that wave power had little chance of becoming economic, Edinburgh University's Professor Stephen Salter has been hammering on the Department of Energy's door in an attempt to get them to admit, at the very least, that they made a mistake. They have now indeed admitted to a mistake and have withdrawn a report on the Duck from all academic libraries. The report contains serious errors which result in the doubling of the unit price of Duck generated electricity. Now the Guardian and other national papers seem to have finally cottoned on to the story.

But the story continues: David Ross a freelance journalist, long time wave power campaigner and regular contributor to SCRAM, was refused permission to use Government pictures in an article he was writing for New Scientist (19:5:90), unless the Energy Technology Support Unit were allowed first to see the article. Presumably, if they didn't like the article he wouldn't have been given the pictures. David refused to be vetted and points out that he had used the picture before, with permission, and without any suggestion that he had first to submit the article for vetting.

The word is that the Government and in particular the Department of Energy are getting very touchy about allegations of nuclear corruption leading to the sinking of the wave programme. They even refused to comment on the story to the Guardian, as they did when SCRAM contacted them 2 months ago. Now is the time to begin pushing for a full and independent inquiry and also for the declassification of the minutes of the final ACORD (the Government's Advisory Council on Research and Development) meeting in 1982, during which the decision was taken, and from which Clive Grove Palmer the man who headed the wave programme was excluded.

The door is open and we must keep kicking at it, eventually it will give.

MALCOLM RIFKIND'S decision to allow Nirex to carry out test drilling at Dounreay was not unexpected. Nor was the howl of protest which followed. With comments like "We give England our oil and gas, and they give us their nuclear waste" and "Why don't they dump it in Trafalgar Square?", you could be forgiven for thinking there has been an outbreak of Nimbyism in Scotland. But, Scots from Dumfries to Dounreay are opposed to Nirex's scheme, wherever it is to be, because they know it will perpetuate the worst excesses of the nuclear industry which threaten everybody's environment on a daily basis. It is not a battle between Dounreay and Sellafield, it is a battle between dumping and on-site storage.

Even if Sellafield is eventually chosen for the dump and even if it doesn't leak in the near future, radioactivity from Sellafield will continue to pollute our coasts and estuaries. Nuclear waste will still trundle through Southern Scotland on its way from our AGRs to Sellafield; as long as the Japanese want their plutonium from Sellafield back, Prestwick Airport will be under threat from this deadly cargo; and Dounreay, our very own reprocessing plant will continue to solicit for reprocessing work of its own.

The first step in implementing a sane waste management policy is to end reprocessing. How can it possibly make sense to import nuclear waste from European research reactors, when no-one even knows whether or not it will be reprocessed at Dounreay? It may eventually get sent back to Europe, or onto America for reprocessing. BNFL and the UKAEA should be tendering for contracts to build on-site storage facilities at the research reactors.

Surely the experience of the French is enough to prove to any doubter that the nuclear fuel cycle has failed: plutonium is worthless now that the fast reactor dream has become a nightmare, and producing MOX fuel is simply uneconomic.

But, the nuclear juggernaut continues - the Japanese feel they can live no longer without reprocessing. It's time we all came to our senses, and started the long process of closing Pandora's Box by halting reprocessing PDQ.

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.

CONTRIBUTIONS

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

LETTERS

SCRAM reserves the right to edit letters to fit the available space. All letters for publication should be submitted by the news deadline given below.

COPY DEADLINES

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Radioactive waste is produced by organisations including hospitals, universities and industry, as well as the nuclear industry. Patrick Green of FoE looks at non-nuclear generated solid radioactive waste and the lack of management in dealing with it.

PLUS: Four page pull-out Wind power broadsheet

Reproduced with kind permission of Steve Bell

Dounreay reprocessing

AFTER a break of nearly 20 years, the UK Atomic Energy Authority (UKAEA) intends to resume reprocessing foreign nuclear fuel at Dounreay in Caithness. The Company hopes to sign contracts within a matter of weeks to store and possibly reprocess spent Highly Enriched Uranium (HEU) fuel from three research reactors in Spain, the Netherlands and West Germany.

In response to a parliamentary question, Tony Baldry, the Under Secretary of State for Energy, stated that the Government "are content for the UKAEA to reprocess such fuel, provided that any reprocessing contract includes options for the return of waste. It would be the Government's intention that such options would be exercised and wastes returned. If, for whatever reason, the fuel were not reprocessed, it would have to be removed from the UK within a strictly defined time limit."

There are two reprocessing plants at Dounreay: the main plant extracts plutonium and uranium from the fast reactor's spent fuel. However, a smaller plant reprocesses enriched uranium fuel from research and Materials Testing Reactors (MTR).

Since the 1950s the United States has provided many countries with HEU fuel for research reactors. These arrangements have included proliferation clauses, because of HEU's importance in the production of nuclear weapons. In the past the spent fuel from the three reactors has been returned to the US where, after reprocessing, some has been used for driver fuel in military production reactors at the Savannah River Plant in South Carolina.

Over the past five years there has been increasing opposition in the US to HEU fuel shipments. In December 1988 the US Department of Energy was forced to announce a 'moratorium' until an environmental assessment was carried out. The report has yet to appear, causing problems for the reactor operators, who, unable to send their spent fuel to the US for reprocessing are running out of storage space.

The three reactors concerned are: one of Spain's two research reactors near Madrid; the European Commission's High Flux Reactor at Petten in the Netherlands; and the Hahn-Meitner Institute (HMI) reactor in Berlin.

The UK Government has agreed to allow the spent HEU fuel to be stored at Dounreay for up to four years, by which time the industry hopes the US will have lifted its ban. Alternatively it may be reprocessed at Dounreay. The contracts are estimated to be worth more than £6m.

If the fuel is reprocessed at Dounreay, it is Government policy to return the resulting nuclear waste. But rather than returning the bulky low and intermediate-level waste, it may be decided to return an equivalent amount, in terms of radioactivity, of high-level waste. If this is the case the UK will still be left with the low and intermediate waste to dispose of.

The Northern European Nuclear Information Group, based in Shetland, point out that "a similar 'return to country of origin' clause is included in Sellafield's reprocessing contracts - but no radioactive waste has ever been returned ... it will be impossible to return the radioactivity which will go into atmosphere from Dounreay, or into the sea from its outfall pipe."

Dounreay is scouring the world for lucrative reprocessing contracts to provide vital income, because Government funds are due to stop in 4-6 years. This could lead to more nuclear waste imports. Owen Pugh, chief executive of AEA fuels says he has received inquiries from many other foreign laboratories and envisages that business from fabricating and reprocessing nuclear fuel at Dounreay could increase to around £25m worth per year.

There are six research reactors in West Germany, all of which have looming spent fuel storage problems. If the spent fuel is not transferred out of the on-site storage facilities soon, the reactors may have to stop operating. The West German Environment Minister, Klaus Topfer, has accepted the plan by the HMI to store their spent fuel at Dounreay, however, the agreement has stirred up a political storm in Berlin.

The reactor has been shut down for the past three years, mainly due to political pressure after a maintenance shutdown. Arguments over the relicensing of the reactor have on several occasions brought the fragile coalition between the SPD (Social Democrats) and the Alternative List (Berlin's Green Party) to the brink of collapse. The SPD had promised to relicense the reactor by the end of May, but it now looks like being delayed until at least July, and, if the Greens get their way, it may never reopen. □

Democracy dumped

A HOWL of protest followed Scottish Secretary, Malcolm Rifkind's decision to overturn Highland Regional Council's refusal to grant the UKAEA planning permission to drill two testbores at Dounreay in Caithness.

The decision follows a referendum, held by Caithness District Council last November, in which 74% of voters rejected proposals to bury low and intermediate-level radioactive waste at Dounreay.

Councillor Peter Peacock, Vice-Convener of the Regional Council said the Region would not give up the fight and "will now have to think harder than ever about how it is going to oppose Nirex".

Lorraine Mann, Convener of Scotland Against Nuclear Dumping described Rifkind's decision as a complete disregard of public opinion in the Highlands and called him "Scotland's Ceausescu".

Alex Salmond, Scottish National Party MP and member of the Commons Energy Committee, said "Rifkind's arrogant dismissal of the democratic will of Scotland and Caithness will haunt the Tory Party up to and through the next election. We give England our oil and gas and they give us their nuclear waste. It has not escaped our attention that the Secretary of State for Energy was unwilling to allow the dumping of low-level waste in his constituency." Winnie Ewing, the SNP Euro-MP for the Highlands and Islands has threatened a campaign of civil disobedience.

The Daily Record, the Mirror's sister paper in Scotland said "Scotland is not Britain's dustbin ... Stick it in Trafalgar Square."

Alex Salmond, Calum Macdonald (Lab), Margaret Ewing (SNP), and Brian Wilson (Lab) have tabled an Early Day Motion (No. 998) in the House of Commons deploring the Secretary of State's "rejection of the democratically expressed wishes of the people of Caithness; and calls on him to rectify this wholly unsatisfactory negation of democratic principles".

The two boreholes will be 1,500 metres and 800 metres deep. Both will be on UKAEA land. Nirex will begin clearing a site in July before drilling starts in late summer. It will take several months to drill the first bore. The second bore will be drilled next spring. Nirex estimate that it will take until the end of 1991 to sift through the information gathered at both Dounreay and Sellafield. It would be 1992 before Nirex could decide whether it favoured Cumbria or Caithness. A further year will be required for detailed investigations into the preferred site, involving sinking a shaft and building an underground laboratory.

A week after Rifkind's announcement, the UKAEA submitted a further planning application. This time for 6,000 boreholes. They will range from 2 to 30 metres deep and cover 3,000 acres around the Dounreay plant. Charges of dynamite would be exploded in the holes and the resulting shock waves monitored to give more of a 3D picture of the area's geology.

No similar application will be made at Sellafield because 'vibroseis' machines have been used there to create the necessary seismic vibrations. These machines don't work in the Dounreay area, because the peat absorbs the vibrations. Nirex describe the two methods as "different ways of getting the same information". Unlike the two deeper boreholes, these will affect 21 landowners apart from the UKAEA, who could of course lodge objections. □

Nirex seminars

TWO Nirex seminars due to be held in Edinburgh and Inverness in May were cancelled by Nirex because their Managing Director, Tom McInerney, has had a heart attack. Three similar seminars have been held for English Local Authorities (in London, Lancaster and Leicester), to convince them of the merits of deep disposal.

The Scottish Nuclear Free Local Authorities have written to Nirex expressing their regret "that these important seminars should be cancelled because of the unfortunate illness of one man". It is felt by Scottish anti-dumping groups that Nirex have used McInerney's illness to avoid the backlash following the Secretary of State for Scotland, Malcolm Rifkind's decision to allow test drilling at Dounreay.

Highlights of the seminars which did take place include the following comments by Nirex:-

- Dick Morris, recently appointed chairman of the Nirex Board, was again described as "independent from the nuclear industry" despite having been director of BNFL for 14 years.
- Nirex claim they will present a safety case "the likes of which has not been known before". However, it emerged that a full safety case cannot be presented until "after the repository was built" because you don't really know what's going to happen until you've done it.

When asked about the importation of foreign waste, Nirex replied "We are not importing waste. BNFL is a completely different company (though they are a major shareholder). The reprocessing of foreign waste is the business of BNFL." However, they did admit that high-level waste would be sent back in place of some of the very low-level waste (such as overalls and lab-shoes) arising from reprocessing of foreign waste, but were not specific on the issue of low and intermediate level waste arising from the foreign contract work. □

Rosyth waste store

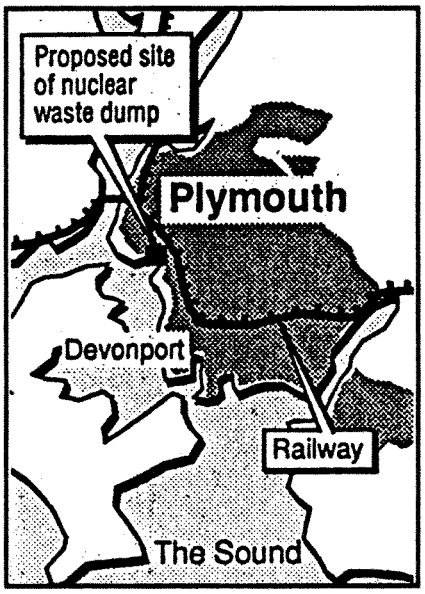
DUNFERMLINE District Council has reversed its opposition to plans for an intermediate level nuclear waste (ILW) store at Rosyth Naval Base, after all major objections were resolved by the Ministry of Defence (MoD).

The store will be used to hold ILW arising from the refitting and decontamination of the Royal Navy's nuclear submarines. The bulk of the waste will be in the form of a radioactive resin, which, according to Captain Killick, Chief Staff Officer (Nuclear) at the base, is kept in special containers "roughly the size of a dustbin, and are encased in concrete". About 6 of these 'dustbins' are produced each year.

The Council originally withheld consent, because the MoD had refused to tell them what waste would be stored at Rosyth, or allow them access to radiological surveys of the base. Captain Killick says "we negotiated with headquarters [and] managed to get the barriers of security lifted", so an inventory of the waste and the survey results have now been provided.

ILW from nuclear submarines was dumped at sea up until 1982, when action by transport unions forced the Government to call a halt. Rosyth, like any other nuclear facility, now has to store its ILW on-site, pending the construction of the Nirex repository, which is due to come into operation in 2005.

At present the waste "just sits outside where the rain can get at it", says Killick "We must decontaminate the nuclear submarines in future. That is going to result in resins we cannot dispose of. The store meets the requirements of the nuclear-free zones and environment groups. It is a damn site safer than just leaving it about in the open air, to get rusty."



The MoD applied for permission to build a similar store, but larger and with thicker walls, at Weston Mill in Plymouth. After opposition from the local authority and the public, their application was withdrawn earlier this year. The Weston Mill site is surrounded by houses, and has two schools in close proximity. It is expected that the MoD will submit a revised application for the Plymouth store in the near future, although the MoD say they "are reviewing all available alternatives", including moving the waste elsewhere.

The discrepancy between the Plymouth and Rosyth stores led to fears that the Devonport dockyard might become the centre for decommissioning nuclear submarines. □

Contact: Plymouth nuclear Dump Information Group, Kevin Owen, 71 Copse Road, Drunken Bridge Hill, Underwood, Plympton, Plymouth, PL7 3QB.

Sizewell B sunk?

PRESSURE is mounting on the Government to cancel Sizewell B, following a review of construction costs. Britain's first Pressurised Water Reactor (PWR) is now forecast to cost £2bn, more than twice the original estimate. The final nail in the coffin may be the fact that the station must now bear all the research, operation and maintenance costs, which were originally to be spread over the 10 PWRs planned by the Government. This could amount to another £2bn, making the cost of Sizewell B completely ludicrous.

The Sizewell project may be further isolated if, as expected, the report of the Hinkley Inquiry inspector rules against the Hinkley Point C PWR.

Alex Henney, author of the right wing Centre for Policy Studies report ***Privatise Power*** estimates that the cancellation of Sizewell B will cut at least £75m annually for 30 years from electricity bills, due to the capital saving and reduced R&D and production costs.

In a new report, published by Greenpeace, entitled The Economic Failure of Nuclear Power in Britain*, Henney says "from the start [Sizewell B] will be expensive to operate and as it ages it will become very expensive to operate. In 15-20 years time many of its one-off components will have to be replaced at considerable expense because they will no longer be manufactured." Despite costing £20m, Henney says the Sizewell Inquiry resulted in a "superficial analysis of the economics of nuclear power".

Henney recommends that the Government consider, amongst other things:-

(1) abandoning Sizewell B immediately.

(2) the early closure of the Magnox and AGRs on economic grounds to reduce the magnitude of the future waste handling task.

He damns the history of nuclear power in Britain as "three decades of state deceit and incompetence on a massive scale". The public and parliament have been "misled ... with claims that nuclear power was cheap". □

*** The Economic Failure of Nuclear Power in Britain by Alex Henney is available from Greenpeace 30/31 Islington Green, London N1 8XE. Full report £15; Summary £5 (both incl p&p).**

Fudging the figures

THE recently published Welsh Office (WO) report, ***Artificial Radioactivity on the Coasts of Wales*** contains "a number of flaws which make the report's main conclusions virtually worthless", according to Tim Deere-Jones of the Irish Sea Project (ISP).

The WO report attempted to establish "the extent of sea to land transfer of radioactivity on the Welsh coast", but, according to ISP, this has been a "complete failure" because the authors "misused inefficient technical equipment".

The equipment in question was the Muslin Screen, which a 1982 Harwell report described as useful for comparing conditions between sites, but not for quantifying the exact amount of radioactivity coming off the sea. The authors justify using the equipment, which is meant to be 20% efficient, to quantify sea to land transfer, by multiplying their results by five, thus compounding all inherent errors.

"It has been patently obvious for many years", say ISP that "the finer the sediments, the higher the potential radioactivity. It is particularly relevant, therefore, to study mud banks and salt marshes in land locked bays and river estuaries where the finest particles occur."

