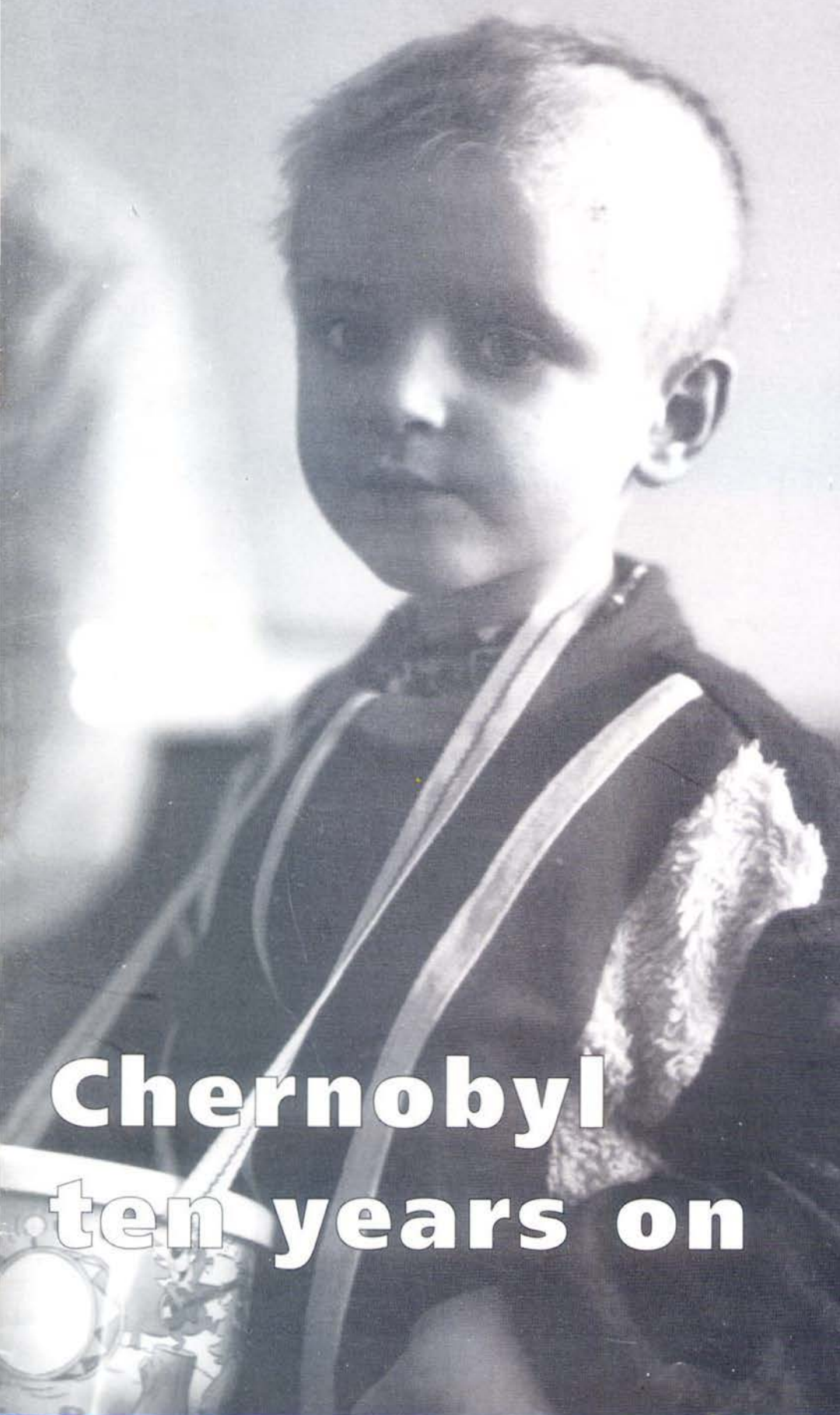


THE SAFE ENERGY JOURNAL

MARCH - MAY 1996



Chernobyl ten years on

ISSUE 108

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Managing the legacy

FOR the first time in its history the UK nuclear industry has no plans for new nuclear power stations. Meanwhile, the government prepares the 'profitable' parts of the industry for privatisation by underwriting risks and retaining ever more liabilities in the public sector.

The announcement by British Energy (BE) that it would not, at present, be proceeding with either Sizewell C or Hinkley C was presumably designed to reassure the City. Nuclear power is not economic; the financial risks far outweigh any possible profit. But the government, in search of funding for pre-election tax cuts, may be able to contrive a saleable package that ensures the shareholders their dividends by retaining future as well as past liabilities for the taxpayer, present and future, to meet. The government, however, has nothing to gain by underwriting any new nuclear stations. BE knows that, and the City knows it too.

The reasons for nuclear power have gone and the dreams vanished: plutonium production; NUM destruction; safe, cheap and reliable electricity generation.

This privatisation may be a case of selling the most-tarnished of the family silver while committing the family to polish it for generations to come.

Now should be a time for calm reflection on nuclear power, its past failures, its present risks and its future liabilities. The real challenge facing the nuclear industry is not whether parts of it can be privatised, but how it is managed in its declining years. The assets, such as they are, should not be used for tax cuts and share dividends but for helping to meet the unknown costs of dealing with their radioactive legacy. Better still would be early closure: the potential costs of a major accident are incalculably greater than any economic benefit from their continued use. The risk is not worth taking, especially if the profit motive is to be put before safety.

As we approach the tenth anniversary of the Chernobyl disaster, we must face up to the realities: the death and suffering that has been and will be caused by that accident; our moral responsibility to help; and, whatever the nuclear industry may tell us, Chernobyl could happen here!

Economic renewables

A recent study carried out for the Department of Trade and Industry has estimated that there are already 2,200 jobs in the UK economy dependent on the wind energy industry. The study's authors also believe that for equivalent output wind power supports more jobs than the conventional power sector. In addition, there is a growing appreciation that locally generated electricity, as provided by appropriately sited renewable energy schemes, is of greater value than electricity produced in large centralised power stations. When this is accounted for, the cost gap between new renewables and conventional generation disappears.

The environmental benefits of using renewable energy sources have long been recognised; now the economic arguments in their favour are also becoming clear.

"A case of selling the most-tarnished of the family silver"

The Safe Energy Journal is the international magazine of Friends of the Earth Scotland's Safe Energy Unit. Views expressed are not necessarily those of FoE Scotland.

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Selling the nuclear industry

FOR the first time since its inception, the UK civil nuclear industry has no plans for any new nuclear power stations. Plans to build Sizewell C or Hinkley C have been dropped by British Energy (BE), the company set up to take the most 'profitable' parts of the industry into the private sector this summer.

Announcing the decision, in December, BE's chief executive, Dr Robert Hawley, said: "At present the future of UK energy prices is sufficiently uncertain for BE to invest in new nuclear, or indeed in any other form of new generation in the short term."

City analysts have welcomed the announcement, saying it will help with the sale of the company. "Everyone knew that new nuclear plant was uneconomic. But, this removes the uncertainty," observed one analysts. This, however, is the only good news that the government has received in the past few months about the sell-off.

Insiders say that the unexpected death of John Collier, chair of Nuclear Electric (NE) and deputy chair of BE, has thrown the delicate power balance within BE's management into turmoil. Hawley, NE's and BE's chief executive, has succeeded Collier as chair of NE, a post which also makes him deputy chair of BE. A dispute appears to be raging between Hawley, who is expected to stand down from his job as chair of NE at the end of March to become full-time chief executive at BE, and the chair and chief executive of Scottish Nuclear (SN), Robin Jeffrey, who is the other deputy chair of BE.

Hawley is believed to have launched a bid to stay on as chair of NE. A move which would also see him stay on as deputy chair of BE, giving him a considerable power base within the new company. There are even suggestions that Hawley wants Jeffrey's job as SN chair. Such a move would most likely elicit the resignation as SN's chief executive of Jeffrey, who along with the first casualty of the privatisation process, former SN chair James Hann, fought hard to maintain a separate identity for SN within BE.

Hawley has also been at the centre of a row between BE and the government over how much of the nuclear industry's multi-billion pound liabilities should be transferred to the private sector. Hawley is believed to be insisting that the government foots the bill for reprocessing work still to be carried out on spent fuel withdrawn from the BE's reactors prior to privatisation.

Committee Report

In evidence to the Trade and Industry Select Committee (TISC), which published its report into nuclear privatisation in March, Gordon MacKerron of Sussex University and Mike Sadnicki have warned that the government will be forced to saddle the taxpayer with an additional £3 billion bill for reprocessing if it wants the sale to meet its financial goals. Their evidence casts further serious doubts on the government's ability to meet magnox

liabilities. In about 15 years time, they say, taxpayers could face annual bills of about £300 million for the nuclear clean-up.

According to a report by MacKerron — one of TISC's advisors — and Sadnicki, the value of the stations being put up for privatisation is minus £2.6 billion. Not only will reprocessing costs have to be shouldered by the taxpayer, but, the report argues, payment towards liabilities has been artificially accelerated over the last few years to cut the cost to private investors by £650 million.

The report, commissioned by Friends of the Earth and the Consortium of Opposing Local Authorities, has not yet been properly published because of a perceived conflict between MacKerron's role as adviser to TISC and his work for environment groups. After receiving a copy of the report, the European Commission is investigating whether absolving BE of liabilities would constitute state aid and would therefore be in breach of European Union rules.

According to an earlier draft copy of the TISC report, obtained by *The Guardian*, the MPs are concerned that the entire nuclear sale will fail to raise more than the £2.9 billion cost of building Sizewell B. According to the draft, the MPs want Sizewell withdrawn from the sale.

The TISC is also further worried about the government's motives for the privatisation, expressing fears that the tight timetable is politically motivated to allow the government to cut taxes in the run up to the next general election. They further warn that the decision not to establish a special decommissioning fund for the magnox reactors, which are all to stay in public ownership, will place severe strain on public spending and could threaten other public sector investments like schools and hospitals when the decommissioning bills fall due.

TISC is highly sceptical of ministerial claims that the magnox decommissioning bill can cut by £900 million, saying that the MPs can be find no evidence to support the claim.

The committee is also highly critical of government ministers for attempting to mislead the public over the sell off. Former President of the Board of Trade Michael Heseltine is singled out for claiming that the sell-off will lead to an 8% cut in electricity bills. According to TISC the fall will be about 5% as the nuclear levy will not expire this year despite Heseltine's promises.

In further damning evidence to TISC, John Reynolds of the financiers



James Capel, has warned that the uncertainties surrounding nuclear waste disposal could also be a major-turn off to potential nuclear investors. BE's stake in Nirex, said Reynolds, is "a small stake in what could be a very big black hole."

For a government on the ropes, the choices are far from easy. Does it give in to Hawley and dump further vast nuclear liabilities on the taxpayer, handing Labour a large pre-election stick, or do they hold to their promise that "liabilities will follow assets" and risk the City's refusal to buy the nuclear industry? One thing is clear, with the promise of £2.5 billion for tax cuts before the general election the government will do all it can to avoid calling off the summer sale.

An alternative would be to sell BE to an overseas company, lock stock and barrel, and avoid having to issue the detailed share prospectus that would be required for public flotation.

Diverting press attention away from the publication of the TISC report, energy minister Tim Eggar confirmed that the Department of Trade and Industry had received inquiries from the US nuclear utility Duke Power about a trade sale.

While playing down the level of interest from the US, saying that an "indirect approach" had been made, Eggar said: "At the moment, we are steaming full power ahead for the flotation, as we have always done, and investigating this alternative approach." Duke Power, however, said: "No one at Duke Power has expressed an interest,

and we have not authorised anyone to do so."

In an attempt to convince the City, and perhaps the government, BE has issued mock accounts showing that had it been in existence for the last five years then its shareholders would have lost just under £1 billion. However, according to its calculations the company will make a £144 million profit in the next financial year, compared with this year's loss of £150 million.

BE claims that its future profits will be boosted by further improvements in station efficiency and reductions in operating costs. Yet with output from the to be privatised plant increasing by 55% since 1992 and operating costs having dropped by 27 percent over the same period, many observe think the company will be hard pressed to squeeze any more from their staff and stations. Further, many think that the improved operating data is the result of a long hard push in preparation for privatisation and is not sustainable.

Massive savings can also be made on managing the company's liabilities, which according to BE's sums will be £14.3 billion. By simply discounting the bills at 3 per cent a year, and not 2 per cent as has been the practice up until now, the liabilities are reduced by a third. This will allow BE to contribute only £15 million per year into the segregated fund which is to be established to cover decommissioning. Government officials, however, have been working on the basis that the

contribution would be at least £30 million and possibly as high as £50 million.

Launching the new numbers, BE's chair, John Robb, was giving little away: "The whole question of whether the company is going to be floated or not is going to run until the last minute.

"The government is going to keep its options open about who they sell this company to right to the last minute. They have an obligation to the taxpayer to do so."

■ All is not doom and gloom for the UK's nuclear construction industry. At a meeting of nuclear engineers, at the end of January, Sir Neville Chamberlain, BNFL chief executive, said his company would take up the challenge of promoting new nuclear build. According to Chamberlain, the government — BNFL's only shareholder — has been both "parochial and short-sighted" for refusing to support new nuclear stations. He said that while BNFL's role in direct financing would be limited, the company could use its extensive network of contacts in the international nuclear community to negotiate a package for building the next UK nuclear station.