ISP's work, described by Tim Deere-Jones in ***SCRAM 73***, shows that fine particle mud from salt marshes at the extreme landward end of the Teifi estuary contained ten times more Sellafield derived, seaborne radioactivity than the coarser sand at the seaward end of the estuary. But none of the samples taken by the WO researchers were from the extreme landward end of estuaries.

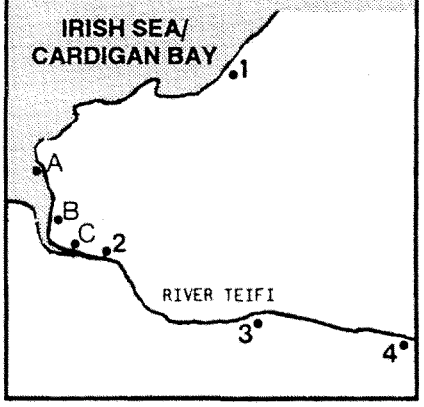
Despite the misuse of inefficient apparatus and the failure to monitor the most important sites, the WO report does manage to observe sea to land transfer taking place. ISP and Dyfed County Council's radiation monitoring programme have observed this phenomenon in South Wales and discovered contamination of pasture grass and lichens up to 10km inland. Despite this the WO report made no attempt to quantify the impact of sea to land transfer on the human food chain.

It is not surprising, therefore, that the WO report, and two similar ones focusing on South-West Scotland and Ulster, conclude that "Doses of artificial radiation to the population are only a small fraction of the recognised limits."

ISP, on the other hand, say this conclusion is "based on the misuse of inefficient equipment, a refusal to investigate sites where the greatest levels of radioactivity concentrate and incomplete study of the mechanisms and impact of sea to land transfer". □

ISP monitoring showing concentration of Ceasium 137 in an estuary, and sea to land transfer

Silt:	
sample A	5.2 Bq/kg
sample B	12.5 Bq/kg
sample C	54.0 Bq/kg
Lichen:	
sample 1	16 Bq/kg
sample 2	45 Bq/kg
sample 3	25 Bq/kg
sample 4	25 Bq/kg



A fuller critique of the Welsh Office report can be obtained from the Irish Sea Project, Cwm Sara, Newcastle Emlyn, Dyfed, SA38 9RF.

Plutonium shipments

THERE is continuing controversy in the US about Japanese plans to transport over 45 tonnes of plutonium by sea from Europe. Arrangements for the sea shipment were rushed through Congress once it became clear to the US and Japanese governments that new stricter safety standards made it impossible to implement the original plan to fly the plutonium back to Japan.

The plan now is to use a single coast guard patrol vessel to escort the plutonium. Japan's Maritime Safety Agency (MSA) has already ordered the vessel, which will be equipped with 20 millimetre and 35 millimetre machine guns. On board will be 2 armed surveillance helicopters. It will have no anti-missile capability.

The Pentagon's position on security is that "air shipment via the polar route is preferable to sea shipment" and that "even if the most careful precautions are observed [for sea shipment], no one could guarantee the safety of the cargo from a security incident, such as an attack on the vessel by small, fast craft, especially if armed with modern anti-ship missiles." When asked what the contingency plan would be in the event of the MSA security vessel and the slow-moving freighter coming under attack a US Department of Energy (DOE) official replied "Would you believe simply heading for the closest port?"

The Japanese answer to these fears is that preparation should not be for "military attacks but attacks by terrorists and pirates. Let's imagine that Libya, for example, mobilizes its navy to seize Pu. The US Navy will discover such movement upon the fleet's departure and will notify Japan. Then we will just sail away from such a threat."

The US has a veto over the transportation of plutonium from Europe to Japan, because they provided the original fuel. The serious questions raised about the adequacy of the security arrangements lead Congress to exercise the veto. Paul Leventhal of the US Nuclear Control Institute (NCI) says he believes "sea shipment of Japanese plutonium is by no means assured."

NCI have analysed Japan's need for the plutonium and found that no shortage will occur before 1998, and there will be no shortage at all if Japan confines its research and development programme to breeder reactors and avoids commercial scale recycling of plutonium in thermal reactors. "Congress might well resist going ahead with the shipments if Japan's need for the plutonium is not certain", says Leventhal.

The Japanese Atomic Energy Commission (AEC) asserts that Japan faces a shortfall of plutonium because fuel fabrication for the Joyo and Monju breeder reactors "will result in a domestic plutonium inventory shortage in 1992". However, the NCI analysis indicates that the output of the Tokai-mura reprocessing plant, plus the plutonium already shipped from Europe, can provide an ample supply for the breeder and incidental research programmes. If the breeder proves to be commercially unfeasible, as seems to be the case in France, then no additional plutonium beyond that recovered at Tokai-mura will be necessary, and Japan could suspend plans for the large reprocessing plant at Rokkasho-mura.

"Japan could explore leaving its plutonium in Europe and receiving instead the equivalent energy in the form of shipments of low-enriched uranium", NCI suggests, "In this way, Japan could avoid a large plutonium surplus, as well as any need to dispose of excess plutonium uneconomically in thermal reactors, as the French are now doing."

The problem is that, if Congress rejects sea shipments, there may well be renewed efforts to go back to the original plan for shipment by air. The DoE is petitioning the Nuclear Regulatory Commission (NRC) tc substitute a weak IAEA standard for the strict NRC code that now applies to crashworthiness requirements for plutonium casks (***SCRAM 76***). □

Torness Waste

FOURTEEN irradiated fuel assemblies were successfully removed from Torness Reactor One in April, and replaced with new fuel. Scottish Nuclear (formerly part of the SSEB) now have to tackle the thorny issue of spent fuel transport to Sellafield via Edinburgh's South Suburban Railway.

Scottish Nuclear have claimed that spent fuel transport from Torness would start in April. However, AGR spent fuel must remain in the station cooling ponds for about 150 days, so transport may not now begin until September.

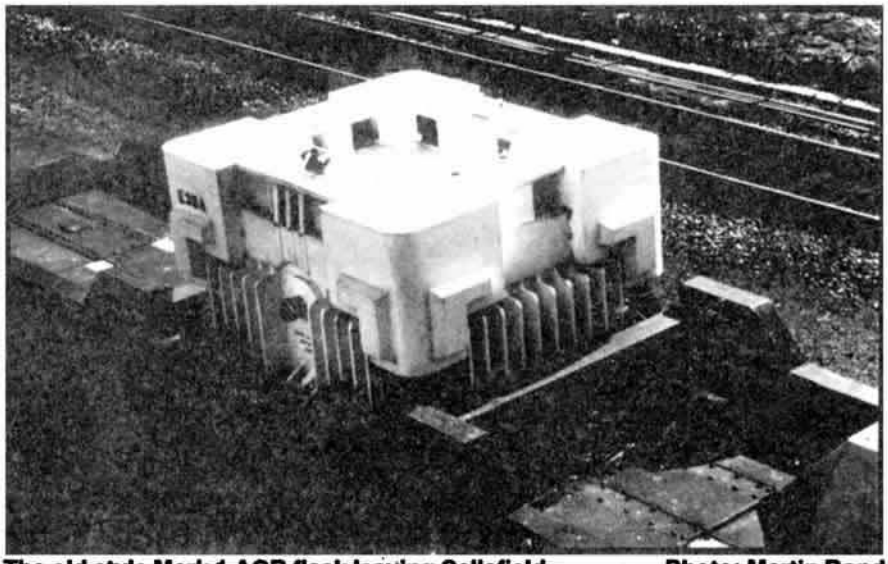
Scottish Nuclear have designed a new waste flask - the A2 flask - to transport the Torness spent fuel to Sellafield. It will have steel walls between 12 and 14 inches thick, the old flasks had just $3^1/_2$inches of steel and a 7inch lead lining.

The ability of the A2 flask to contain the high radiation emitted by spent AGR fuel has been questioned by nuclear consultant, John Large: "The level of gamma radiation emitted by spent AGR fuel is too high to be excluded by steel. AGR fuel is three times more radioactive than fuel from older Magnox reactors. I am doubtful whether the acceptable maximum surface emission level for gamma rays of 0.5 microsieverts per hour can be achieved by steel alone."

Large also doubts whether the A2 flasks can be certified in time for Scottish Nuclear to use them when spent fuel starts being transferred to Sellafield: "The Department of Transport tell me that the new flask has not reached compliance, is not acceptable at this time and will not be acceptable for some time for the transport of fuel ... they will have to use the Mark 1 AGR." Scottish Nuclear deny this.

The SSEB admitted at the 1984 public inquiry, which dealt with the proposed railhead for Torness at Skateraw, that new flask designs were under consideration. However, the Board declined to submit these designs to the inquiry. The main issue discussed at the Skateraw inquiry was the integrity of the Mark 1 flask. Having won that inquiry the SSEB were free to introduce a different design which has not yet been open to public scrutiny.

It is not clear why the A2 flask is being introduced at this stage in the AGRs history. There can be little justification for introducing a new waste flask when it has been obvious since 1982 that Torness would be the last of the AGRs. □



The old style Mark 1 AGR flask leaving Sellafield **Photo: Martin Bond**

Britain losing its yen?

JAPAN'S first commercial facility for the enrichment and reprocessing of nuclear fuel and storage of nuclear waste looks set to open despite national opposition.

The nuclear complex in Rokkasho village on the northern tip of the main island of Japan, which will cost $6,500m, is due to be completed in the late 1990s.

At present nearly all of Japan's nuclear fuel is supplied by the US, and their spent fuel is sent to the UK and France for reprocessing. The consortium of over 100 companies building the reprocessing plant hope to be able to start taking spent fuel from Japanese power stations in 1994, and to begin reprocessing in 1997. At full capacity, the plant should be able to reprocess spent fuel from 30 of the country's 37 nuclear reactors. The remainder will continue to be sent to Europe.

Japanese high-level waste from reprocessing plants in Europe will be stored for 20 to 30 years at Rokkasho from 1993 onwards.

The Ministry of International Trade and Industry will provide Rokkasho village with subsidies amounting to $10,000 for every man, woman and child in the village. The money, which is over four times the village's annual budget, will be used for 96 new village projects including a fish farm, a sports centre and a ski resort. This huge sum of money has effectively quashed almost all local opposition. □

Superphenix

SUPERPHENIX, the French prototype fast breeder reactor, has been closed, yet again. The plant has been shut down since October and an attempt to resume operation in April was postponed when a leak of liquid sodium was discovered in the secondary cooling circuit. It is now hoped that the reactor will be able to restart in June.

Once the plant starts up it is expected to produce some 2bn kWh of electricity by the autumn, when it will have to be shut down for the replacement of a number of control rods. Another shutdown, taking several months, is planned for 1991 when further control rods will have to be changed.

The plant was also shutdown in May 1987, for 20 months, because liquid sodium was leaking from a fuel drum. The French government eventually allowed the reactor to restart without the drum. A replacement fuel drum will not be installed until the end of 1991. Until then it will not be possible to load new fuel, but there is apparently enough in the plant to last until 1992/93.

A similar leak in the secondary cooling circuit caused a shutdown at Dounreay in April. Of particular concern was the way news of the sodium leak was discovered. The Dounreay workforce was informed, but because the plant's operators thought the accident insignificant, it was not made public until a local journalist started asking questions two weeks later. □

Melox

DESPITE rather dubious economics, the French government has given the go-ahead to the construction of the Melox plant, which will produce Mixed Oxide Fuel (MOX) (*SCRAM 76*).

The plant, which will be built at Marcoule in southern France, will make use of some of the 4m tonnes of plutonium produced every year at the La Hague reprocessing plant - MOX is a mixture of uranium and plutonium. Plutonium production in France far outstrips demand, now that the fast reactor programme has been postponed. Making MOX fuel for use in conventional reactors is the only way in which the dangerous plutonium stocks can be used up. □

Over the next eight years the Government intends to force electrcity consumers to pay a tax of 10p in every pound, raising a total of £9.2 bn. It will be used to support 'non-fossil fuel' electricity (nuclear and renewable energy). The tax represents a payment of about £146 for every domestic consumer. MIKE HARPER, Friends of the Earth's Assistant Energy Campaigner, explains why FoE is launching a campaign to stop this gross misallocation of resources .

The nuclear tax and you

UNDER Section 32 of the Electricity Act, 1989, Area Boards, or 'public electricity suppliers' (PESs) as they are now to be called, are required to contract for a specified amount of non-fossil fuel electricity. This is known as the Non-Fossil Fuel Obligation (NFFO). The Boards are able to recoup the additional costs of such purchases (when compared to the costs of electricity from conventional fossil sources - eg coal) by charging the difference to their customers on a pro rata basis.

It is argued by the Government and the industry that since consumers already pay for the nuclear power the NFFO is not "an additional payment". The 'Nuclear Tax' represents a payment of additional costs over what is possible either through the promotion of energy efficiency, or the use of conventional fossil-fuel technology. In that sense it is both 'additional' and unnecessary.

The quantity of nuclear power which each Area Board is obliged to buy has already been determined for the next 8 years. The obligation varies widely. from Board to Board (Table 1). These variations may lead to differences in the amount of tax paid by consumers.

All consumers who receive electricity from 'licensed suppliers' (ie people who have a licence to transmit electricity) pay the nuclear tax. This includes all the Area Boards and any generating companies who by-pass the area boards to sell, and transmit, electricity directly to customers. Currently these direct contracts are limited to large companies.

The only people who escape the tax are those who generate their electricity 'on-site', or 'self-generators' as they are called. However, since the tax is levied only on sales of 'fossil' electricity, if you receive a direct contract for electricity from a company only using renewable energy sources, then obviously you do not pay the tax.

Nuclear prop

Although the tax is raised for all non-fossil fuel sources, which includes most renewable energy schemes (wind energy, biomass, etc), the majority of it will be used to support nuclear power.

Initially the total non-nuclear component is expected to be 300 MW, rising to 800 MW by 1998[1] as more renewables come on stream. This compares to an initial total for nuclear power of 8,548 MW, decreasing to 7714 MW in 1998 as older capacity gets taken off[2]. In other words, for the first year the nuclear component will be 96.6% but will decrease to 90.6% in 1998. This clearly shows that the tax is nuclear based and justifies the epithet the Nuclear Tax.

Quite evidently, the scale of this subsidy is scandalous and therefore embarrassing for the Government and the nuclear industry. Despite initial assurances that the effect of the tax on the consumer would be made clear, the Government and the Area Boards are backing away from full disclosure.

In a written response to a Parliamentary Question, (15/2/90), the Government said it would not make it policy to insist that the amount of the tax was detailed separately on electricity bills. Yet up until then they had consistently said that it would be disclosed:

1. "The levy will ensure that the costs of generating electricity from different fuel sources become transparent. For the first time

PES	1 Apr '90	1 Apr '92	1 Oct '92	1 Apr '95	1 May '95	1 Apr '96	1 Jul '96
EEB	1171	1159	1125	1076	1012	1115	1057
SOU	1060	1049	1019	974	916	1009	957
LON	855	846	821	785	738	814	772
MEB	829	820	797	762	716	789	748
EMEB	769	761	739	707	664	732	694
NWEB	718	710	690	660	620	683	648
SEE	710	702	682	652	613	675	640
YEB	701	693	673	644	605	667	632
MWEB	496	490	476	455	428	472	447
SWEB	487	482	468	447	421	463	439
NE	453	448	435	416	391	431	409
SWA	299	296	287	275	258	284	271
Total	8548	8456	8212	7853	7382	8134	7714

Table 1: Nuclear capacity requirements for area boards in MW

NFFO and decommissioning pattern

Date	NFFO (MW)	Change	Reactors which correspond to change
1-4-90	8548		
		-92	Winfrith (90MW)
1-4-92	8456		
		-244	Bradwell (245MW)
1-10-92	8212		
		-359	Trawsfynydd (390MW)
1-4-95	7853		
		-471	Hinkley Point A (470MW)
1-5-95	7382		
		+752	Sizewell B & Dungeness A (net 751MW)
1-4-96	8134		
		-420	Sizewell A (420MW)
1-7-96	7714		

Table 1 gives a further indication that Sizewell B may be delayed. There is a sharp increase on 1 April 1996 in the level of nuclear capacity which area boards are required to contract for (an increase of 752 MW). Since this is the only increase for the whole 8 year period and since it is of significant size, it suggests it is for the introduction of Sizewell B.

On 26 April 1990, John Wakeham, Secretary of State for Energy, said in answer to a parliamentary question from Frank Dobson:

"The timetable for the completion of the station is a matter for Nuclear Electric plc. The CEGB indicated in its last report and accounts that it aimed to achieve full commercial load in May 1994, six months after the start of fuel loading." (Hansard, Col 277, 26/4/90).

They cannot both be correct.

customers will be able to see how much extra (if anything) they pay for diversity." (Notes to the Electricity Bill, prepared by the Department of Energy in 1988).

2. Cecil Parkinson, then Energy Secretary, when debating an amendment to the Electricity Bill on the Fossil Fuel Levy, declared "we shall be making orders, justifying them to Parliament and making the costs transparent so that customers, for the first time, know what they are." (Hansard, 7/2/89, Standing Committee E, Col 738.)

3. "The additional cost of meeting the obligation [ie buying nuclear power] compared with the cost of generating the same electricity from fossil sources will be shown in the fossil fuel levy [the Nuclear Tax]." (Tony Baldry, Under Secretary for Energy, 29/1/90.)