BNFL is also considering asking the government for the sites earmarked for the proposed Hinkley and Sizewell PWRs.

Chamberlain said: "other players are trying to distance themselves from their heritage. It is clear that BNFL now is the nuclear industry in the UK." □

RCF inquiry shows Nirex's case is flawed

AFTER five months and an expenditure of well over £10 million the public inquiry into Nirex's proposal for a Rock Characterisation Facility (RCF) at Gosforth in Cumbria has come to an end, with environmental campaigners confident that they have scored a "scientific victory" in their opposition to the plan.

According to Friends of the Earth (England, Wales and Northern Ireland) (FoE) any attempt to go underground now would disturb the natural patterns of ground water in the area, making it impossible to establish a safety case if Nirex decides to press ahead with building the UK's nuclear deep underground nuclear waste repository at the site, some two miles from Sellafield.

FoE maintains that a complete baseline picture of the undisturbed rock needs to be obtained before proceeding with the RCF. Their senior energy

campaigner, Dr Patrick Green, says that the RCF "is right on the cutting edge of science, so what's an extra 20 years of research on a timetable of 100,000 years."

One of FoE's key inquiry witnesses, Glasgow University's Professor of Geology, David Smythe, says he is "naturally predisposed to what Nirex has to do ... I'm certainly not an anti-nuclear greenie ... But at present they are in a complete mess. Their surveys and interpretations are inconsistent, the data are mutually contradictory."

Nirex claims it does not "need a comprehensive understanding and description of all features and processes" in the area's geology. "Nirex is dealing with uncertainties by making conservative judgements until such times as these uncertainties can be better resolved," says its science director, John Holmes.

The Inquiry Inspector, Chris

MacDonald, is now expected to submit his verdict to the Environment Secretary at the end of October. However, Nirex does not expect a final judgement from the Environment Secretary until spring next year. If the RCF is given the go-ahead, the Irish government has warned that it might take action in the European Courts to block the development.

Speaking at the inquiry, the Irish Environment Minister described the RCF as a "Trojan Horse" which would inevitably result in the final repository being built at the site. In its evidence, the Irish government detailed a number of criticisms of Nirex's approach, casting doubt on the geological and hydro-geological suitability of the Gosforth area and questioning whether the long-term proposal for a deep underground repository near the marine environment was consistent with European Union and international law. □

US vetoes Dounreay reprocessing

DOUNREAY'S bid to win contracts for reprocessing of up to 14,000 US-origin spent highly enriched uranium (HEU) fuel rods has failed. The US government has issued a full Environmental Impact Statement on its proposed policy on what to do with some 23,000 such rods, currently held in 33 countries, which rejects the Dounreay option.

Despite months of lobbying by the Department of Trade and Industry (DTI) on behalf of Dounreay, the Clinton Administration said that following meetings with the DTI and the UKAEA, which operates the Dounreay site, "it would not be possible to ensure compliance with the United States' nuclear weapons non-proliferation policy objectives."

"The primary concern was the inability to ensure that any separated HEU would be blended down to LEU [low enriched uranium, which is not a weapons-grade material]. Obtaining the reactor operator's agreement to such a policy would likely require significant financial subsidies. The potential cost of achieving agreement to down-blend the uranium, plus uncertainties regarding Dounreay's long-term availability, led DOE [the Department of Energy] and the Department of State to conclude that the successful implementation of this alternative could not be relied upon."

Further, the US plans to set fees for countries returning US-origin HEU which "would recover as much as possible of the US's expenses for the management of spent nuclear fuel without encouraging them to resort to reprocessing." In these circumstances, the only reason for countries to opt for reprocessing at Dounreay would be for continued supply of HEU fuel.

While publicly citing its non-proliferation policy as a reason for ruling out Dounreay, senior DOE officials have also said that the representations from environmental groups, local authorities and members of the public in Scotland also played a large part in the decision. At the end of last year a Scotland-wide opinion poll, commissioned by Friends of the Earth Scotland, showed that 84% of people in Scotland are opposed to the reprocessing work being carried out at Dounreay. In addition, a referendum of all 20,632 registered voters in Caithness, organised by Caithness Against Nuclear Dumping, showed two thirds opposition.

Dounreay's new spokesman, Morris Grant, expressed disappointment at the US decision, adding: "But, it is to be remembered that there is still material in reactors in Europe and Australia that is not US-origin and which could be sent to Dounreay for reprocessing."

It has also emerged that the European Union's nuclear agency, Euratom, is negotiating with its Russian counterpart, Minatom, for the supply of two tonnes of HEU from scrapped nuclear warheads. The material would be sent to Dounreay to be turned into HEU fuel for use in research reactors in Belgium, Germany and the Netherlands.

Dounreay has confirmed that the material may be heading to Caithness, but has declined to say in what form it will be received or what would be involved in turning it into fuel elements. However, this could allow Germany, Belgium and the Netherlands to choose the cheaper option of returning their spent US-origin HEU to the US, while receiving Russian HEU to continue operating their research reactors unmodified.

No new reprocessing contracts can be entered into until the current application for renewed discharge authorisations for the Dounreay site are issued by HM Industrial Pollution Inspectorate (HMIPI). A consultation into the application ended on 23 February and HMIPI are now processing the large number of objections received.

Public inquiry call

Highland Regional Council, the new Highland Council, Sutherland District Council and the Western Isles Council have all called on the Secretary of State for Scotland, Michael Forsyth, to call a public inquiry into the proposed new discharge limits.

According to a report commissioned by Western Isles Council from Dr David Sumner, a senior research fellow at Glasgow University, the documents issued by HMIPI for public consultation are seriously flawed and designed to mislead.

Dr Sumner observes that while the proposed new discharge limits will stay the same or be reduced, this "conceals the fact that in the last decade or so they [the UKAEA] have only utilised 10% or less of their authorised limits. What they are proposing to do now is to actually utilise 40, 50 or even 60% of the limit. The result is that discharges will actually go up."

According to Sumner, some radioactive discharges will increase by 20 times, to levels similar to those at Sellafield. He further reports that the UKAEA's treatment of the doses which can be accrued by the so-called critical groups fails to recognise that if a person was to fall into all such groups then it would be

possible for them to receive a radiation dose in excess of government limits.