4. "As nuclear power still costs more than fossil power, the levy is needed so that extra costs can be identified and fairly shared out." John Wakeham, Secretary of State for Energy, 26/2/90.

While some Area Boards have indicated that if sufficient demand transpires, they will itemise, on individual electricity, bills the amount being levied to support nuclear power, most are resolutely opposed to such a move.

Friends of the Earth is launching a campaign to ensure that everyone who pays the Nuclear Tax is aware how much it is, and what the money is going to support. In addition, FoE wants to use the opportunity to show why this money is being wasted, when it should be directed to the fuller support of renewables or to the promotion of energy efficiency and energy conservation.

Return to sender

We are asking individuals, as customers, to return their next electricity bill to the Area Board asking for the amount of the Nuclear Tax to be specified in that and all future bills. The Area Boards must be told that we, as consumers, are not prepared to sit back while £8,740m of our money, which represents the minimum extra costs of nuclear power, is sucked down the nuclear plug-hole.

The Government expects the Nuclear Tax to decrease from 10.6% to 5.5% over the next eight years, "as fossil fuel prices rise and more efficient nuclear capacity comes on stream"[1]. Even if this reduction were to take place, it would not alter the total amount of money raised over the 8 years to 1998, but merely alter the balance between different years. Thus, it is likely for 1990 that the sum raised will reach over £1,500m, which will hypothetically decrease over the next 8 years creating an average level of taxation of £1,150m.

FoE considers this an entirely dubious expectation of future events and to be merely a means of convincing the European Commission to agree to the package of state aid measures which comprises the subsidies to the nuclear industry. In the words of the energy journal Power In Europe, "the only way it [a reduction] could be done would be the rapid closure of Nuclear Electric's most expensive nuclear stations and the cancellation of the Sizewell B PWR." That should be the way forward. □

References

1. European Commission press release, 28/3/90, IP(90)267.

2. Source: Statutory Instruments, No 263, laid before the House of Commons 16/2/90.

In some ways the bureaucratic chaos which surrounded the Chernobyl accident in April 1986 was reassuring: surely things couldn't be that bad in the West? PETE ROCHE has been delving more deeply into the causes and consequences of the disaster.

The legacy of Chernobyl

IN SOVIET Society it was nothing unusual to find a nuclear power station, still requiring safety tests in 1986, licensed for commercial operation from 1984. Zhores Medvedev explains in his new book, ***The Legacy of Chernobyl****, why the plant's operators did not attempt to gain clearance for that disastrous experiment conducted on 26 April 1986: "It would have meant acknowledging a cover-up which had occurred more than 2 years previously ... the tragedy was the product of administrative anarchy."

Medvedev, who alerted the West to the 1957 disaster in the Urals, has pieced together from limited Soviet literature, and Western sources, the clearest picture yet of events leading up to that fateful night, and its aftermath which will haunt the nuclear industry for evermore.

'Glasnost' has not been very much in evidence during the Chernobyl saga, and there are still annoying gaps in our knowledge. For example, nobody knows why Valery Legasov, head of the Government Commission which reported to the International Atomic Energy Agency (IAEA), and Deputy Director of the Institute which developed the RMBK reactor, committed suicide a day after the second anniversary of Chernobyl.

Nuclear explosion

We may be reassured by Soviet incompetence, because 'it couldn't happen here', but when we learn that the IAEA's post-accident review failed to elicit details of the sequence and causes of the errors because it wouldn't have suited their own "vested interests", that reassurance is short-lived.

Medvedev confirms the theory proposed by Don Arnott and Steve Martin in *SCRAM 64* that the accident included a nuclear explosion. Chernobyl prompted debate in 1986 about the safety of reactors, such as the Magnox reactors, without secondary containment. However, the explosion "would probably have breached any modern containment vessel".

A full 20 hours after the original explosion it was finally established that the graphite in the reactor core was burning, the core was still melting and enormous quantities of radiation were still being released. Over 6 days, helicopters dumped more than 5,000 tonnes of sand, lead and other materials onto the reactor core. Initially the radioactivity declined from 4 million curies (or megacuries MCi) on 27 April to 2MCi on 1 May. The supply of oxygen to the graphite fire had been cut off, but the fission of radionuclides, which could generate far higher temperatures than any conventional fire, continued. The radioactivity escaping through the sand cap began to increase again to 5MCi, on 3 May, and 7MCi, on 4 May. There was a danger that the reactor core, with a temperature of 2,500°C, could burn down into the water below the reactor vault, causing an explosion spewing out the remaining radioactive inventory.

Inside the sarcophagus

On 5 May 8-12MCi escaped, almost as much as on the first day of the accident. Ruthenium 103 and 106, which has a melting point of 2,250°C, was present in the radioactive plume. By 6 May the disaster was beginning to subside, and 'only' about 0.15MCi were released. But this was still more than the total release from the 1957 Windscale fire. Even at the very end of May the daily releases were higher than the total release from the Three Mile Island Reactor in 1979. The total core inventory of the Unit 4 Chernobyl reactor prior to the accident was 1,100-1,200MCi. Thankfully only about 5% of this (50MCi) was released into the environment before the graphite fire was finally extinguished, after ten days of immense effort. 20MCi of this is likely to have been deposited within a 30km radius of the plant.

However, it wasn't until October 1986, when the reactor was finally entombed, that it stopped contaminating the environment. Even now "no one knows", according to Medvedev, "what is left inside the sarcophagus and whether the Chernobyl radioactive volcano is really dead. Nor do they know whether it will be safe for future generations."

On Saturday 26 April life went on as normal in Pripyat. Children went to school and many people worked their allotments between the town and the plant - there were no warnings to stay indoors and close the windows. A few people responded to rumours and tried to escape through a forest, which by then was already severely contaminated. Evacuation only took place on the Sunday afternoon. Some 50,000 people were, therefore, needlessly exposed to radiation for 36 hours.

By 29 April it was clear that further evacuations were necessary, yet there was an "inexcusable delay" before ordering it. Another 90,000 people were evacuated between 8 and 11 days after the accident from 170 towns and villages. "It is difficult to conclude", says Medvedev, that the response "was adequate and satisfactory ... As a result many more people were exposed to serious radiation risks than was inevitable in an accident of this scale." The Soviet report to the IAEA says that the 135,000 evacuees from the 30km exclusion zone around the plant received a dose of 120mSv before they were moved. But this figure is based on external radiation only.

There were areas of heavy contamination, which should have been included in the original evacuation plans, as far as 300km away from Chernobyl, and areas 400km away where children and pregnant women should have been evacuated. Villages in the Gomel and Mogilev regions of Byelorussia and the Zhitomir region of the Ukraine had to be evacuated in 1989 because their inhabitants were approaching the new maximum permissible dose of 350mSv per person. Some of the evacuated villages in the Mogilev region were 200km north of the accident site.

Further evacuations

The Soviet Parliament agreed in April this year to evacuate a further 180-200,000 people from the Ukraine, Russia and Byelorussia over the next 2 years at a cost of £16bn. Deputies (MPs) have been critical of the official maximum limit for contamination. People have been told that it is safe to live in areas contaminated by up to 5Ci/km^2 (200,000 Bq/m^2). (For comparison, selling lambs for slaughter from any area with a surface contamination of more than 10,000Bq/m^2 was banned in the UK.) Deputies from Byelorussia want the limit lowered to 1Ci/km^2. Dr Alexei Yablokov, deputy chair of the Soviet Parliament's Ecological Committee,

says that 2.5 million people are still living in contaminated areas; the 200,000 who are to be moved live in 'very contaminated' areas. The City of Gomel in southern Byelorussia, for example, which has a population of half a million, has contamination of up to 8Ci/km^2.

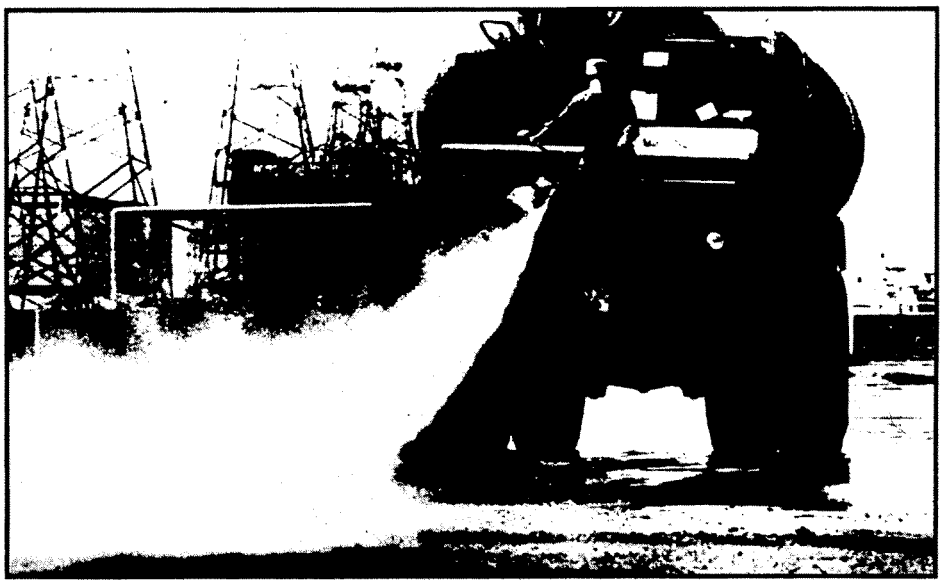
The exclusion zone represents a huge source of radioactive dust. Despite attempts to fix the dust with chemical sprays during the summer of 1986, most of it remained volatile. When the wind blew in a southerly direction there was alarm in Kiev, where the streets were being constantly washed. Heavily contaminated spots continued to appear throughout 1986 until the winter snows stopped the radioactive dust spreading.

Everything from topsoil to fallen leaves in the exclusion zone had to be classified as nuclear waste. Much of it was probably buried at the Chernobyl site, which has been isolated from the Pripyat river basin by a waterproof dam deep under the ground. It is unlikely this method would meet international regulations for the disposal of nuclear waste. "The scale of the contamination of the environment was so enormous in 1986 that it is not surprising that the task of protecting the population was not entirely successful", says Medvedev, but "the long-term health effects ... are only partly due to external radiation. Nearly 60-70% of future health problems will be caused by the consumption of contaminated agricultural products."

Caesium contamination

In 1988 some 10,000km^2 of land was contaminated with more than 15Ci/km^2 of caesium 137, so clean food was brought in for the 230,000 people living in the areas. However, 21,000 km^2 was contaminated with between 5 and 15 Ci/km^2 of caesium 137 (200,000 - 600,000 Bq/m^2) - far too high for agriculture, but this land was not abandoned. A further 100,000km^2 must have had levels of between 1 and 5Ci/km^2 of caesium in 1989 (37,000 - 200,000 Bq/m^2) - too high for livestock agriculture.

Why consumption of locally produced milk was not immediately forbidden to the rural population living close to or in the exclusion zone prior to evacuation is "very difficult to understand". Even after market sales were forbidden in the large cities, the rural population around Chernobyl continued to consume locally produced milk, dairy products and vegetables. It is officially acknowledged that people living inside or near the exclusion zone received an exposure of up to 400mSv. Children living in Kiev would have received an unacceptable level of radioactive iodine, even before 1 May when restrictions were placed on farm produce from the Chernobyl area.



Chemical spraying to try to prevent the spread of radioactive dust particles

Secrecy about the exact levels of contamination "intended to prevent an exodus, merely stimulated one", and absurd rumours circulated. Despite double salaries as well as extra money to buy clean food for people living in the 'zone of special control' around the exclusion zone, rural professionals and young women left in numbers which caused problems for the authorities. The unauthorised possession of a dosimeter was still treated as a crime two years after the accident, leading to a black market in such equipment.

The official casualty figure of 29 deaths does not include the military, according to Medvedev. Soldiers would have been treated in special military hospitals, and no one knows how many were taken there. Yuri Shcherbak, a Deputy from the Ukraine, told a news conference in Moscow on the 4th anniversary of Chernobyl that the real figure is 300 deaths so far. Earlier in April he told the United Nations in Geneva that 1.5 million people in the Soviet Union, including 160,000 children received a significant dose of radiation to the thyroid gland.

Health register

In 1986 600,000 people were officially classified as having been 'significantly exposed', and are therefore included on a special register of people whose health will be monitored for the rest of their lives. This register includes everyone evacuated, as well as those living in the zone of special control, so it will almost certainly be larger by now. Again military and civilian personnel involved in the clean up are not included in the register, unless they happen to live in the Ukraine. By 1989 another 600,000 people had been involved in decontamination work.

An accurate assessment of the number of long-term cancers is impossible from the information available. And none of the bodies carrying out assessments can agree on the methodology. Robert Gale, the American bone marrow specialist who treated victims of Chernobyl, estimates between 5,000 and 75,000 extra cancers worldwide, nearly half of which will be in the Soviet Union.

The UK National Radiological Protection Board (NRPB) have predicted 1,000 extra cancers in the European Community, and say it will be impossible to detect the health impact of the accident. However, US studies estimated 5,000-6,000 extra cancers over the next 50 years in the Community.

Using NRPB methodology, Soviet experts estimated 18,000 extra cancer deaths in the European part of the Soviet Union over the next 70 years. But using the American methodology, the figure rises to 50,000. These figures do not include other serious health effects, such as genetic problems and mental retardation.

A statement from a group of Deputies, who have been trying to persuade the Soviet Government to take more positive action, sums up the true gravity of the situation: "Chernobyl and its consequences are the biggest catastrophe of modern times, a disaster on a planetary scale. The Government should proceed from the principle that people must be resettled from the whole of the contaminated territory. In scope it can be compared to the resettlement of a whole republic." □

Note: Medvedev is a former Soviet scientist with a background in agriculture and radiobiology. He was exiled in 1973 and is now a senior research scientist for the UK National Institute for Medical Research.

*** *The Legacy of Chernobyl* by Zhores Medvedev. Blackwell, 1990, 352pp, £19.95.**

There are hundreds of nuclear sites throughout the world: experimental and commercial reactors, fuel handling and fabrication plants, not to mention the sites contaminated by radiation through accident or industrial incompetence. The many and wide ranging problems of decommissioning and decontamination were discussed, in London, at the Second International Seminar on Decommissioning of Nuclear Facilities. THOM DIBDIN, a freelance journalist, was at the conference.

Decommissioning: the final folly

IN THE mid seventies, the French electricity utility, EdF, proposed a very modern solution for what is a uniquely 20th Century problem. When their Chinon A1 experimental nuclear power station reached the end of its working life, they isolated the reactor core and then turned the surrounding building into a theme museum.

Neat as this solution may be, it is not one which bears too much repetition. The regulation and safety of the decommissioning process, clearing up the chaos at Three Mile Island, rehabilitation of a contaminated site in East London, the strategy for decommissioning Hunterston A and British Nuclear Fuel's Hundred Year Plan for Sellafield are all topics which will recur until the end of the nuclear age.

Decommissioning has been defined in three stages by the International Atomic Energy Agency: defuelling; dismantling of non-radioactive plant with isolation of the nuclear island; and return of the site to 'green field' status (see box 1). Although these definitions were made with commercial reactors in mind, they are applicable to other radioactive facilities.

Simple or simplistic?

What could be simpler? Rather, what could be more simplistic: most reactors were neither built nor designed with decommissioning in mind. According to Mr. S Gordelier, the decommissioning manager at the Technology division of Nuclear Electric, even for commercial reactors, which have had relatively uneventful working lives, such as Berkeley, stage one will take at least three years and require careful planning and control.

In all, nine Magnox stations will require decommissioning in the near future. While every reactor is unique, the process for them all will be similar to that for Hunterston A, which was shut down earlier this year. At Berkeley the defuelling process has already begun.

At Hunterston, "the controlling factor for the duration of Stage one will be the rate at which fuel can be dispatched from the station and the stage is expected to last about five years", Mr P McOwat, the General Service Manager of Scottish Nuclear, told the conference. At the end of this time all fuel from the station will have been sent for reprocessing. Defuelling will start as soon as possible after the closure of the second unit, to ensure that the majority of the fuel leaves the site without delay.

"Although the decay heat will be low during defuelling, it will be necessary to maintain a cooling capability", said McOwat. However, it will also be necessary to prevent the vessel temperature from falling too low, so "provision is being made to supply heat when the reactors are out of service".

Second stage

During Stage 2 all the plant outside the reactor shielding will be dealt with. Much of it is not radioactive, (the turbines, cooling water plant etc.) and will be demolished using conventional techniques while ensuring that there are no adverse effects on the remaining equipment, particularly the safety systems. However, there is a significant amount of work which will involve contaminated materials.

According to McOwat, "the gas circuit will produce large quantities of low level waste, comprising carbon steel material with surface contamination dominated by cobalt 60." Thus, he argues, "significant reductions in activity will occur if operations are delayed by a few tens of years. Since the gas circuit at Hunterston is housed in a weatherproof building, storage in situ for a limited period is an option being considered."