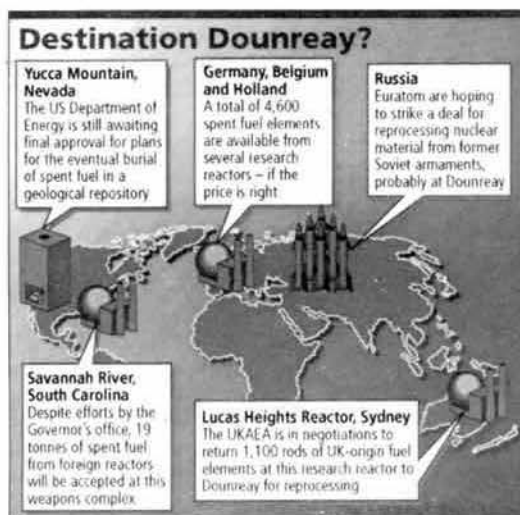
Another paper, produced by Ian Fairlie of Imperial College London for the Nuclear Free Local Authorities (NFLA), reveals that the UKAEA's application's collective dose calculations are fatally flawed. The UKAEA fails to report C-14 and I-129 releases and consequently fails to report their effects; while this omission is noted by HMIPI no action has been taken.

Both I-129 and C-14 are long-lived radionuclides which are potent contributors to collective dose. Indeed, such is their potency that BNFL at Sellafield has spent £10 million on a C-14 clean-up plant.

Fairlie is also highly critical of the UKAEA's calculation of £1 million for the health detriment of its proposed programme of work. According to Fairlie the figure is arrived at by under-reporting the collective dose and by attributing a low value to human life. The UKAEA uses a detriment figure of £20,000 per man sievert of exposure, which translates into a human life being valued at £400,000. However, when carrying out cost benefit analysis during road traffic studies the Department of Transport (DoT) uses a figure of £700,000, while the Commission of the European Communities (CEC) uses a value of £2 million.

Taking into account I-129 and C-14 and employing the DoT and CEC life costs gives a health detriment for Dounreay's activities of £2.3 million and £6.5 million respectively.

In addition, the legal adviser to the NFLAs, Jamie Woolley, says the application breaches a number of international commitments, including: the Paris Convention; the OSPAR convention; and Agenda 21. Woolley concludes that not only would a public inquiry remedy the serious flaws in the consultation documents but that it is a legal necessity. □



Scotsman

Monju leak poses questions for Japan

SERIOUS questions are now being asked of the Japanese nuclear industry following a sodium leak at the Monju experimental fast reactor and a subsequent attempt to cover up the severity of the accident by the operator, Power Reactor and Nuclear Fuel Development Corp (PNC).

The accident occurred on 8 December last year when liquid sodium coolant erupted from a defective weld in a tube for temperature measurement. Video pictures taken by officials of Fukui Prefecture, the district where Monju is sited, as well as by NHK TV, show that the piping room where the accident happened was littered with debris.

Observations further indicate:

- that the ensuing sodium-water reaction lasted for hours, filling the room with fumes and showering the reaction products all over the room and;
- the partial melting of steel structures, including the thermometer tube, the ventilation duct inlet and the floor

directly under the leak, indicating the burning of the sodium at temperatures in excess of 1,500°C.

Observers believe that there was a spray fire, contrary to an initial PNC statement that "a minor leakage in the secondary sodium loop caused some fumes." It has also emerged that the one-minute video PNC released of the room following the accident showing mainly intact pipes and clean floors was heavily edited. A Science and Technology Agency investigation has revealed that there were also 4-minute and 11-minute videos.

One of the videos further revealed that PNC workers entered the room at 6am on 9 December and not 10am as claimed by PNC. The plant's air conditioning was not shut off until three hours after fire alarms began to ring, despite regulations which say it should have been shut down immediately. Some experts believe that this could have contributed to the intensity of the fire.

The problem of finding out exactly what happened on 8 December, and who

is responsible for the attempted cover up, has been further exacerbated by the suicide of the PNC deputy general manager of the general affairs department, Shigeo Nishimura. In one of three suicide notes, he wrote: "The [PNC staff] were confident in their technical ability. But they may have found it difficult to explain their panic and confusion after the accident. It is most difficult for people to judge others and discover the truth."

Following the accident, Tokuo Kurita, the governor of Fukui Prefecture, wrote to Japan's prime minister, Tomiichi Murayama, demanding the suspension of all experimental plans at Monju.

It could take two years to get the Monju reactor back on line. But Fukui and other local authorities are expected to call for the reactor to be closed permanently. It is believed that this accident and PNC's attempts to cover it up could well be the beginning of the end for Japan's ambitious fast reactor programme. □

Chernobyl could close

A memorandum signed between the Group of Seven (G7), the world's leading industrial countries, and the Ukrainian government could see the Chernobyl nuclear plant closed by the year 2000.

The deal worth some £1.5 billion involves the development of a number of projects designed to allow Ukraine to close the station. According to the UK's Department of Trade and Industry (DTI) it "sets out a framework for a comprehensive programme of measures to support the closure of Chernobyl ... It includes projects at Chernobyl to upgrade safety in the short term and to prepare for decommissioning. It also provides support for power sector

restructuring and investment in energy alternatives including safer nuclear power plants."

In announcing the deal, Sheila Copps, the deputy prime minister of Canada, which currently chairs the G7, said: "The closure of Chernobyl will be an important step towards improving nuclear safety, not only in central and eastern Europe, but throughout the world."

However, the Ukrainian environment minister, Yuri Kostenko, said the deal was not legally binding, but was a first step in creating a "very fruitful" background and base to build on.

Meanwhile, Adi Roche, director of the Chernobyl Children's Project, has

warned that "the next Chernobyl will be Chernobyl". Roche says that the concrete sarcophagus which enshrouds the stricken reactor number four is on the verge of collapse. Although the G7 proposal also includes plans "to develop solutions to the problem of the Unit 4 shelter", Roche believes it may be too little too late.

The sarcophagus was hastily erected in the wake of the 1986 disaster and has deteriorated to a frightening extent. Holes and fissures, some big enough to drive a car through, now cover an estimated 1,200 square yards of the concrete shield. Its walls are sinking and the concrete support pillars are in imminent danger of collapsing. □

Mochovce moves

THE Slovak government is pressing on with plans to complete the Soviet designed Mochovce nuclear power plant. Instead of using European Bank for Reconstruction and Development (EBRD) funds, the Slovak government is putting together a finance package backed by Russia, two leading Czech banks and a west European bank.

Slovakia suspended its \$275 million loan application to the EBRD after intense lobbying by environmental groups, the European Parliament and the

Austrian government had made the EBRD attach a number of conditions to the proposed loan which proved unacceptable to the Slovak government. In particular the EBRD wanted to see the closure of the oldest of Slovakia's Soviet designed reactors, at Bohunice, by the end of the century.