The intermediate level waste generated during the station's life will also have to be disposed of at this stage. Notoriously, at Hunterston, the sleeve design for the fuel elements produced a greater volume of graphite than at any other station. 2,000 cubic metres of graphite debris with other waste will fill the on-site waste bunkers by the end of Stage 1. As McOwat pointed out, "the volume of untreated packaged waste would therefore be considerable and would incur high disposal costs."

Scottish Nuclear are hoping to use "reduction techniques" on the waste before encapsulating it in concrete. McOwat made no mention of the type of techniques which are being planned, although he did say that "all the necessary operations have been demonstrated and no basic development work is required, but in each case a design of plant specifically for Hunterston A will be required and the specification, design, procurement and commissioning will take several years to complete."

Because of the amount of waste generated, the timing of the completion of NIREX's proposed deep repository will have implications for the Stage 2 decommissioning process. As the planned date for completion of the repository is 2005, McOwat admits that

BOX 1: THE THREE INTERNATIONALLY AGREED STAGES OF NUCLEAR DECOMMISSIONING

STAGE 1: Final shutdown and surveillance, involving the removal of all fuel and taking appropriate measures towards the eventual disposal of accumulated operational waste and plant decommissioning.

STAGE 2: Restricted site release, involving the dismantling of plant and buildings external to the reactor's biological shield and completion of processing of accumulated operational waste.

STAGE 3: (Which may be deferred for several decades after Stage 2) Unrestricted site use, involving the complete dismantling and removal from the site of all materials, equipment and structures with radioactivity levels above those acceptable for unrestricted use of the site.

any packaged waste will have to be stored until then: "If no other considerations apply, a delay of at least fifteen years from shutdown would be necessary to avoid double handling and the building of temporary storage facilities."

No site

Furthermore, there are several considerations concerning the requirements for the repository which will affect the way in which the waste is packaged. As no repository site has yet been chosen, the chemical and radioactive contents of the packaging cannot be defined. If the packaging had to be changed after encapsulation, this would incur further costs and, more importantly, cause extra exposure of workers.

"A further uncertainty in the optimisation of waste treatment and disposal is the lack of clear definition as to the 'de minimus' level and its interpretation", according to McOwat. While a value of 0.4Bq per gramme has been indicated, no limit on surface activity, or the total mass over which this value can be averaged has been defined. These limits would affect the amount of waste which could be treated as "non-radioactive".

Because of these considerations, the timescale for Stage 2 has yet to be finalised. Indeed, early completion "may not be advisable".

In common with most commercial operators, Scottish Nuclear are hoping to defer Stage three decommissioning for several generations - probably for 100 to 130 years. An accounting trick known as 'discounted cash flow', whereby invested capital is assumed to grow at some 2% above the rate of inflation, in combination with the decay of radiation over this time, considerably reduces the financial load of decommissioning.

In 1988, when the total cost of decommissioning a CEGB station was estimated at £288m, £210m was allocated for Stage 3. By setting aside £16m now, this sum is estimated to grow to £210m over 130 years, giving a total current cost of just £94m. This compares with the 1987 estimate of £412m by the House of Commons Energy Committee for returning a Magnox station to a 'green field' site.

While neither McOwat nor Gordelier acknowledge any safety problems with Stage 3 (Gordelier went so far as to say "dismantling does not have the potential for any significant release of activity to the public or environment") there patently are hazards.

BOX 2: REGULATION

In the UK the Decommissioning process is regulated with the same general provisions applicable to a site's operation. Direct responsibility for safety remains with the licensee or operator. Four UK Acts of Parliament and one International Treaty are enforceable:

- **The Radioactive Substance Act, 1960.**

This regulates the disposal of radioactive wastes in accordance with authorisations granted jointly by the Department of Environment and the Ministry of Agriculture in England. For Wales and Scotland, these exist with the Welsh and Scottish Offices.

- **The Nuclear Installations Act 1965 (as amended 1969)**

This Act concerns the granting of a licence to operate a nuclear site, and is administered by Her Majesty's Nuclear Installations Inspectorate (NII). While the licensee may surrender a licence when they wish, it does not terminate until the NII gives notice in writing that there has ceased to be any danger from radiation from the site. During this time, the NII may issue Directions which continue some of the licence's conditions after it's expiry.

- **The Health and Safety at Work Act (1974)**

This deals with hazards affecting workers and other persons from any work activity, including any nuclear site.

- **The Ionising Radiations Regulations (1985)**

These set upper limits on radiation exposure to workers and members of the public.

- **Euratom Treaty, Article 37**

Any decommissioning activity on a nuclear plant has been deemed to be in a different category to that of operation and therefore requires a new submission to the Euratom Commission.

Mr Sweeney, of Associated Nuclear Services Ltd, believes that "during the operations associated with Stage 3 Magnox reactor dismantling some specific hazards may arise". These include the generation of flammable gases during the deferment period and the "possibility of the generation of graphite dust during dismantling giving rise to an explosible condition".

These potential difficulties may be of low probability, but an explosion caused by ingniting graphite dust in air could quite easily scatter radioactive debris over a large area. It is depressing that the two utilities who will be responsible for our safety still cannot bring themselves to acknowledge such possible safety implications.

Monumental folly

The real debate in decommissioning concerns waste management. Whether a nuclear site is closed early because of opposition, or it is closed at the end of its "useful" life, decommissioning will have to go ahead. The question is to what timescale, where the waste will end up, and whether Stage 3 should be done at all. Some people believe the isolated reactor core should simply be entombed as an eternal monument to the folly of the nuclear age. (SCRAM 62)

The Nuclear Utilities have a new found regard for public perceptions of what they are doing. Indeed McOwat said that "A further important consideration [of the timing of Stage 2] is the attitude of the public to nuclear waste and to nuclear power in general. This will always have a very strong influence on the choice of timing and methods and will possibly be the deciding factor in many cases." It is strange then, that these questions have not been the subject of public debate.

The problem is that despite the painful lessons learnt about the need for accountability following the accidents at Chernobyl and Three Mile Island, there still remains an elite brethren of nuclear scientists. It is still their belief that they have to "demonstrate to the public" the safety of their plans. Surely the emphasis should be on consultation before the event, not justification of it afterwards with theme museums and other slick propaganda exercises. □

*** Full documentation from the conference is available from the organisers: IBC Technical Services, Bath House (3rd floor), 56 Holborn Viaduct, EC1A 2EX. Cost £55.**

As the environmental problems of carbon based fuels are faced up to, the use of hydrogen as a replacement is receiving renewed consideration. GRAHAM STEIN looks at the prospects of 'the Hydrogen Economy'.

Towards a hydrogen economy

In Jules Verne's "The Mysterious Island", published in 1874, the hero was asked to predict the fuel of the future, he replied "I believe that water will one day be employed as a fuel; that hydrogen and oxygen which constitute it, used singularly or together, will furnish an inexhaustible source of heat and light, of an intensity of which coal is not capable."

The idea of hydrogen derived from water as the dominant multipurpose fuel for transport, the home and industry has been termed 'the Hydrogen Economy'. It is a vision which, over the years, has been in and out of vogue. Today's renewed interest stems mainly from environmental concerns; hydrogen can be burned, used in a heat engine or in a fuel cell to produce electricity (SCRAM 76) with water as the only major waste product, with no oxides of carbon and only trace quantities of oxides of nitrogen.

Hydrogen acts only as a 'carrier fuel' and must be derived from primary fuels. The choice of the primary fuel used to produce the hydrogen determines whether or not the system is non-polluting.

Sources of hydrogen

There are two possible sources of hydrogen for large scale production, fossil fuels and water. The most common method is steam reforming of natural gas, where hydrogen from both the natural gas and the water is liberated along with carbon dioxide. Similar methods can be employed with other fossil fuels, but they also produce CO_2. Hydrogen manufactured this way is used predominantly in the chemical industry, as a possible fuel this technique offers no net energy benefit nor any reduction in CO_2 emissions.

Alternatively, liberating hydrogen from water has captured the imagination of more than just Jules Verne. Splitting water into hydrogen and oxygen can be done by electrolysis - passing of an electric current through an aqueous solution. If the electricity to do this is generated from fossil fuels then the process offers few benefits. But, hydrogen from 'clean' electricity offers the potential for a non-polluting energy system. Some advocates of hydrogen dream of cheap electricity from a vastly expanded nuclear industry, producing hydrogen for vehicles and for energy storage, thus overcoming nuclear power's inability to adjust output to meet demand. For others this is a nightmare, but, in any case, on current trends it is certainly far removed from reality.

Another nuclear 'dream' for hydrogen from water was to use high temperature nuclear heat in thermochemical cycles. This would avoid the inherent inefficiency of electricity generation from heat, but interest evaporated as even the nuclear industry realised the safety implications of a nuclear power station and a chemical plant side by side.

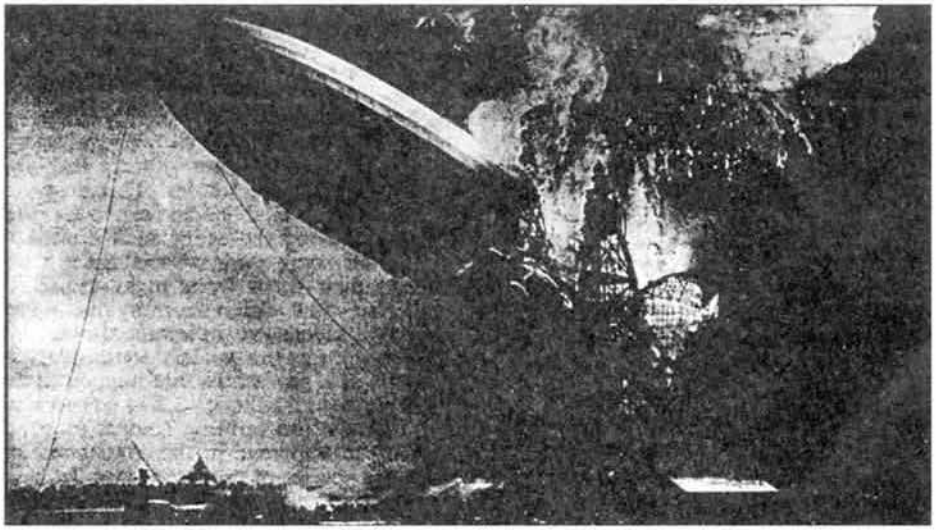
Renewables

Nuclear energy's problem of matching supply to demand would also exists in a scenario where energy was produced predominantly from renewables, most of which are intermittent in nature. Combining alternatives with hydrogen offers the prospect of an environmentally acceptable, sustainable energy system. Energy sources such as wind, wave and photovoltaics could be used for electrolysis of hydrogen, which can be stored more easily than electricity.

Storage

A number of different storage methods are possible, depending on the application. Some systems are fully established, others are still being developed. Storage as a compressed gas in pressure vessels is the most commonly used, but the cost of pressure vessels makes this method inappropriate for large scale applications. Like natural gas, hydrogen gas can be stored in gasometers or underground: in depleted oil or gas reservoirs; in aquifers; in salt cavities; or in natural or mined rock cavities. Underground storage is the most appropriate method for large scale energy supply (see Table). The storage of hydrogen as a liquid at low temperature is used by the space industry, requiring lighter, less expensive storage vessels than for pressurised gas, but liquefying equipment is expensive. A recent development for storage is absorption as metal hydride, which is being developed for use in cars by, amongst others, Daimler-Benz.

Hydrogen stored underground can be transmitted along pipelines - existing natural gas pipes would usually be



The Hindenburg disaster, a major setback for hydrogen

suitable - the hydrogen could then be burned to provide space and hot water heating or to generate electricity (perhaps as combined heat and power) or to produce electricity directly in a fuel cell (SCRAM 76).

It was in the wake of the early 1970's oil crisis that the European Commission (EC) began examining hydrogen as a fuel for the future. Two research projects were funded between 1975 to '83, at a cost of around £16 million. These programmes and further work at the EC's joint research centre at Ispra in Italy clearly indicated that hydrogen could play an important role in the energy industry.

A 1982 study sponsored by the Organisation for Economic Co-operation and Development (OECD) suggested that hydrogen will initially be used to convert coal to liquid fuels, with a transition to direct use of hydrogen as fossil fuels become unacceptable.

Despite such forecasts, the Department of Energy and the Energy Technology Support Unit (ETSU) have shown little interest. An ETSU report in '83[1] concluded that "a national RD&D programme on hydrogen is not required on energy strategy grounds", but suggested "limited participation in international programmes".

Other countries, including Canada, the USA, the Soviet Union, Sweden and West Germany, are involved in hydrogen research and development, with several pilot schemes already operating.

Pilot schemes

At Härnösand in Sweden a project called WELGAS (Wind, ELectricity and GAS) was established in 1985, as part of the towns 400th anniversary celebrations. A small 55kW wind turbine on a 22m tower was used to provide a house with electricity and hydrogen. The electricity was used for space and water heating, lighting, and to produce hydrogen, leaving a net surplus to be sold to the public electricity utility.

The hydrogen, produced by electrolysis of filtered water at a record efficiency of 80% and stored in tanks of metal hydride, fuelled the kitchen stove, met some of the space heating requirement and was also used to fuel a specially converted Saab car. The kitchen stove was a standard town gas stove fitted with stainless steel catalytic burners which coloured an otherwise invisible flame and reduced the formation of nitrous oxides. Two detectors were fitted to prevent gas leaks from the stove by switching off the main gas tap within seconds and sounding an alarm. The project received funding from a number of companies involved in supplying equipment and by the Swedish Department of Energy.

	Unit Storage Costs £/GJ	
	Daily Cycle	Annual Cycle
Above ground storage		
Compressed cylinder	0.9	240
Metal hydride	1.1	130
Liquid hydrogen	1.3	12.3
Underground storage		
Depleted gas well or aquifier	0.31	2.70
Dissolved-salt cavity	0.32	6.70
Mined rock cavern	0.34	13.10

Hydrogen storage costs (1983 prices): Source Ref.1

Another innovative scheme, in the village of Silberstedt, West Germany, is the world's first wind powered petrol station. The wind turbine (a 200kW Vestas machine) provides all the petrol station's electricity, some directly, the rest by an internal generator fuelled by hydrogen. The hydrogen is produced using surplus electricity from the wind turbine and stored in tanks. Hydrogen is also sold as fuel for converted cars. West Germany is now pouring millions of D-Marks into R&D of this technology.

Other W.German projects include a solar hydrogen scheme in Bavaria, using photovoltaic cells for electrolysis; and in Hamburg a fleet of buses running on hydrogen is planned for 1996.

Recent improvements in electrolyser design include the development, by Asea Brown Boveri, of a solid polymer electrolyte which improves efficiency and reduces the electrolyser size by about 90%; and the Billings Corporation in the USA have developed a so-called 'laser cell' (named after the production method) which will act as an electrolyser and also reverse the process to operate as a fuel cell producing electricity directly from recombining hydrogen and oxygen.

Through projects and developments like these, the technology necessary for a move to hydrogen is being established and people's wariness of hydrogen, based partly on the vivid images of the Hindenburg disaster, are also being overcome.

Areas for possible future development include catalytic photolysis - the use of solar energy to directly split water into hydrogen and oxygen - where a number of possible methods are being investigated.

Hydrogen is still more expensive than other fuels, but improvements in electrolysers and other developments are helping to reduce costs. If the full cost of environmental damage is taken into account then hydrogen from renewables is already cheaper than other energy sources. Many governments and commercial companies are now seriously looking at hydrogen as a fuel for the future, and though it is not yet assured a growing place in the energy market, it does seem that once again everyone is out of step but our Department of Energy! □

Reference

(1) *The future role of hydrogen in the UK energy economy* by K F Langley. ETSU R15, HMSO, June 1983.

Considerable quantities of low and intermediate-level waste comes from sources other than the nuclear industry. Patrick Green, Friends of the Earth's Radiation Campaigner, examines the lack of management of non-nuclear generated solid radioactive waste.

Waste not want not

THE nuclear industry is not the only source of radioactive waste in the UK. Other organisations such as hospitals, universities, research facilities, and industry also produce waste, as does the decontamination of land. Organisations seeking to dispose of radioactive waste must be granted an authorisation by Her Majesty's Inspector of Pollution (HMIP) under the Radioactive Substances Act 1960 (RSA60).

At present around 1400 organisations, in England and Wales, have been authorised under the RSA60 to dispose of radioactive waste, either by discharging it directly into the environment (as liquids or gases) or as solid waste. In addition to these known sources of waste there is an unknown number of contaminated land sites that if decontaminated could give rise to large volumes of wastes in need of management.

In terms of volume of solid wastes produced (for both the low and intermediate categories) the waste from the non-nuclear users is approximately equivalent in volume to that generated by the nuclear industry, excluding the volumes of waste generated by reprocessing.

Low-level waste

The Radioactive Waste Management Advisory Committee (RWMAC) have estimated, in their 9th report, that by the year 2030 228,000m^3 of low level waste (LLW) will have been generated from research, medical and industrial users, compared to 208,000m^3 from the operational requirements of the nuclear industry. Therefore, in terms of operation of a facility the non-nuclear users produce more waste than the nuclear industry.

For LLW arising from decommissioning before 2030, 37,500m^3 are estimated to arise from non-nuclear users compared to 162,000m^3 from the decommissioning of nuclear stations. However, this does not include the possible volumes arising from the decontamination of contaminated land.

For instance during 1989/90 the decontamination of the Laporte site in Ilford, Essex (*SCRAM 65*) has led to the production of approximately 52,500m^3 of radioactive waste. Of this just over 50,000m^3 has been classified as 'de-minimus' waste and has been sent to a landfill site. Around 1.5m^3 of intermediate level waste (ILW) has been sent for storage at Harwell. The rest was originally due to be sent to Drigg but the site was unable to accept either the volume or the amount of radioactivity. In the end, 2000m^3 of thorium waste was sent to a landfill site for controlled waste under a specific exemption order of the RSA60. The remaining 50m3 of waste, containing thorium and radium is due to be sent to Drigg. Although the volume seems small, in terms of amount of radioactivity this waste is equivalent to around one sixth of Drigg's annual authorisation.

Intermediate-level waste

In terms of intermediate-level waste (ILW), RWMAC estimate that 16,200 m^3 will arise from non-nuclear users compared to 23,500m^3 from the nuclear industry. For decommissioning wastes produced before 2030, 960m^3 have been estimated to arise from the nuclear industry compared to 17,000m^3 from non-nuclear sites. Therefore, in terms of the total volume of waste generated by 2030, including decommissioning wastes, the volumes from non-nuclear users are predicted to be larger than from nuclear stations, 33,200m^3 compared to 24,500m^3.

For both of these categories the volumes of decommissioning wastes from the nuclear industry will increase post 2030.

High-level waste

For high level waste (HLW), the non-nuclear users are also predicted to generate 148m^3 of waste.

The purpose of these comparisons is to demonstrate that the non-nuclear users are a major contributor to the production of the radioactive waste in the UK. Yet at present there is no clear government strategy for managing this waste which is generally 'dumped' by one of several routes:

i) Solid wastes with an activity of less than 0.4Bq/g, or for organic solvents containing less than 4Bq/l of tritium or Carbon-14 can be exempted from the Act.

ii) Solid wastes containing less than 400kBq in any 0.1m^3, or 40kBq per article, can be disposed of with ordinary domestic refuse;

iii) by incineration (the resultant ash is then dumped by one of the other routes);

iv) special precautions burials on local authority or private landfill sites (Note: local authorities have a duty to accept radioactive wastes sent to their refuse tips);

Estimated Volumes of Low Level Waste Produced until 2030

1. Operational Waste from:	Volume (m^3)
Reprocessing	560,000
Nuclear Industry	208,000
Non-nuclear	228,000
2. Decomissioning Wastes:	**Volume (m^3)**
Reprocessing	50,000
Nuclear Industry	162,000
Non-nuclear*	37,500

*Excludes waste generated by decontamination of land.

Source: RWMAC 9th Annual Report, 1988; Table 3.2b

v) disposal on-site may also be granted where the ownership of the site can "be assured for long enough for the radioactivity to decay to insignificant levels";

vi) disposal at Drigg;

vii) intermediate level waste is stored at Harwell awaiting the opening of Nirex's hole in the ground;

viii) liquid wastes can be discharged directly to the public sewer system, to rivers or to the sea.

A major difficulty in assessing the impact of non-nuclear generated radioactive waste is the general level of secrecy surrounding the RSA60. Information on the volumes, activity and environmental impact of non-nuclear generated waste being disposed of via these routes is not publicly available.

At present disclosure of information relevant to an activity carried out under the RSA60 is an offence. The maximum penalty for contravention is two years in prison. Quite clearly, this secrecy is a dangerous absurdity. Until very recently the level of secrecy even extended to the names and addresses of organisations with an authorisation.

Disposal problems

Even under current disposal routes, which are not acceptable in environmental terms, it is interesting to note that many non-nuclear users face a number of problems with radioactive waste management. The major problem is the unavailability of disposal routes. RWMAC commented recently, in its 10th report, "that many non-nuclear industry users of radioactive materials are facing increasing difficulties in finding disposal routes for their wastes ... Disposal at Drigg with its increasing costs is often the only practical option available."

This statement raises the question, if waste is not going to Drigg where is it going? Unfortunately, RWMAC does not seem to have any detailed information on waste disposal from non-nuclear sites. They comment, without presenting supporting evidence, that disposal at Drigg of wastes which could have been disposed of via a special precautions burial at a local authority site is a mis-use of the "limited capacity" of Drigg. Conversely, another unanswered question is whether special precautions burials or other means of disposal are being used for waste that should be going to Drigg but cannot because of its limited capacity.

Estimated Volumes of Intermediate Level Waste Produced Until 2030

1. Operational Waste from:	Volume (m^3)
Reprocessing	77,200
Nuclear Industry	23,500
Non-nuclear	16,200
2. Decomissioning Wastes:	**Volumes (m^3)**
Reprocessing	47,000
Nuclear Industry	960
Non-nuclear*	17,000

*Excludes waste generated by decontamination of land.

Source: RWMAC 9th Annual Report, 1988; Table 3.2b

An example of the problems involved in non-nuclear waste management is illustrated by the experiences of the new owners of the Ilford site. Here HMIP granted permission to develop the land as long as it was decontaminated. The waste was originally intended for Drigg, but because of the large volumes of waste generated by the decontamination the bulk of the waste will be disposed of via a specific exemption order in a landfill site.

The inability of Drigg to handle large volumes of waste and the difficulties involved in finding alternative means of management currently acts as a major disincentive to decontamination projects.

It is important to note that whatever the plans of Nirex they will have little impact on non-nuclear producers of radioactive waste. It is clearly unacceptable for such large volumes of waste to be treated in such an ad-hoc manner.

Storage

The Department of Environment's (DoE) current waste management strategy could best be described as one of quick disposal into the environment by whatever route is available. This is unacceptable. However, the lack of information available under the RSA60, makes it very difficult to develop a sane alternative. As a point of general principal it is clear that non-nuclear generated waste, along with nuclear generated waste, should be managed in properly engineered storage facilities.

Quite clearly the whole question of radioactive waste management for non-nuclear producers needs reviewing urgently. This means that:

1. The Government's Green Bill should be amended to allow any information about non-nuclear generated radioactive waste to be available on demand.

2. The DoE should undertake an urgent review of waste management regimes of non-nuclear users to assess the waste management practices, routes of disposal and volumes of waste that are currently being disposed of.

3. The DoE should initiate a national survey to identify the number and scope of radioactively contaminated land sites with the intention of indentifying the volumes of waste arising from decontamination that will need to be stored.

4. The Government should bring to an end the use of landfill sites and local authority refuse tips as disposal routes for non-nuclear radioactive waste.

5. Waste producers should have absolute financial liability for the decontamination of radioactively contaminated sites. Where waste producers are not identifiable, there should be a system of Government grants to assist decontamination.

6. The Government should formulate a national radioactive waste management policy which covers both the production and management of this waste. This should include on-site storage of nuclear generated waste and storage of non-nuclear wastes either at the nearest available store or in specially constructed stores.

7. The Government should urgently develop interim storage facilities for non- nuclear generated waste while the national waste management strategy is developed. □

Fuel poverty

A MAJOR new report connecting the issues of fuel poverty and global warming warns against using increased fuel costs to fight the greenhouse effect because this approach would take no account of the millions of people who already cannot afford to heat their homes adequately.

The report *Fuel Poverty and the Greenhouse Effect** produced by Neighbourhood Energy Action, Friends of the Earth, Right to Fuel and Glasgow Heatwise calls for a national energy efficiency programme costing £16 billion: "500,000 low-income homes should be upgraded each year (and completed by the year 2005) at an average cost of £2,500".

30% of the UK's households, with the lowest incomes, produce only 24% of our domestic carbon dioxide emissions. The report argues that "It is the better off households that are the polluters; the poor are already contributing through deprivation." What is needed is an investment programme to enable the poor to use fuel more efficiently, so that fuel poverty is reduced, without an increase in weekly expenditure or atmospheric emissions.

It agrees that increased taxation on energy will result in a drop in emission but "only at the expense of greater deprivation for those on low incomes". There are 6.4 million families in the UK who fall into the low income category. As a result of being cold, many homes are rife with condensation and the resultant mould. Condensation is not just pools of water on the window sill. It generates foul smelling mould that is unhealthy, causing asthma, allergies and bronchial diseases. "Any household forced to live in these conditions" says the report, "is already experiencing a polluted environment that can only be cured by adequate levels of warmth".

Among the specific recommendations made are:

- environmental and social policies should be integrated with an emphasis on capital investment in the more efficient use of energy in low income homes;
- the fuel industries should make a financial contribution, based on turnover, towards the cost of the programme;
- the energy efficiency standards of a property should be reflected in the rent, to provide landlords with an incentive to improve them, and to compensate tenants for living in homes that are expensive to heat;
- benefit levels should be related to the energy efficiency of the dwelling to assist claimants until their home is improved and to protect against real fuel price increases and;
- all electrical appliances should comply with minimum efficiency standards and be labelled to show their typical running costs.

Greeting the publication of the report the Director of NEA, Andrea Cook, said "It is an important reminder to all of us of the tragic extent of fuel poverty in this country. Whilst all the attention is on energy conservation as a means of saving the planet, everyone seems to have lost sight of what it can do to improve the quality of life for the poorest people. They already suffer the misery of cold homes and high fuel bills. With a comprehensive programme of practical home insulation we could prevent further the damage to the environment and to the health and happiness of millions of people on low incomes." □

*** Available from National Right to Fuel Campaign, 318 Summer Lane, Birmingham B19 3RL; £5.00.**

Inscrutable efficiency

JAPANESE progress in energy efficiency sets an example that the UK would be well advised to follow, according to a new report* from the Association for the Conservation of Energy (ACE).

Over 90% of Japan's primary energy is imported, mainly in the form of oil, so when the 1973 oil crisis hit, they were forced into action. They wanted two things: security and stability of supply, and reduced dependence on oil. In 1979 the Government introduced the Law Concerning the Rational Use of Energy. It provides a broad framework of fiscal, technical and educational measures which promote energy efficiency, encompassing the public as well as the private sector, and targeting individuals as well as organisations.

The report's findings are summarised in "Seven Lessons from Japan" which include:

- Increased economic growth does not have to mean a rise in energy demand. Since 1973 Japan has been growing at a rate of 4% a year whilst its total primary energy requirement has increased by only 1%. In other words it now takes 34% less energy to produce a unit of GNP in Japan than it did in 1973.
- Market forces alone are inadequate. Japan used financial incentives, information, standards and education to ensure that its programme was a success. "This recognition of the limitation of market forces is in contrast to the inconsistent policies adopted by British Governments during the same period", say ACE.
- The programme is the responsibility of the powerful Ministry of International Trade and Industry (MITI) which has the authority and the influence to ensure that energy conservation measures are implemented across all sectors. This is almost the exact opposite of the situation in the UK.
- Japanese law requires all companies whose energy consumption exceeds 17 tonnes of oil equivalent to employ 4 energy managers, who are required to pass an exam for state-approved energy managers.
- Drastic improvement in plant and appliance efficiency have made made as a direct result of the setting of standards by MITI.
- Japan has been the fastest-growing industrialised economy, and this success has been substantially aided by its success in improving energy efficiency.

The UK Government has estimated that energy efficiency could halve the nation's annual fuel bill of £40 billion. ACE believe that "If the UK is to reduce its trade deficit and to retain its position in the increasingly competitive single market, then it must learn these lessons from Japan, and make improved energy efficiency a national priority." □

*** *Lessons from Japan*. Available from ACE 9 Sherlock Mews, London W1M 3RH.**

US Efficiency

THE American public have given their seal of approval to the use of energy efficiency as a means to cut pollution, dependence on oil imports and the cost of energy, it has been revealed in a survey conducted by the Department of Energy (DoE).

The DoE have issued an interim report on their progress towards formulating a national energy policy which will lay down goals, inducements and penalties covering everything from how much oil should be produced domestically to the amount of light each watt of electricity should yield.

Energy Department officials argue that this comprehensive policy is necessary because of Congress' reluctance to to take the initiative in the absence of a crisis.

The report contains written submissions from 1,000 individuals and organisations and summaries of the testimony of 375 witnesses at sixteen hearings held across the country. "This process is unique at the federal level this is the first time in my memory that the federal government has involved the public in such a direct way in the development of a national strategy", said Energy Secretary Admiral James Watkins. It contains the thoughts of business executives, academics and pressure groups on a whole host of energy options including: oil; gas; coal; nuclear fusion and fission; renewables; and energy efficiency.

It is hoped a comprehensive plan can be established early next year, Watkins comments "the hardest choices lie ahead". □

Greenhouse effect

GLOBAL WARMING has left the annals of science fiction and has become science fact: the prestigious Intergovernmental Panel on Climate Change (IPCC) has confirmed that humanity is destablising the natural greenhouse effect with potentially disastrous results.

Over 300 experts from 40 countries, who had been drawn together to review the evidence for global warming, concluded that "The greenhouse effect is real; even without man-made contributions, natural greenhouse gases already keep the earth warmer than it would otherwise be.

"Man-made emissions are substantially increasing the atmospheric concentrations of the greenhouse gases: carbon dioxide, methane the chloroflourocarbons, nitrous oxide and tropospheric ozone. These increases will lead to a warming of the earth's surface."

John Houghton, chief executive of the British Meteorological Office and chair of the IPCC working group responsible for the report, described it as "a remarkable scientific consensus: fewer than 10 scientists disagree".

Carbon dioxide is the main player in global warming, producing over half of the effect. It and other long lived gases "adjust only slowly to changes in emissions". They warn that present day emissions "of these gases are committing us to increased concentrations for decades to centuries. The longer emissions continue at present day levels, the greater reductions would have to be to stabilise at a given concentration."

The long lived gases will "require reductions in man-made emissions of 60-80% to stabilise their concentrations at today's levels; methane [a short lived gas] would require only a 15-20% reduction".

Business-as-usual

If we choose to ignore the warnings and continue with 'Business-as-Usual' the IPCC estimate that over the next century the rate of change in temperature will be between 0.2 and 0.3°C resulting in a temperature rise of about 4°C. Also, sea levels will rise between "9cm and 29cm ... by 2030, with a best estimate of 18cm, and 28cm to 96cm higher by 2090, with a best estimate of 58cm; due mainly to the thermal expansion of the oceans and the melting of some land ice".

Ecosystems, they say, "will be affected both favourably and unfavourably by a changing climate and by increasing carbon dioxide concentrations. If climate changes rapidly the composition of ecosystems will change and some species will be unable to migrate or adapt fast enough and may become extinct."

There are still some holes in the scientific picture of the world's climate system. Filling such holes is particularly important in forecasting what will happen to specific regions rather than giving a general view. The IPCC calls for further work to:

- understand better the various climate processes, particularly those associated with clouds, oceans and the carbon cycle;
- improve our monitoring of a number of climate variables on a global basis, and further investigate changes which took place in the past;
- develop improved computer-based numerical models of the earth's climate system and;
- increase support for national and international research activities.

Just five hours before the publication of the IPCC report Mrs Thatcher made a long awaited, and eagerly anticipated speech. It was a disappointment. Speaking at the opening of the UK's showcase Hadley Centre for Climate Prediction and Research, she said "Providing others are prepared to take their full share, Britain is prepared to set itself the very demanding target of reductions of up to 30% in presently projected levels by the year 2005." This means by the year 2005 we will be back to 1990 levels of CO_2 emissions. There is a great deal of curiosity as to how the Government will achieve such reductions without passing legislation which harms the electricity privatisation or their much loved 'car economy'. This will not be made clear until the environment white paper is published in September.

David Gee, the new Director of Friends of the Earth, greeted the announcement saying "If the rest of the world adopts your targets we will fail to control global warming ... It will also send the wrong signals to developing countries, which will be quick to point out that Britain has the expertise and the resources to make big savings in greenhouse gas emissions. Underestimating what has to be done could cost us dear, in the long run."

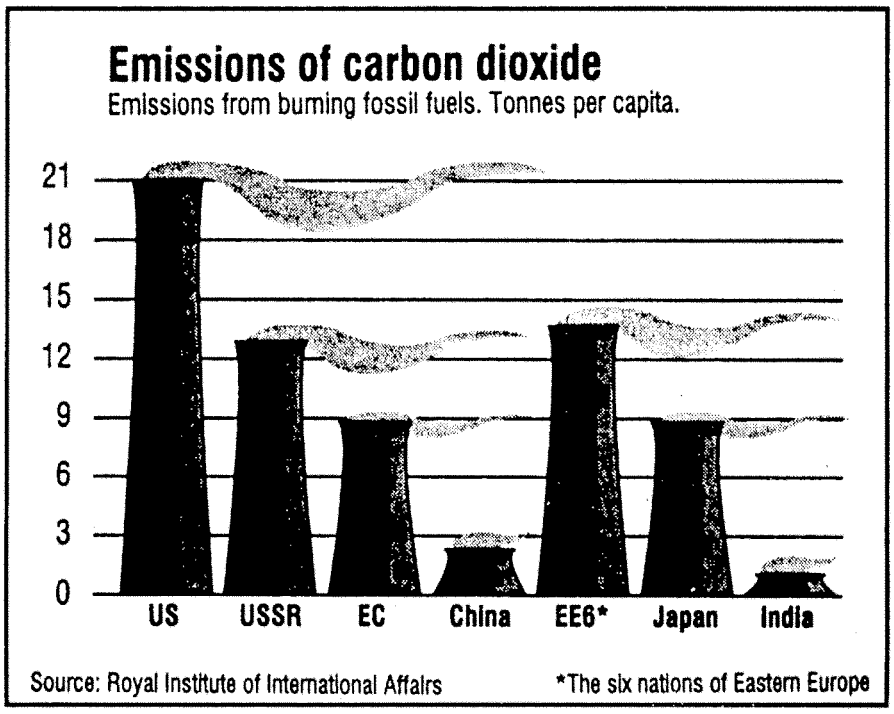
However, other countries in Europe have adopted tougher standards than those boasted by Thatcher, West Germany for example actually intends to cut its present day emissions by 25% by 2005. Clearly the Prime Minister had one country in mind, the United States of American. America produces about 20% of the world's CO_2 emissions and so far have said little on the subject of cutting their emissions.