The first of the VVER-type reactors at Mochovce was 90% complete when work was stopped in 1992 and the second was 80% complete. Now, the state power utility, Slovenske Elektrarne (SE), hopes that work could restart on the site in the spring. It intends to place contracts with Czech, Slovak and Russian groups

to finish the two reactors and upgrade their safety systems. Safety improvements will be carried out by Siemens of Germany and Framatome of France.

SE insists that the plant will be completed to standards laid down by the International Atomic Energy Agency and will also comply with recommended by Riskaudit, a Franco-German consultancy.

The new plan will be fiercely opposed by the neighbouring Austrian government which has written to both the EBRD and the European nuclear agency, Euratom, voicing "serious doubts about the safety of the installation." □

Nuclear chickens come home to roost

In the light of British Energy's decision to stop investing in nuclear power plant construction, Dr David Lowry looks at 40 years of nuclear power stations in Britain

SINCE British Energy announced on December 11 that it was pulling the plug on new nuclear power plant construction, commentators and experts in the media have agreed that it was the City's calculation of the palpable and unavoidable radioactive legacy that has killed a profitable future for nuclear power in Britain. But that is the proximate not the real cause.

British Energy's decision came 16 years almost to the day after Margaret Thatcher's first Energy Secretary David Howell told Parliament that the nuclear industry — then part of the nationalised Central Electricity Generating Board — was to proceed with the ordering of a total of 15,000 megawatts of power. The hot favourite choice was the pressurised water reactor designed and developed in the US.

Large programme

The programme would mean one new station being ordered each year from 1982 for the next 10 years subject to the necessary safety clearances and consents. Howell proclaimed this "a reasonable prospect against which the nuclear power industries can plan."

Friends of the Earth begged to differ, claiming that the programme would be "one of the largest industrial projects in British history, costing more than all the phases of the nuclear programme over the past 25 years," and emphasised the major mistakes in earlier optimism over nuclear power. The decision had been foreshadowed by a notorious leak of the minutes of a Cabinet sub-committee held two months earlier on 23 October.

The leak revealed the hidden agenda of the Conservative cabinet to press ahead with a large nuclear programme, based on the US PWR design, despite the serious accident in March that year at the Three Mile Island PWR station near Harrisburg in Pennsylvania, that had sent shock waves through the world's nuclear stations only surpassed by the Chernobyl accident seven years later. Presided over by Thatcher, Howell told Cabinet sub-Committee E that "nuclear power elsewhere in the world was based on the PWR which was generally thought to have cost advantages (despite TMI) over other reactor types." He proposed that a deal be hatched between Britain's National Nuclear Corporation and the giant US conglomerate Westinghouse.

The leaked minutes also added the comment that it was noted that "a nuclear programme would have the advantage of removing a substantial portion of electricity production

from the dangers of disruption by industrial action by coal miners or transport workers."

Evidently this was based on the bitter experience of the Conservative government under Ted Heath in 1974 going to the country over a confrontation with the mineworkers and losing.

Thatcher was leaving nothing to chance — as her confrontation with the miners a few years later painfully proved. The decision to switch from indigenously developed gas-cooled reactor designs — the magnox followed by the advanced gas-cooled reactor (AGR) — to US designed PWRs barely six months after the Three Mile Island (TMI) accident and in the wake of years of technocratic battling within the nuclear industry under the previous Labour government, was a bold — if with hindsight, error laden decision.

Political agenda

The Conservative programme dressed it up with a coherent veil of logic, even though the now not-so-hidden agenda was a political one.

The electricity industry, it argued, needed a diversity of supply options — oil, gas, coal, some renewables, bolstered by energy conservation and efficiency — but it was nuclear that was to be the jewel in the crown.

As put in Energy Paper 39⁽¹⁾ — a two-volume study released to coincide with the nuclear reactor announcement — "by 2015 nuclear energy will be the only primary source capable of being expanded with relatively stable costs to meet continuing growth in energy demand." But the real deep-seated and unacknowledged problem with nuclear power goes back to its birth as an offshoot of the military bomb programme. It could all have been different.

After all, the secret British atom project early in World War II called Maud or Tube Alloys actually proposed developing the scientific nuclear knowledge by engineering a controlled nuclear reactor to create industrial-scale heat generators. This was put on the back shelf by the boffins when the politicians, especially the transatlantic alliance, decided that the bomb was the priority.

The Manhattan Project then led to the nuclear arms race. Both the US and Britain first designed reactors to produce plutonium as a nuclear explosive. The US project at the remote Hanford atomic complex in Washington state, created plutonium for the Nagasaki bomb in 1945 and the US nuclear arsenal thereafter.

The British equivalent, the infamous Windscale Piles at Sellafield, generated the plutonium for Britain's bomb in the 1950s. They were closed in 1957 after a serious fire. Their successor plant, the Calder Hall magnox reactors adjoining Sellafield across the Calder River, had already been opened a year earlier in October 1956. The Queen opened the Calder Hall reactors expressing the hope that they will provide the basis of Britain's greatest scientific contribution to humankind.

But in fact, the prime purpose of the reactors was military plutonium production, providing the civil nuclear industry with an industrial scale prototype on which they could model their power plant designs.

The difficulties subsequently experienced over the next four decades by the nuclear industry in Britain with uneconomic reactors can be identified as being the result of the scaling-up of a military plutonium production reactor, rather than designing a plant that was engineered to optimise electricity and minimise radioactive waste. But in the mid 1950s, at the birth of civil nuclear power, these were not the priorities.

Meanwhile, the US pursued a different route to commercial nuclear power: a partnership between private industry and the super-quango, the US Atomic Energy Commission (USAEC), bolstered by the uniquely powerful Congressional Joint Committee on Atomic Energy.

PWR's origins

Atomic myth has it that the US government, instead of modifying its plutonium reactors at Hanford, scaled-up a reactor design for submarine propulsion, which was necessarily compact to fit into the confined space available.

In fact, the father of the PWR, Admiral Hyman Rickover, established a project for the US navy in 1950 for both submarine and surface ship propulsion. It was a modified version of a surface-ship PWR that was installed at the Shippingport power plant in Pennsylvania in 1954. Rickover's research project was so well resourced that he was in an intriguing technocratic position to design a variety of reactor types.

Indeed, nearly 20 generic types were in various stages of development, primarily based on enriched uranium fuel — compared to the natural uranium used in magnox plants in Britain — which allowed for compactness. It also required pressurisation of the water cooling and heat exchange system.

From January 1955, the USAEC launched its power reactor demonstration programme,

jointly with private industry in which Westinghouse, with whom Rickover had special links, played a key role. Forty years later, the chickens have finally come home to roost for both the gas-cooled and water-cooled reactors with British Energy's abandonment of nuclear reactor investment in a gush of tears.