US intransigence

Bob Watson, a NASA scientist involved with the first IPCC working group, believes that "The majority of US scientific thinking is behind this report. I'm confident that the US administration will take it seriously." However, President Bush's advisors - science advisor Allan Bromley and environmental quality advisor Michael Deland - can still be heard to recite scientific papers that cast doubt on global warming, as does the US Chief of Staff, John Sununu, and the budget director, Richard Darman.

The two other IPCC working groups have yet to produce reports. One is studying the potential effects of climate change and the other is attempting to formulate policy and response strategies. The latter is reported to be having serious difficulties. Both will report to the full IPCC meeting in Stockholm in August.

As the cold war thaws, it may be that its successor has already been found. But this time environmental destruction on an unprecedented scale is a reality, not just a threat, with unprecedented co-operation on an international scale being the only possible answer. □



Severn consultation

THE latest studies into a tidal barrage across the Severn Estuary are now up for public consultation, writes **Max Wallis**. A recent meeting sponsored by Friends of the Earth in Penarth, at the proposed landfall on the Welsh side, sets the scene.

The favoured 16km tidal power scheme, running from Lavernock Point to Brean Down, has 216 bulb turbines, each 9 meters in diameter, is capable of delivering a peak 8,640 MW, seven times that of the near-by Aberthaw coal-fired power station. The design uses reinforced concrete caissons built in shore-side yards and floated into place. It would run in between Flatholm and Steepholm islands, with its main shipping lock on the Lavernock side. The present design of the lock would allow for 70,000 tonne vessels, and therefore preclude future shipping over twice this size that might deliver ore to Llanwern steelworks, for example.

Arthur Hooker, a retired engineer, outlined several drawbacks of the scheme: the cost of £8.2 billion is underestimated - not only would delays in such a huge project be probable and very costly, but interest and inflation during the 7 years construction would raise the nominal cost to £15bn; substantial new 400kV power lines, through some sensitive areas, are required; shipping to Portbury and Sheerness will be disadvantaged by the 1m drop in high water and; there would be danger for small craft and pleasure boats seaward of the barrage, under the severe currents and turbulence created.

As an alternative, Hooker outlined the smaller tidal power scheme which could be sited at the English Stones near the position for the new Severn Bridge. That scheme, investigated jointly by Wimpey and Aitkins, was dropped in 1986 because they believed the basin would rapidly silt up. However, a new study has shown that siltation can be cut by 75% if the water intake is via high level sluices. Studies have been restarted. It would generate only one fifth of the power, but at 1/7 to 1/8 of the cost of its big brother. Just 5.3km long, it would have 30 turbines of 6.6m diameter, and could be combined with a new rail crossing as it runs above the Severn tunnel. It is twice the size of the proposed Mersey Barrage. However, as the respective tides are 4 hours apart, the two barrages would complement each other.

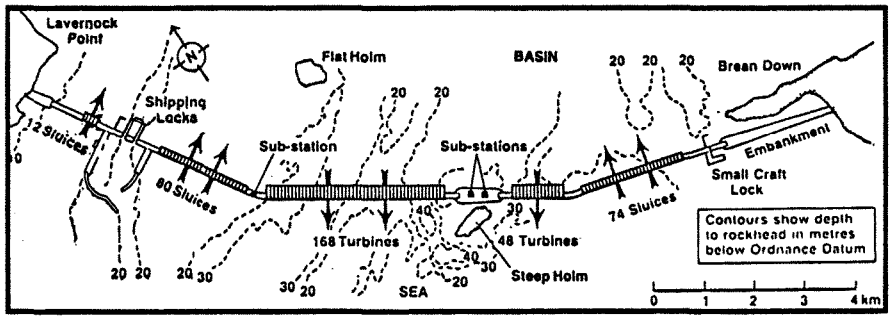
The second speaker, Dr Chris Mettam, biologist at Cardiff University, presented the ecological arguments. He described how the salinity decreases upstream, from 35 units in the Irish Sea to 20 or 25 units at Nash Point, 15 miles below Barry, and 5 or 10 by the Severn Bridge. The salinity also varies with the state of the tide, which makes things difficult for plants and animals. He reported that the number of species of creatures like worms decreases greatly above Nash Point.

The soft mud deposits, habitat and feeding grounds, that exist above Cardiff are steadily being eroded. Judging by the height of the sewage pipe supports, it seems that 6ft has disappeared since the 1920s. The cliffs below Cardiff are also eroding.

The estuary supports large numbers of birds, but their density is low.

Severe currents and wild waters in the Severn impoverishes its biology compared with other estuaries, concluded Mettam. With the proposed tidal barrage and reduced tidal range, the biology should become richer, like for example the Tayner estuary. Particular species might suffer, but a more diverse ecology should develop.

While further studies are needed, it seems that in ecological terms, the tidal barrage would be beneficial overall. It would also serve to protect the estuary from storms and sea level rise. But, in economic terms it is a non-starter. If Britain is to use its tidal resources, the smaller scale Hooker scheme is the type of project needed. Penarth FoE have decided to press for its consideration as a practical tidal project. □



Mersey mayhem

A BARRAGE across the Mersey would jeopardise thousands of jobs in the shipping, chemical and oil industries according to a report produced by the the Ship Canal User's Association (Scusa).

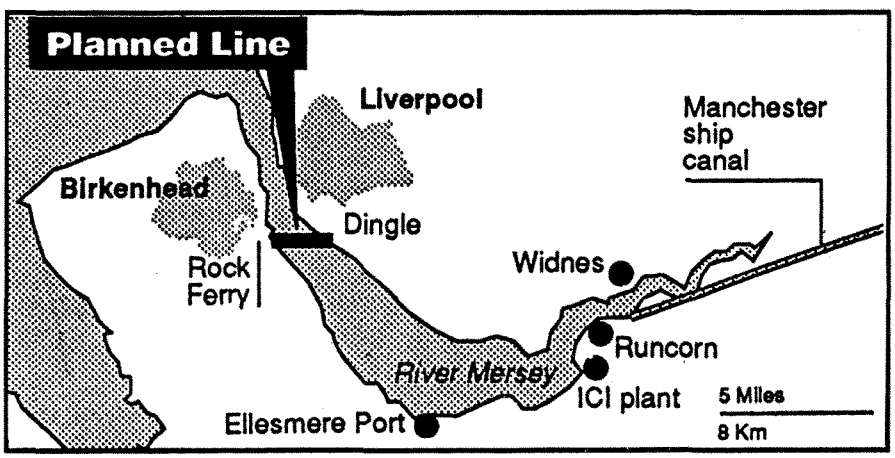
The report, a copy of which has been sent the the Energy Secretary, John Wakeham, argues that the barrage would hamper the passage of ships between the Mersey and the Manchester Ship Canal, that Liverpool's Garston docks could not survive the disruption caused during construction, and that there would be an increased risk of ships carrying dangerous cargoes being stranded on sandbanks.

Oil and chemical complexes up the estuary from the proposed barrage site also face problems, especially during the four year construction period, according to Scusa, threatening billions of pounds worth of investment. Michael Armitt, chair of Scusa's Mersey Barrage subcommittee, is confident that the oil and chemical industries will join in the fight against the proposal.

The main problem lies in the difficulty in alternately fighting and using the estuary's massive 10m tide to gain access the the canal. Currently, access can be gained for only three or four hours each tide, Scusa say that during construction this will time will be halved, and the movement of the 6,000 ships which use the canal annually will be seriously effected.

Safety will also be compromised because there would only be a small margin for delay in negotiating the two sets of locks, this say Scusa could result in ships being trapped in the estuary during low tide. Many of the ships carry dangerous or potentially polluting chemicals and there could be disastrous results if any went aground.

John Wakeham and the Government will now be placed in the unenviable position of being caught between the powerful construction and chemical lobbies. □



Solar developments

WORK being conducted at Israel's Weizmann Institute is taking the idea of commercial solar power nearer to becoming a reality.

The Institute has been studying solar power for many years, but the upsurge in concern over the sate of the environment, and in particular global warming, has led to the construction of a large new experimental facility.

The work can be divided into three main areas: improving the efficiency of converting solar power into electricity; converting it into chemical forms of energy; and converting solar energy into non-heat energy for a variety of industrial uses such as photochemistry.

Stacked in four rooms, in a new tower, four experiments derive their power form 64 computer controlled mirrors which can deliver up to 3,000kW of concentrated sunlight. Previously the Institute could only harness 20kW of the sun's energy.

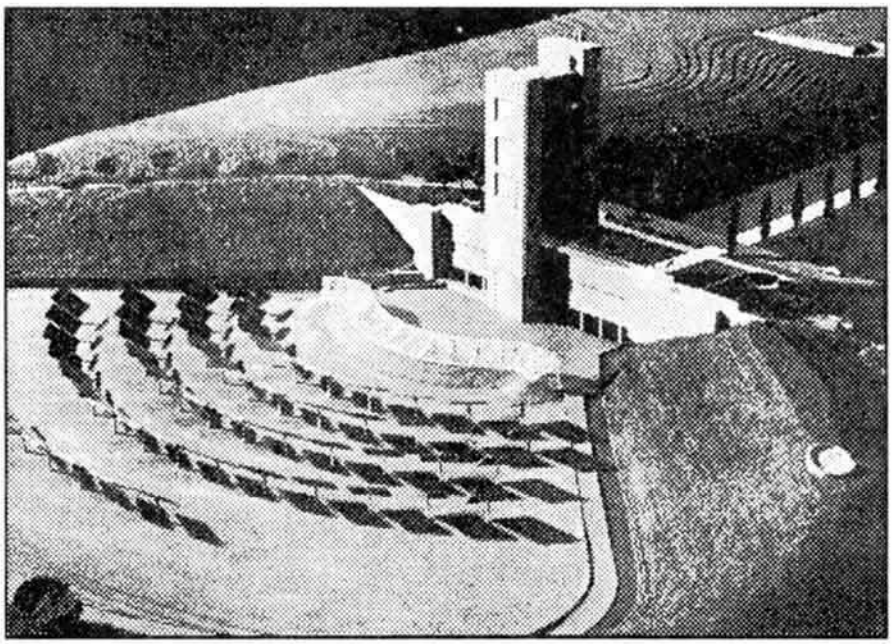
Half of the facility is geared towards electricity generation. The first project is attempting to improve the efficiency of already established photovoltaic cells. The second is examining the feasibility of using the sun to power a gas turbine. A one metre square mirror focuses the sunlight from the field mirrors onto a heat box which houses 80 ceramic pipes, through which compressed air is passed. "The trick is not the turbine. The trick is to be able to to heat the air up to high temperatures", says Prof Israel Dostrovsky, head of the Institute's Energy Centre.

They are also trying to produce chemical fuels. Dostrovsky comments, "All fossil fuels are produced by nature storing [the sun's] energy in chemical forms. But can we do it, not over millions of years, but in seconds? The answer is that we can." Ideally Hydrogen would be produced, however the necessary temperature of 2,000°C to make hydrogen from the sun and water is very difficult to achieve.

Instead they are looking at manufacturing a mixture of hydrogen and carbon monoxide by combining methane and carbon dioxide using solar energy. This can be achieved at half the temperature required for hydrogen production. The gas can be burnt, according to Dostrovsky, to extract heat; the original methane and CO_2 can be reclaimed to start the process over again. Work is about to begin on a 400kW design after encouraging results were obtained from an early 10kW prototype.

The fourth project involves trying to convert solar energy into laser light, which can be used to improve the efficiency of the photochemical process, which already has proven industrial applications.

Dostrovsky believes that the barrier to using solar power is not technological: "the reason the sun is so little used today is the lack of work done on it. It has been almost zero." □



Green light

ENERGY efficient lighting could reduce the UK's electricity demand by 8%, cut the emission of greenhouse gases by 1.4% and bring down the emissions of acid rain gasses by 5% according the Department of Energy's Energy Technology Support Unit (ETSU).

The ETSU study, ***The Abatement of Gaseous Emissions by Energy Efficient Lighting****, says the UK could halve its annual lighting bill by using "currently available energy efficient technologies". Of this more than half would come from switching to compact fluorescent lamps from filament lamps.

Because the public and industrial sector are the biggest users of lighting, they have the biggest scope for improvements. Although fluorescents already account for about 55% of their lighting they could still save around 7.1TWh a year by switching the remainder over to compacts. Electronic ballasts which are currently only used in about 5% of the commercial and public market's lighting could further reduce demand by 2.5TWh. More effective energy management offers a further 2.3TWh reduction.

The domestic sector stands to make the biggest financial savings, because incandescents provide more than 90% of its lighting. ETSU calculate that it is cost effective to replace any incandescent bulb with a compact if the light is used for more than 250 hours a year, and that this is the case for 93% of domestic sector lights. By adopting the new energy efficient technology, householders could cut their lighting bills by 66%. However, ETSU concedes that there are considerable barriers to full marketpenetration.

The main problems are that most consumers are either not aware of compacts or are put off by the high costs. Compact fluorescent lamps can be up to 30 times more expensive than conventional bulbs. This creates a "vicious cycle ... in which the energy-efficient product is neither widely available nor widely demanded". □

*** Energy and environment Paper No. 2. the Abatement of Gaseous Emissions by Energy Efficient Lighting by N J Eyre. Available ETSU, Building 156, Harwell Laboratory, Oxfordshire OX11 0RA.**

Wind and water

YORKSHIRE Water have applied to Bradford District Council for planning permission to build a small wind farm on land adjoining the Chelker Reservoir, near Ilkley.

They hope to produce one quarter of the electricity consumption of their two pumping stations from 4 wind turbines. Costing £1m the turbines are expected to produce over 3 million units of electricity a year. Yorkshire Water believe that the turbines will significantly reduce their costs and plan to sell any excess power to the grid.

It is believed that other recently privatised English and Welsh water companies are also studying wind power. □

REVIEWS

Green Energy: A non-nuclear response to the greenhouse effect
by Dave Toke
Green Print & SERA; 1990, 136pp, £5.99

"A world in which poverty is endemic will always be prone to ecological and other catastrophes."
The Bruntland Report.

Being green for the author is more than just environmentalism, it is about social issues also. We cannot simply attack the problems of the environment by pushing the poor further into the gutter. He believes "that it is possible to achieve at least modest growth in the context of the type of sustainable development described by the UN sponsored Bruntland Report. We must fight the poverty in both the industrialised world and the developing world."

Sustainability is the key to unlocking his particular vision of a Green Energy future. This fundamental belief rules out nuclear power: "reliance on nuclear energy means reliance not only on an energy source, uranium which is finite, but also on an energy source that brings with it the insoluble problems of nuclear waste, the risk of horrific accidents and the political dangers of nuclear proliferation and nuclear terrorism."

There is a sustainable energy path which "relies, in the long term, on renewable energy (natural sources of energy which do not run out), and allows rising living standards." He warns the traditional left that they must cast aside their attachment to coal as well as oil and gas.

A large proportion of the burden of trying to get out of the greenhouse trap lies with the industrialised world, which will have to formulate policies that will aid the developing world: "The industrialised nations must radically reduce their fossil fuel emissions and help developing nations use energy efficiently as well as assisting their deployment of renewable energy sources."

Table 5.1 Shares of UK primary energy consumption in 'moderate scenario (PJ)

	1987	*2025*	
Coal	3020	1245	
Oil	3375	2125	One MTCE is taken
Gas	2243	1365	to equal 26.4PJ.
Nuclear	525	–	
Renewables	54	1545	
Total	9217	6280	

The contribution from renewables (PJ)

	Heat supplied or fuel saved (PJ)[2]
Wind (onshore and offshore)	650
Tidal	150
Wave	5
Hydro	55
Geothermal	200
Biofuels	425
Solar	60
Total	1545

Energy efficiency and renewables will be the central planks of any sustainable energy strategy throughout the world, says Toke. He goes on to outline various technologies and tactics that can be used to pursue a sustainable energy strategy. This takes us through Least Cost Planning, Combined Heat and Power, Wind Power, Wave Power, etc. Many of the arguments, facts and figures will be familiar to regular SCRAM readers. It is however constructive to see them brought together in one volume.