Although the expense demanded by the waste legacy, including the difficult-to-calculate final costs of decommissioning closed reactors and nuclear fuel chain facilities, have proved an insurmountable addition to British Energy's bills, it was the fateful choice of relying on military reactors and not designing power reactors from scratch, that planted the poisoned seed which has grown over 40 years into the present day atomic impasse.

Hidden costs

For decades, the British nuclear industry was able to hide the real cost of nuclear-generated electricity from its gas-cooled reactors, because of the massive hidden subsidies from the military programme, which shared some facilities such as Sellafield and always had a finger in the research and development pie, distorting civil priorities.

When Britain finally switched to the PWR option in December 1979 it did not have the appropriate technological base to build such reactors. The Sizewell B design, an amalgam of the best of US designs, generally called SNUPPS, was built incorporating all the state-of-the-art computerised safety systems, demanded in the wake of the near environmental and actual economic catastrophe at Three Mile Island.

These safety add-ons, integrated into the design have pushed the costs through the roof, from around £1.87 billion in 1982 to over £3 billion today.

Nuclear power would never have got started without the massive early investment in the Tube Alloys and Manhattan projects — or the Soviet equivalent, the Ministry of Medium-Sized Machines (sic) — yet it was the scaling up of early military design which caused the economic collapse of nuclear power in the US in the early 1980s, the Chernobyl accident in 1986 and now British Energy's pull-out of nuclear power.

The nuclear industry has many insurmountable problems, but it is ironic that its military origins have led to the present crisis. □

Reference

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"For decades, the British nuclear industry was able to hide the real cost of nuclear-generated electricity from its gas-cooled reactors, because of the massive hidden subsidies from the military programme"

□ Dr David Lowry is an independent environmental policy and research consultant, and a writer on nuclear issues.

The neglected relics of uranium mining

Peter Diehl
considers the environmental problems that have been left by uranium mining around the world

The world's largest uranium producers (tonnes of uranium)

1946-1992

USA	339,290
Canada	257,692
Germany (East)	217,791
South Africa	143,302
Czechoslovakia	102,245
Kazakhstan	72,000
France	68,174
Namibia	56,682
Niger	56,575
Australia	54,143
Zaire	25,600
Gabon	22,226
Bulgaria	21,000
Romania	16,850
Hungary	16,718
India	5,920

No estimates available for total production of USSR and China.

SINCE the end of the Cold war, the legacy of the Nuclear Age is coming to light little by little. The relics from uranium mining are part of this.

The by-products from uranium mining in open pits and underground mines are waste rock and ores of uneconomical low grades. The uranium milling process (including chemical extraction of the uranium) produces waste slurry — the uranium mill 'tailings'.

These slurries have about the same volume as the mined ore and they present a serious hazard for a number of reasons:

- the slurries contain long-lived and partly water-soluble radionuclides (eg, thorium-230 with a half-life of 80,000 years and radium-226 with a half-life of 1600 years) — 85 % of the ore's initial radioactivity is present in the slurries;
- the slurries' radioactive contents emit gamma radiation;
- the radioactive gas of radon-222 forms continuously within the slurries, escapes from the deposits and spreads into the environment; the decay products of radon-222 (for example polonium-210 and lead-210) deposit in the surroundings and can cause lung cancer when inhaled;
- the slurries also contain high concentrations of toxic substances, eg, arsenic and molybdenum;
- chemical processes taking place inside the deposit lead to a continuous mobilisation of contaminants from the deposit;
- in the case of earthquakes or heavy precipitation, there exists the risk of liquefaction of the slurries with subsequent dam failure and the release of large amounts of contaminated tailings.

Cocktail of contaminants

While the radioactivity of the slurries is low compared to that of high-level nuclear waste produced in nuclear power plants, it cannot be neglected due to the enormous amounts (about 1 billion tonnes worldwide) and its longevity.

The slurries are usually pumped into tailings ponds or old mining pits. From these deposits, the contaminants can escape into the environment through various pathways: wind erosion of dried slurries; emission of radon gas; seepage to surface waters or groundwater; spreading of the slurries due to erosion; misuse of the dried sandy tailings for construction purposes or landfills.

During recent years uranium mining by leaching has gained importance. Leaching avoids the need

for removal of the uranium-bearing ore from the deposit by the injection of a leaching liquid (for example ammonium carbonate or sulphuric acid) through injection wells into the underground deposit and the pumping of the uranium-bearing liquid back to the surface through production wells. This method is called in-situ leaching.

In the United States, the country with the largest cumulative uranium production to date, in-situ leaching is, for economic reasons, the only uranium 'mining' method being used at present. In Europe, large-scale in-situ leaching facilities were in operation in the Czech Republic and in Bulgaria. In Eastern Germany, an underground mine converted to in-situ leaching was in operation at Koenigstein near Dresden until 1990.

It is nearly impossible to avoid leakage of the highly contaminated leaching liquid beyond the limits of the ore deposit, and to restore natural groundwater quality after the end of the active production period.

In the case of Koenigstein, about 100,000 tonnes of sulphuric acid were pumped into the ore deposit. At present, 1.9 million cubic metres of leaching liquid are contained in the pores of the rock. The liquid has a high content of contaminants; the drinking water standards are breached for a number of substances by the following factors: cadmium 400 times, arsenic 280 times, nickel 130 times and uranium 83 times, among others. This liquid presents a hazard to an aquifer used for drinking water supply.

Groundwater contamination is far higher at the Czech in-situ leaching facility of Straz pod Ralskem where 3.7 million tonnes of sulphuric acid were injected. The contaminated liquid has moreover spread horizontally and vertically beyond the leaching zone itself, contaminating the largest groundwater reserve of Northern Bohemia.

In-situ leaching in Bulgaria reached a similar order of magnitude: here, 2.5 million tonnes of sulphuric acid were injected into the ore deposits. Some of the in-situ leaching facilities are located close to drinking water wells.

In the case of the uranium mill tailings, every effort must be directed towards confining the contaminants in the safest and most permanent way possible, to avoid contamination of the environment. Due to the long half-lives of the radionuclides involved, and the unlimited toxicity of the contaminants, the tailings must be carefully contained in the long term. All possible management options can, however, only provide protection for a limited period of time. A real elimination of the hazard is impossible. So far, legal requirements for the long-term confinement

of such tailings exist only in the United States. The measures taken provide a safe confinement of the contaminants for a period of 1,000 years — without active maintenance. While this period of time is still short compared to the longevity of the hazard, it presents at least a manageable goal for the reclamation activities.

In Eastern Germany, there are more immediate problems. The main dam of the 50 million tonnes Helmsdorf tailings deposit near Zwickau, for example, does not even meet the legal dam stability requirements. In the case of a dam failure, large parts of the village of Oberrothenbach would be flooded by the tailings slurries. The current plan is to first remove the water ponding on top of the tailings; due to its high contaminant loads (eg, arsenic at 10,800 times the drinking water standards), it must be treated in a water treatment plant built specifically for this purpose before it can be released. Then, a dehydration of the slurries is planned to increase the dam's stability. It is still unclear, however, whether the management options intended for this purpose will be successful. The extent of the groundwater contamination caused by the deposit, and how it can be stabilised in the long term, is also unclear.

The preferred management option for in-situ leaching facilities is the removal of the contaminants from underground by flushing, to avoid long-term impacts on groundwater. Immobilisation of the contaminants underground by changing the geochemical environment has also been tried, but the long-term effect of this option is questionable, and it can in no case function for all the contaminants involved.

The only option considered for the Czech facility at Straz pod Ralskem is to pump groundwater from the deposit over several decades. This causes inflow of clean water from outside the deposit, thus flushing the contaminated areas. Although this method can remove a considerable fraction of the contaminants, it is expensive and restoration of the natural conditions is not possible.

In Koenigstein the leached ore deposits are to be flooded with water in an attempt to dissolve the contaminants and remove them in a water treatment plant. Since the leaching zone is not to be flushed by forced flow, the process might last for centuries, if it is successful at all.

During the Cold war, uranium was initially mined for the production of the nuclear bomb. Cost, health and the environment were not considered. For the countries involved, uranium mining was an issue of national importance.

Since the sixties, more and more uranium has been used for the supply of nuclear power plants. In the Western world, a uranium market developed. In expectation of a shortage of uranium, the uranium price increased drastically from \$7 to \$43 per lb U_3O_8 . But in the early eighties, when it became obvious that the

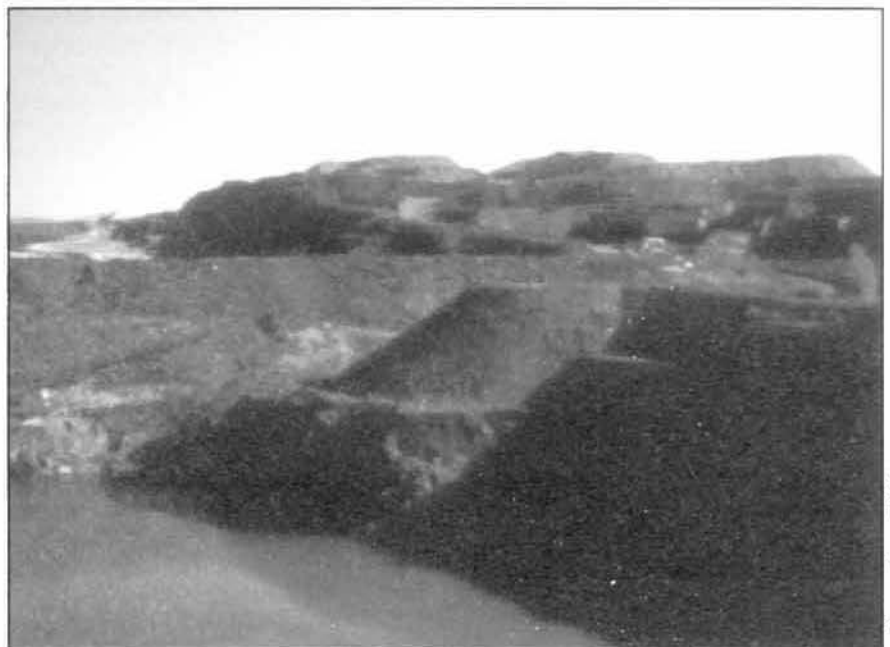
construction of new nuclear power plants would not meet forecasts, the uranium price dropped again and has since stayed at a low level of around \$10 per lb U_3O_8 .

With the fall of the Iron Curtain, the oversupply on the uranium market further increased. The CIS states entered the market with cheap uranium, and China became a supplier. However, stockpiles will be exhausted in the very near future; another rise in the uranium price can therefore be expected. An indication of this is the recent continuous rise of the uranium price: between October 1994 and May 1995, it climbed from \$9 to \$12 per lb U_3O_8 , where it has since remained.

An example of the conditions under which cheap uranium is produced by the new suppliers can be found at the Priargunsky uranium mine in Eastern Siberia. With its estimated annual production of 2,900 tonnes, it is the only uranium mine currently operating in Russia. In November 1994, Greenpeace found highly elevated radiation levels in a village nearby. The uranium levels in soil exceeded normal values 20-fold; the radon concentration in homes is above the standards for occupational exposure in 36% of the homes, as a consequence of the mine ventilation. The whole production of the mine is being sold abroad, mainly to France, Germany, United Kingdom, Spain, USA, and Argentina.

Similar impacts are now coming to light for uranium mining in Ukraine. Since the 1950s, uranium has been mined in two mines near Kirovograd. High radiation levels were monitored in the city of Zholtiv Vody: the gamma dose rate reads 10µGy per hour (about 100 times background) at 459 locations, and at 571 locations even exceeds 30µGy per hour. The government now plans to perform a medical-social aid program to deal with the impacts of

"The preferred management option for in-situ leaching facilities is the removal of the contaminants from underground by flushing, to avoid long-term impacts on groundwater."



An open pit mine Le Bosc near Lodève (Hérault, France)

Photo: Peter Diehl

Photo: Peter Diehl



Heap leaching at Pécs, Hungary: addition of the leaching liquid on the top of a pile

the uranium mining carried out so far. Nevertheless, the government plans to establish an independent nuclear fuel industry, and to increase uranium production (from the presently estimated 1,000 tonnes per year) at least three-fold by the year 2003.

Canada has been able to stabilise its role as the world's largest uranium producer during the last few years, due to the numerous high grade ore deposits discovered in the northern part of the country. The management of the legacy of uranium mining, and in particular of the uranium mill tailings, is nevertheless very problematic: the tailings slurries are often simply dumped in numerous lakes; contaminants can then reach the food chain of indigenous people living in the area.

Due to current market conditions, uranium mining companies in the traditional uranium mining countries are busy restructuring their businesses. Uneconomic mines are being shut down, activities are being focused on the ore deposits with the highest ore grades, and these deposits are being mined in the most economic way.

In Germany, all uranium mining was stopped after unification. Hungary and Bulgaria have announced the shutdown of all uranium mining activities for the near future, while uranium mining continues at a drastically reduced capacity in the US, the Czech Republic, and France.

France, the largest uranium producer in Western Europe, has reduced its domestic production from 3,394 tonnes in 1988 to 1,000 tonnes; a further reduction to 400 tonnes by 1999 is scheduled. The only mine to be kept in operation in the long term (Lodève in Southern France) presently produces losses of 100 French Francs per kilogram of uranium produced. The losses are thus nearly as high as the current uranium market price.