He gives two scenarios to show how a Green Energy strategy could work. named the 'moderate' and 'radical' strategy. The radical strategy assumes that the UK will become as energy efficient as technically possible by 2025. However if either strategy is going to be used it would most likely be his "Moderate Scenario" in which the UK would use 32% less energy than in 1987 (see table).

The book provides a useful starting place to all who are worried about the environment and the role energy plays in it, and also highlights many of the areas which could cause major difficulties in finding a global solution to the greenhouse effect.

MIKE TOWNSLEY

Uncle Henry's Last Stand
by Alasdair McKee.
Richard Drew; 1990, 197pp, £4.99.

"A story of Death, Misanthropy and Apocalypse."

Alasdair McKee's first novel is set in the weeks preceding Armageddon, and tells the story of the relationship which develops between Henry Dundas and his newly orphaned nephew, Roderick. Although the book is not "some grand epic of the Apocalypse", the end of the world has "a small, but not unimportant part to play."

Henry Dundas is "a self-proclaimed misanthropist", feared and shunned by most of his neighbours and obsessed with prophesizing the end of the world. When Roderick is sent to live with him in his remote Highland glen, Henry's cynicism and indifference lead him to believe he is re-enacting "Kidnapped". Contact with other inhabitants of the glen only serve to fuel his imagination further and, like his fictitious hero David Balfour, he tries to escape across the hills.

Eventually, uncle and nephew begin to enjoy their inflicted cohabitation. But has their adjustment to each other come too late? Neighbours and other unseen forces are already beginning to work against them.

In the impossible but admirable figure of Uncle Henry, McKee gives us a glimpse of the sane and the ridiculous. The story is told through the eyes of Roderick, a solitary type with a lively imagination. McKee's keen observation and comic wit penetrate the surface of social interaction, laying bare the relationship in all its stages and complexities.

The concluding chapters lead the reader through a series of unexpected twists and turns to the point where Uncle Henry has the last laugh ... or does he?

From the lighthearted beginning to the tragic end, McKee holds on to his sense of the ridiculous, and does not fail to make his point.

The funniest serious book I've read in a long time.

HELEN LECKIE

REVIEWS

Hothouse Earth - The Greenhouse Effect & Gaia
by John Gribbin.
Bantam Press; 1990, 273pp, £14.95.

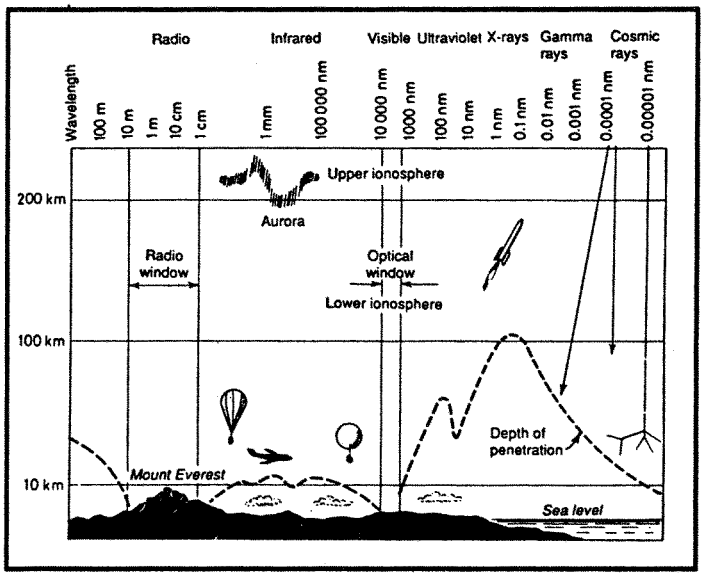
Winds of Change -
Living With The Greenhouse Effect
by John Gribbin and Mick Kelly.
Hodder & Stoughton; 1989, 162pp, £9.95.

Over the years John Gribbin, a freelance writer and physics consultant to New Scientist, has had access to many of the world's leading scientists, this access makes Hothouse Earth a very interesting volume.

It is an attempt to explain the greenhouse effect - which is in-fact a natural process which keeps the planet warm enough to sustain life - against a back-drop of the natural climate process, a task that any lesser mortal may have shied away from. By and large he succeeds. This success can lead to severe depression on the part of the reader. The scope of the problems we now face are bewilderingly complex.

Apart from declaring 1988 the warmest year since 1988, there is no doubting the calibre of evidence presented here. It is, so far, the best scientific and populist account of the greenhouse effect, with only a limited amount of space being donated to the rhetoric of world politicians. Yet it is with these politicians that the future lies. It makes a pleasant change from the hit-and-run newspaper coverage that the greenhouse effect has up until now attracted.

Winds of Change is refreshing in that it not only describes the problem but proposes some solutions. It is the companion volume to Central Televisions compelling documentary "Can Polar bears Tread Water?" and is very easy to read, and beautifully presented.



Radiation at different wavelengths penetrates the atmosphere to different depths

"That the world spends over $2.5 billion a day on its military establishments, dwarfing into insignificance expenditure on environmental protection, health care and development aid, is contemptible", we are told. "It is misplaced priorities and false preconceptions of what constitutes security that give rise to the greenhouse problem."

There are ways in which the greenhouse effect can be fought, and the book contains many excellent suggestions. But, perhaps, its most poignant paragraph is its last: "This is the challenge that global warming presents - a challenge, and an opportunity to create a more just, equitable and safer society. What value is there in modern civilisation - what have we gained - if the quality of life that has been developed is not available for all?"

MIKE TOWNSLEY

DEATH NOTICE

DEMOCRACY:-
Killed tragically by Malcolm Rifkind on Tuesday 15 May 1990*.
Sadly missed.

Chief Mourners:
Highland Regional Council;
Caithness District Council;
and the 74% who opposed Nirex in the Caithness referendum.

No flowers.
Donations to S.A.N.D.
(Scotland Against Nuclear Dumping)
Treasurer, George Clayton,
22/2 East Castle Road, Edinburgh EH10 5AR.

*Malcolm Rifkind, Secretary of State for Scotland, overturned Highland Region's refusal to allow the UK Atomic Energy Authority permission to carry out test drilling at Dounreay in Caithness, on behalf of Nirex, to 'check' the rock's suitability for the dumping of nuclear waste.

Grit and Diamonds:
Women in Scotland Making History 1980-1990.
Ed. Shirley Henderson and Alison Mackay.
Stramullion; 1990, 274pp, £5.95.

Stramullion, Scotland's only feminist book publisher, launched Grit and Diamonds towards the end of May. The book chronicles contributions made by women to recent Scottish history. It does not claim to be a comprehensive or impartial report, but chooses rather to focus women's chosen concerns in the form of their own verbatim reports.

The book contains 76 articles dealing with women's activities in the domestic, social, sexual, political, cultural and environmental areas. Three of these articles deal specifically with the environment; Mairi MacArthur, amongst others, stresses the 'women's dimension' which has been present in environmental campaigning and points out how the nuclear industry now target women and mothers in their advertising, due to their own specialised contribution. These chapters should be of specific interest to SCRAM readers.

Regardless of areas of specific or individual concern, Grit and Diamonds should be of general concern. The recurring theme of the book is that of united struggle and determination, and it should go some way to filling the gap sadly left by the media in general.

Women have certainly shaped the history of the past decade, Grit and Diamonds does not only record this, it re-affirms our links as women and gives us the strength to carry on into the nineties.

HELEN LECKIE

LITTLE BLACK RABBIT

The decision by the Secretary of State for Scotland, Malcolm Rifkind, to overturn Highland Regional Council's refusal to allow Nirex to drill test bores at Dounreay set LBR thinking. Highland Region said No! Caithness District Council said No! 74% of the voters in a Caithness-wide poll said No! Perhaps, though, Rifkind's decision was swayed by Nirex's interpretation of this overwhelming rejection of their plans; the vote showed "a measure of local support", they said, adding that "57% of the total electorate did not vote or voted in favour of the proposal".

If Rifkind appreciated this sephological somersault, he might like it less when similarly applied to his own position as MP for Edinburgh Pentlands. The total of those who did not vote or voted against Rifkind as their MP at the last General Election was a convincing 70%.

With all the fuss over drilling 6,000 holes at Dounreay in Caithness ("the tea bag county") local opposition is growing. Winnie Ewing SNP MEP for the Highlands wishes to throw herself under a Nirex bulldozer (though the deterrent effect of such a threat is debateable). Opposition groups have said they will use every means to oppose Nirex. But publicly Nirex and the UKAEA are happy to carry on the investigations into Dounreay's suitability as a nuclear dump, secure in the measure of local support - 15%.

UKAEA's public air of confidence, however, is not matched by their actions. Security at Dounreay is the responsibility of the UKAEA's own police force. The precise numbers of police and most details about their activities are top secret, but LBR has discovered some revealing news. The police force have secretly been visiting the nearby US naval base at Forss for training in riot control!

LBR has noticed that the Energy Technology Support Unit (ETSU), located within the Harwell nuclear research complex, get a touch upset when their impartiallity is questioned. Several months ago much amusement was caused when ETSU chose to refute suggestions that they were too closely connected with the nuclear industry by placing an article in, of all places, ATOM - the monthly magazine of the UK Atomic Energy Authority.

ETSU's image also emerges from the Salter's duck fiasco (scandal?) somewhat tarnished. LBR now avidly collects ETSU stories, and the latest on the list concerns ETSU's fuel cells project officer, Alan Mercer. When asked about ways of producing hydrogen to power fuel cells Mercer came up with an impressive list;

1. Nuclear power;
2. err ... ;
3. That's it.

So much for wind, wave, solar, tidal, ...

A well read rabbit, LBR was perusing the *New York Times* when he spotted an advert headed "Journalists: are you prepared to cover the next nuclear accident?" (Or as Nucleonics Week put it: "are you prepared to be covered at 'the next nuclear accident?'") The ad, offering reporters preparatory counseling on a $249 *Times*-produced video cassette, assumes there will be an accident, "minor" or "major", in any case serious enough for a well prepared scribe to come equipped with a dosimeter as well as a tape recorder. The ad says that the *Times* video coaches journalists "in clear, nontechnical language, how to take the responsible precautions that let newsgatherers do the job they want to - without misgivings". The closing moments of the cassette describe the use of various personal dosimeters and particle-filtering face masks. The on-screen advice that comes with the face mask demonstration: "Don't go where you know you'll need it."

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:

- ☐ £12.50 (ordinary)
- ☐ £15 (overseas)
- ☐ £30 (institutional)
- ☐ £5 (concession)
- ☐ £20 (supporting)
- ☐ £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.

Signed _____ Date _____

Wind power

The History

ROMANTIC, slow moving, sail driven, windmills spring to mind whenever wind power is mentioned. Yet, this could not be further from the reality of today's wind industry, which owes more to the 20th century aerospace industry than it does to the windmills of history.

Believed to have been first used in Babylon for irrigation, the idea of harnessing power from the wind arrived in the UK with the return of the Crusaders. At the height of their popularity, the late 18th and early 19th century, there was around 10,000 windmills operating in the UK. When electricity became the currency of energy the windmill faded into history.

Some engineers, however, tried to drag the windmill into the electric age. By and large they failed. But some impressive machines were built: in 1931 a 100kW wind turbine was built in Yalta, in the USSR, and in 1954 another 100kW machine was built in Costa Hill, Orkney. The availability of cheap oil and coal, and general ignorance of the environment, meant there was little incentive to keep developing wind power.

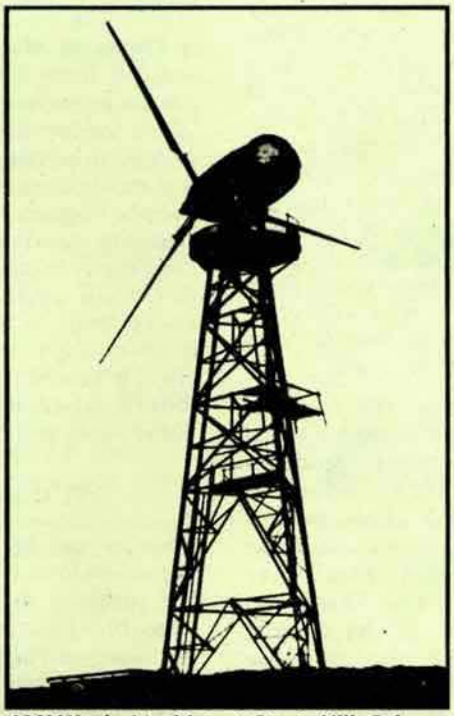
Renaissance

The wind renaissance did not begin until 1973, when the oil crisis, precipitated by the Yom Kippur war, forced the industrialised world to recognise the fragile nature of its energy system. Sadly wind was not considered for its non-polluting nature but for its potential in undermining the energy stranglehold of the middle east.

"Wind energy ranks as one of the most promising of the renewable energy sources for generating electricity", say the Department of Energy (DoEn). Although many countries around the world began investigating wind in the immediate wake of the crisis, the DoEn did not establish a programme until 1977. It is their view that, "if wind power is to make a substantial contribution to energy supply in the UK, then large, probably multi-megawatt, machines will be required."

In pursuance of their multi-megawatt dream they commissioned a 3MW aerogenerator (LS-1) on Burger Hill in Orkney, which is considered by many to be no more than a diversion. It is the largest operating wind turbine in the World, and a remarkable piece of engineering. When opening it, at the end of 1987, the then Energy Secretary, Cecil Parkinson, said the machine, which could provide enough electricity for 2,000 Orcadian homes, "could be a major step towards large-scale commercialisation of wind power". However, two weeks later he told Parliament "I cannot honestly see how we will generate large quantities of electricity from the wind." This gives a clear indication of the confusion shrouding the Government's renewable energy programme.

They now argue that "If predicted costs can be achieved, in principle it is possible that by 2025 onshore wind power could be supplying at least 10% of our electricity needs, and perhaps as much as 20% in the longer term."



100kW wind turbine at Costa Hill, Orkney

The British Wind Energy Association believe that 'predicted' costs less than 2p/kWh can be achieved now, with off-the-shelf machines - below those of the coal or nuclear industry. "20% of all generation is a reasonable target and there are even greater long term prospects", they say, calling for an urgent 4 or 5 year programme costing £172 million "not only because of the increasing power demand this country is facing but also for British manufacturers to retain their lead in world markets".

The world market is what has sustained the British wind industry. The great Californian 'wind rush' - where 83% of the world's installed wind capacity provides over 1.8 billion kWh of electricity, negating the emission of about 28,000 tonnes of sulphur dioxide, 17,000 tonnes of nitrous oxides and a staggering 5.6 million tonnes of carbon dioxide - provided a focus for James Howden of Glasgow. Howden have now pulled out of the wind industry, in which they were world leaders. And, although they lost an estimated £13 million on badly produced blades for the California's Altamont Pass wind farm, Alan MacLachlan, Howden Group Secretary, laid more emphasis on the poor home market than on their Californian experience for the Company's decision. Privatisation, he said, "has retarded the development of wind power". He is sceptical about the Government's commitment to wind energy: "It said it before and it said it again recently in privatisation, that wind power was a favoured source. However, nowhere is anything progressing particularly fast."

UK potential

The UK, Scotland in particular, has one of the best wind regimes in the world, yet all we have is plans for three 8MW experimental wind farms, none of which will be in Scotland. Whilst Denmark and Holland, who have far less attractive wind regimes than the UK, both plan to have 1GW of wind generated electricity by the turn of the century.

The UK programme to investigate renewables began in 1973 headed by the now deposed 'King of Nuclear Power', Walter Marshall, then Chief Scientist at the DoEn. By 1979 the Government's attitude to renewables was clear, Energy Paper 39 estimated that Nuclear Power would be contributing 71.6 million tonnes of coal equivalent (mtce) with all renewables providing a derisory 2.1 mtce. Even by 2025 renewables were only being credited with 8.8 mtce against the nuclear industry's 230 mtce.

The UK's attitude to renewable energy is perhaps best illustrated by a 1978 Central Electricity Generating Board internal memorandum, which leaked, "It is important to explore these alternatives to both satisfy ourselves that nuclear expansion is fully justified, and to demonstrate this to others, since groups opposing nuclear expansion have made substantial progress in the last few years."

To end on an optimistic note: the Government is back tracking on the nuclear dream: and there now seems no way that they could provide 71.6 mtce by 2,000. Wind, however, has a far shorter build time and could if given the political will fill a considerable amount of nuclear power's shortfall.

Environmental Impact

WHEN considering pollution from wind turbines there is no need to worry about hidden dangers. With the exception of environmental impact during the construction phase, the pollution from wind turbines can be classified as aural and visual ie. seen and heard.

Nobody wants to see a forest of wind turbines squatting on top of their favourite beauty spot. Inevitably there will be some people who are impossible to please. But, by using careful siting criteria and modern landscape architecture techniques it should be possible to minimise the visual intrusion.

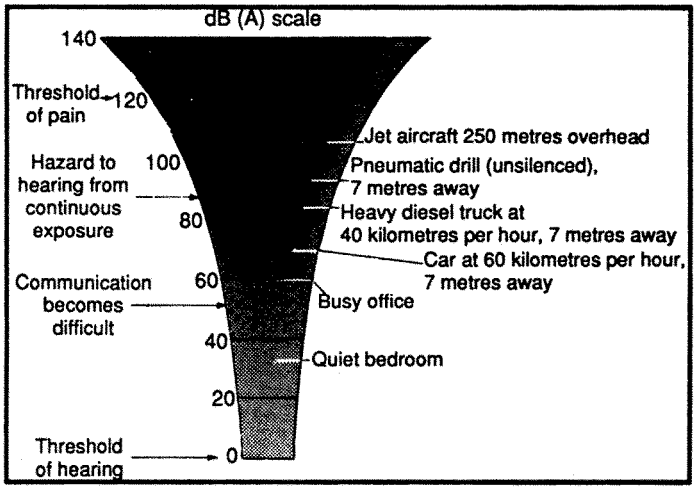
Malcolm Moss MP, during the Commons debate on Renewables (Oct '87), expressed the fears of many: "I too have reservations about peppering our countryside with 75ft high monster windmills. The prospect for the fens landscape is positively horrendous." To put this into perspective, it would take between 10,000 and 20,000 medium sized turbines to meet between 10 and 20% of the UK's energy demand, this is under half the number of electricity pylons which scar our countryside. It could also be argued that the prospect for the Fens, which is largely below sea level and on the coast, if we do not take measures to combat global warming is far from pleasant - Moss' descendants might have to go scuba diving to enjoy the beauty of the area.

Many environmental organisations, like the Countryside Commission, have also expressed concern about the impact of wind power. They are worried about National Parks, Sites of Special Scientific Interest, Areas of Outstanding Natural Beauty, etc. One local authority even went so far as to make planning approval on a wind turbine conditional on its being surrounded by trees. However, Alexi Clarke, a researcher at the faculty of Technology at the Open University, calculates that after discounting protected sites it would still be possible to produce between 10 and 20% of the UK's demand.

Noise

Dr Michael Clark MP asked at the Commons debate on Renewables "I wonder whether we want every beauty spot in the country turned into an electricity generating site with 100m blades making a noise like a helicopter every minute of the day." Most of the noise made by a helicopter comes from the engine. Wind turbines can be heard, but the level of noise is nowhere near that of a helicopter, most of the noise comes from the blades. The sound is more akin to that of trees blowing in the wind.

For example, the medium sized 250kW turbine at Illfracombe, Cornwall, produces about 70dB(A), which is roughly the same level of sound you would hear standing 7m from a car travelling at over 35 miles an hour. But, in the nearest house, 300m away, the noise drops to 32db(A), which is the same as the noise in a library. Indeed it is only in light winds that the turbine would be audible above the ambient noise. A buffer zone



of between 300 and 500m, depending on the size of the machine, would be adequate to isolate the noise completely.

Work on establishing a European-wide standard for buffer zones is on-going and it is expected that an agreement will be reached by the end of this year.

A flickering shadow effect coming from the turbines can cause serious problems. When the turbines are close enough to housing, shadows cast inside houses can attain a strobe frequency capable of inducing disorientation and even convulsions in the 2% of the UK population who are epileptic. Although this is an unlikely and extreme effect it should not be overlooked when establishing buffer zones around turbines.

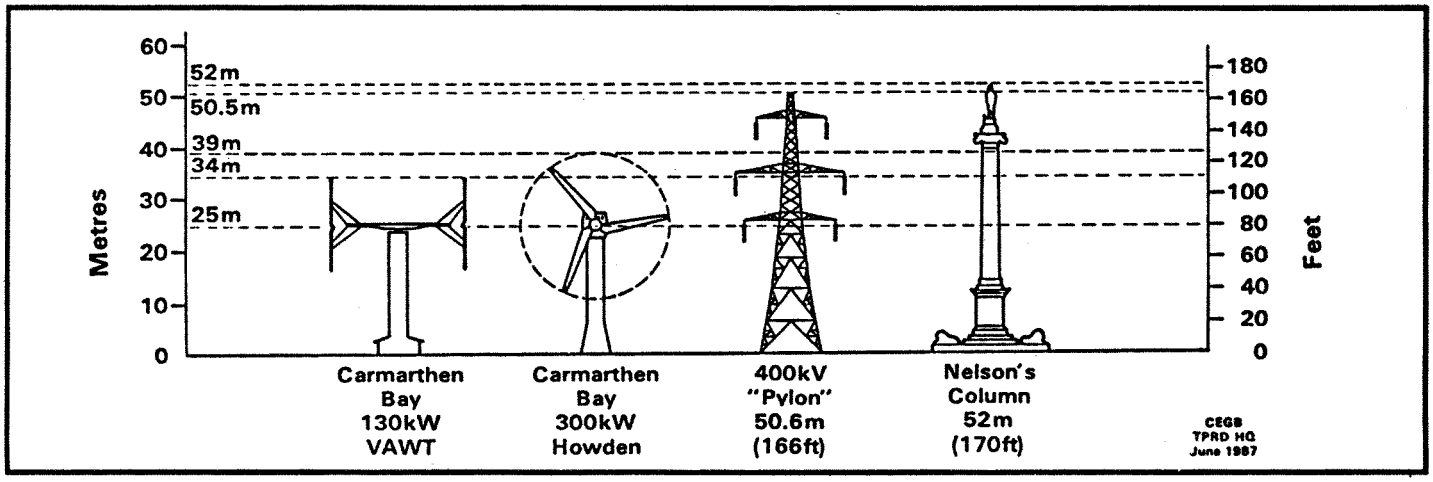
Wild life

There would be a minimal impact on local wild life, but the turbines do present a possible hazard to bird populations. The presence of a turbine in a bird flight path could dissuade them from using it and thus alter the habits of local birds. Studies being conducted by the North of Scotland Hydro Electric Board and the Royal Society for the Protection of Birds (RSPB) at Burger Hill, where there are several turbines adjacent to an RSPB sanctuary, have so far indicated no adverse effects.

Electromagnetism

Although not strictly a pollution problem, wind turbines can interfere with electromagnetic transmission. This could cause a public outcry because the sacred TV is particularly susceptible. Incorporating booster systems on TV transmitters and receivers can alleviate this problem and would cost only a small fraction of the turbine. They can also interfere with aircraft and shipping navigation systems. However, the shadow effect for interference is only effective up to a distance of 2km, so it should be easy enough to avoid sensitive areas.

No energy system is without environmental impact. A choice has to be made. Do we prefer to continue generating electricity by conventional means and destroy the global environment or are we prepared to chose small scale local pollution which we can see and hear?



Windfarms

MARCH 23rd 1988 was a significant day in the wind power calendar. At the the British Wind Energy Association's annual conference Walter Marshall, then head of the CEGB, announced the Board's intention to build 3 wind farms in England and Wales. The projects will now be run by National Power and PowerGen, the CEGB's private successors, and jointly funded with the Department of Energy.

With a total capacity of about 8MW the farms will have around 25 medium sized machines and produce enough electricity for 5,000 people. The turbines will be arranged in rows covering an area of about 2km^2, and although this seems like a large area, the space between the turbines can be used for grazing or farming.

The main reason for the windfarms, claim the Board, is to gain further operational experience and to gauge public acceptability. They promised full public consultation on the developments.

The three sites chosen were Capel Cynon in Wales, Cold Northcott in Cornwall and Langdon Common in the North Pennines. However, the promise of full public consultation is proving to be hollow.

The choice of Langdon Common sparked of a fierce controversy. It is an Area of Outstanding Natural Beauty (AONB), a Site of Special Scientific Interest, and because of its special ornithological interest it is also a Special Protection Area. The Countryside Commission, the Nature Conservancy Council (NCC), the RSPB and the Council for the Protection of Rural England have all voiced strong opposition to the project.

Ecological concern

The NCC said "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." As a result the Board announced a new third site, Redburn Common, which is still in the AONB and will therefore also be fiercely resisted.

Michael Spicer, Energy Minister at the time of the initial announcement, said there would be "at least one windpark" in Scotland. However, there has still been no indication of where that will be. Scotland has 73% of the UK's wind capacity, according to Alexi Clarke, which could provide up to 15% of UK electricity requirements without encroaching on sensitive areas.

One windfarm proposal for Eaglesham Moore near Glasgow now seems doomed to failure. Scottish Windfarm developments, a consortium brought together by the Scottish Development Agency and including the National Engineering Laboratories (NEL) and James Howden of Glasgow, is now on the brink of collapsing. Howdens are no longer interested and a question mark hangs over the future of NEL because of the Government's desire to privatise them.

At the 1989 European Wind Energy Conference, held in Glasgow, Ian Lang, Scottish Office (SO) Minister, disclosed the SO's intention to stimulate the development of wind power in Scotland. But, towards the end of his speech the true extent of the SO's support became clearer: "We must be realistic, it is not inconceivable that those who are urging us today to commit more and more resources to renewables will tomorrow be criticising us even more vociferously for ruining the countryside."

It now looks as if the UK's first wind farm will be built and operated by a private wind power enthusiast. Peter Edwards, a Cornish farmer, has been given planning approval for a 3MW wind farm at Dellabole, in North Cornwall.

Although his original application for planning permission to the Cornwall District Council was refused, he managed to get them to reverse their decision after they visited a working wind farm in Denmark. Following the visit he gained unanimous approval from the council.

Optimism

Edwards is optimistic about the future of wind power in Cornwall: "In theory, at least, we could use wind and water round here to produce all of Cornwall's energy. If this works then I expect lots more wind farms in Cornwall." His comment is backed by the results of a study conducted by the Cornwall Energy Project, which found that the wind resource of the area alone is 1,500MW - 2,000MW more than is currently consumed.

If wind farms are to provide a significant amount of power for future generations, then an approach which involves local communities in deciding where the wind farms will be put would be a far better way to proceed.

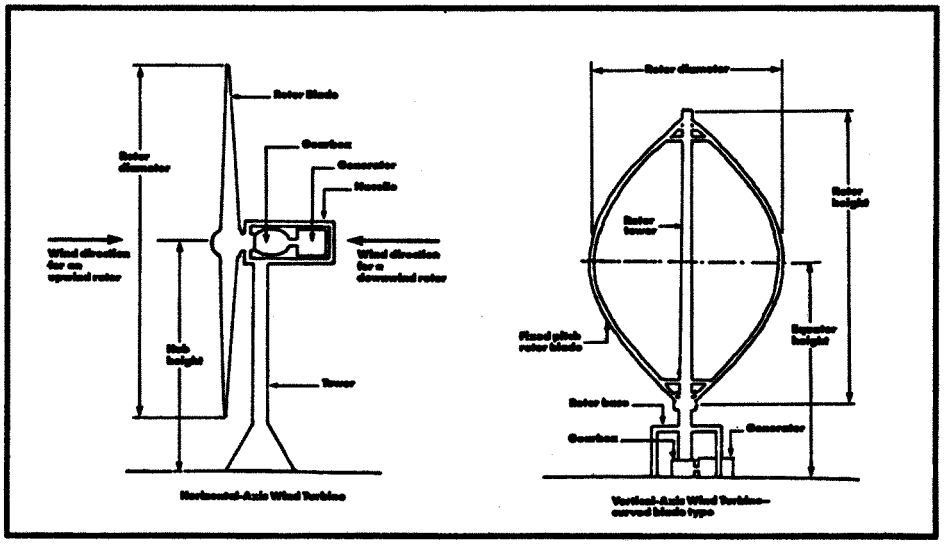
Turbine types

A PROPORTION of the solar radiation reaching the the earth is absorbed in the atmosphere. The result is uneven heating of air which causes air to move between areas of high and low pressure. The power available increases with the cube of the wind speed, so if the speed doubles the power increases by 8 times.

There are two basic designs of modern wind turbine, horizontal and vertical axis machines.

Horizontal axis machines - where the axis of the blades rotation is parallel to the wind stream and the ground - are the most common, and can be found in many places in the UK. For electricity generation, wind turbines have 2 or 3 slender blades with an aerofoil section that generates aerodynamic lift.

Vertical axis machines - where the rotor motion is perpendicular to the wind stream and the ground - are much less common, but offer certain benefits. They can harness wind coming at them from any direction, they need less structural support because unlike horizontal axis machines their gear boxes and generators can be placed on the ground, and because they do not turn end over end they do not suffer from the severe gravitational forces which place heavy strains on horizontal axis machines.



It is thought that in the long term horizontal axis machines may offer the the best prospect for exploiting the stronger and more continuous winds to be found off-shore.

Privatisation

IT IS difficult to say whether or not the Government's obsession with privatising the electricity supply industry has had a good or bad effect on the wind industry. It is, however, fair to say that the UK wind industry could hardly be described as healthy.

Last year the Government announced that there would be a renewable 'ring fence' erected within the Non Fossil Fuel Obligation - to protect the nuclear industry from the harsh realities of the free market, such as economic competition. This ring fence will require the distribution companies, established by privatisation, to buy 50MW of renewable energy by 1992, and 600MW by 2,000. It was established in an attempt to stave off criticism of the Government's nuclear favouritism.

Given a very tight deadline by the Government, private generators managed to submit proposals for over 2,000MW of renewable power before the cut-off date, at the end of 1989, for inclusion in the first stage 50MW ring fence. Around 500MW of which was for wind turbines. Unfortunately, this now seems to have backfired.

At the time of writing, the European Council has ruled the NFFO's expected 20 year duration out-of-order, and have reduced it to 8 years. The future of many of the projects submitted for the Department of Energy's (DoEn) consideration now look uncertain. The economics of renewables, including wind, favour long term contracts because of their high capital costs and low running costs. The British Wind Energy Association greeted the news saying it "would undermine all attempts at successfully exploiting wind energy in Britain in the short term". There is no NFFO in Scotland. This, argue the Scottish Office, is because hydro power already provides a significant amount of Scotland's electricity.

Independent boost

One positive thing has come out of privatisation. The bias of the rating system, which for many years precluded most independent use of wind power, has been removed. Formerly independents had to pay at least 10 times the rates per unit of electricity that the Electricity Boards paid. One turbine, on Fair Isle, typifies the old imbalance, after 6 years of successful operation its owners, the 26 strong island community, were presented with a rates bill of over £11,000. This took the unit price of its electricity up to 12p a unit. Fortunately, after a bit of bureaucratic chicanery the bill was withdrawn.

Originally, the Government wanted to phase-in an equitable rating system over a number of years, but once again successful lobbying, mostly on the part of the fledgeling Association of Independent Electricity Producers, and considerable press attention forced the Government to amend the law from 1 April 1990.

The DoEn are now reported to be immersed in a face saving exercise and are desperately trying to find a way in which renewables can be accommodated within privatisation.

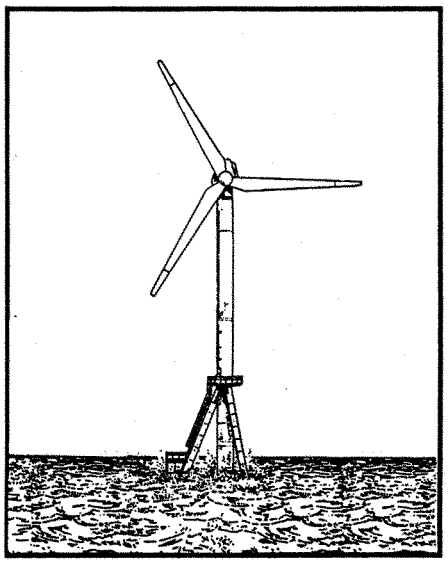
Offshore Wind Power

SOME people believe that the real potential for generating electricity from the wind lies offshore. This view is shared by the CEGB and their successors, who intend to place a 700KW machine 5km offshore, near Wells-next-Sea in Norfolk.

The machine will be mounted on a metal tripod which will be piled into the sea bed. According to the CEGB "offshore work is being conducted because it is uncertain whether land based windparks on a large scale would be publicly acceptable. It is hoped that the machine will be operational some time early this decade."

Offshore wind offers major advantages, average wind speeds are considerably higher and it is unlikely that there will be problems with visual impact or planning permission. The Board calculate that the wind potential, limited to areas no further than 5km out and less than 30m deep, could produce 240TWh of electricity, which is roughly equal to the total UK demand in the early 80's, and easily equal to that required if a comprehensive strategy of energy efficiency were to be carried out.

In 1979 a DoEn study found that there are no technical barriers to siting wind turbines offshore. Despite this they still rate offshore wind power as a "long shot".



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Useful Addresses

Scottish Campaign to Resist the Atomic Menace (SCRAM), 11 Forth Street Edinburgh EH1 3LE (031 557 4283/4)

Network for Alternative Technology and Technology Assesment. Faculty of Technology, The Open University, Walton Hall, Milton Keynes.

Friends of the Earth, 26-28 Underwood Street, London, N1 7JQ. (071 490 1555)

Socialist Environment Resource Association, 11 Goodwin Street, London N4 3HQ.

Renewable Energy Enquires Bureau, ETSU, Building 156, Harwell Laboratory, Oxfordshire, OX11 ORA. (0235 432450)

British Wind Energy Association, 4 Hamilton Place, London W1V OBQ.

Centre for Alternative Technology, Llwyngwern Quarry, Machynlleth, SY20 9AZ. (0654 2400)

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