Following the shutdown of uneconomic uranium mines, most countries concerned now face another problem: in most cases no cash reserves were built up and the clean-up will have to be paid for with taxpayers' money.

From the US experience, the reclamation of the mill tailings deposits alone requires funds comparable to the proceeds from selling the uranium produced. The German government's cost estimates for the reclamation of Wismut's uranium mining and milling sites amount to a total of DM13 billion for a period of 10 to 15 years. These estimates do not include sites returned to local authorities before 1962. At a total production of 220,000 tonnes of uranium by Wismut, these estimates correspond to DM 60 per kilogram of uranium, exceeding the current market price for uranium by about 50%.

While these costs, at least in part, must be considered consequential costs of the Cold war era, it becomes evident that the continuation of uranium mining at the current market price would not be possible if funds were to be saved from the proceeds for a later clean-up.

Those countries which continue uranium mining maintain the illusion of cheap uranium and cheap nuclear energy for short-term advantages, at the expense of the environment, the health of residents, and future generations.

In Sweden, a first attempt was made in 1995 to acknowledge the responsibility of customers for the environmental and health impacts of uranium mining in the producing countries. The Christian Democrats brought a motion before the Swedish parliament, signed by the Centre, Left and Green Parties, that would set standards for imports and set prices on associated external costs. Sweden receives, at present, 40% of its annual demand of 1,600 tonnes of uranium from Russia. The motion was rejected.

In other customer countries there is no intention to introduce such regulations. The German Federal Government, for example, denied in 1989 responsibility for environmental and health effects caused from mining uranium for German utilities in foreign countries, as this was only a matter for the producing countries. This attitude was for the first time challenged in another case in 1993, the Ok Tedi copper and gold mine in Papua New Guinea. In a motion brought before parliament by Christian Democrats and Free Democrats, and consented by the majority of the parliament, the Federal government was called upon to use its influence with the German shareholders of the mining company and the government of Papua New Guinea to demand Western environmental standards and compensation for the people affected. This decision marks Germany's first acknowledgement of its responsibility for the conditions under which raw materials are produced abroad. But, so far, it has remained an isolated case. □

□ Peter Diehl was for many years speaker of the *Citizen Committee Against Uranium Mining in the Southern Black Forest, Germany*

Chernobyl: the disaster continues

It is ten years since Chernobyl exploded, but for the people that live in the surrounding countries, and for the young men drafted in to contain the damage, it is far from old news. Belarus, northern Ukraine and parts of Russia were exposed to the worst of the radioactivity released. Putting out the fire and decontamination work was done at the expense of the health of 600,000 mostly young men drafted from across the former Soviet Union. What of these so-called 'liquidators'? And what of the inhabitants of the affected areas?

Given that the radioactivity from Chernobyl was 200 times that from Hiroshima, it is hardly surprising to find that the populations most affected by Chernobyl are suffering a great deal. What is surprising is that it took five years for any substantial international recognition of their plight. It would seem that amongst the fears that something similar could happen again, superpower politics and the worsening economic state of the former Soviet Union, the Chernobyl victims were forgotten.

In 1991, however, a fax from a Belarus hospital alerted the Irish CND office to the situation in Belarus. A plea for children in Belarus to be given a break from the contaminated environment which was constantly exacerbating their illnesses. The Irish responded by inviting a group of children over to Ireland for a recuperative holiday which lead to further holidays. Material help was also sent and visits made to Belarus, one to make a documentary, under the name of the Chernobyl Children's Project. These activities by the Irish and by others finally raised the profile of the Chernobyl victims. Adi Roche, director of the Chernobyl Children's Project, describes how the Chernobyl story unravelled for her over the past five years, in her book *Children of Chernobyl*.

Children of Chernobyl

Adi Roche went to Belarus to help make the documentary *Black wind, white land* — living with Chernobyl (which has never been broadcast in Britain) to provide a picture of life after Chernobyl that it is impossible to glean from statistics.

From her book, it is evident that she was at times petrified of the radiation, despite being armed with protective clothing, dosimeters, time schedules, uncontaminated food and a ticket home — things denied those living with Chernobyl. Some indication of just how frightened the Belarussians must be.

It is not hard to understand why, for instance, guards at the entrance to the 'purple zone', the most radioactive place on earth, prefer to boast about never wearing protective clothing rather than admit the risks by protecting themselves. In fact, nothing about how the Belarussians cope shocks, as the situation they find themselves in is the most shocking of all.

Between the lines of the 285% increase in thyroid cancer, the 99% of Belarus contaminated, the 50% fall in birth rate, Adi's accounts reveal the everyday stories. Families evacuated from one town only to find their new town even more contaminated, having to plan movements by radiation maps published daily in local newspapers, being told to change clothes twice a day, babies abandoned by parents unable to cope with their deformities. The liquidators have formed their own support group, but membership is falling — 13,000 liquidators have died, 20% by suicide.

The visitors spent a lot of time at hospitals and orphanages, and inevitably personal attachments were formed. Igor achieved some fame by being the first recognised 'deformed' victim of Chernobyl. Learning that because he had survived to four years of age he would be transferred to an adult mental asylum, the group decided to help, and he now lives with a family in England. And in 1995 there was a concerted effort on behalf of four children transferred to Ireland for specialist treatment after one of them, a ten-year-old boy, told Adi he would die if left behind. Three recovered, Evgeniya died in Ireland at the age of six and a half. She had osteoporosis and all her internal organs were damaged by prenatal radiation exposure.

The Chernobyl Children's Project has arranged holidays for 1,000 children, sent medicine worth \$3.75 million to Belarus and donated a fleet of ambulances. Providing help is a comfort to the benefactors as well as the recipients — a human reaction to an inhuman disaster.

Any conclusions?

Scientists investigating Chernobyl victims now largely agree that exposure to large doses of radioactive iodine in iodine-deficient children resulted in an increase of cancer of the thyroid, in part because someone had the presence of mind to utilise Chernobyl for a controlled study. For other illnesses though, researchers often cannot attribute increases to the radiation, as there is little scientifically testable evidence. Some researchers deny any increases.

To the people most affected by the Chernobyl aftermath, the testability of their illnesses, whether they are attributable to Chernobyl alone or a combination of factors is academic. Illnesses suffered now and diseases that are likely to appear in the future are often very treatable.

Associations between illnesses and radioactivity may not be conclusive. But this cannot be allowed to hinder a properly-funded international effort to mitigate the very obvious suffering. Many, many more lives can be saved than is possible by voluntary groups like the Chernobyl Children's Project. □

As scientists argue over statistics and contemplate further studies, is the human tragedy of Chernobyl being overlooked?
Helen Snodin reports on the ongoing Chernobyl disaster



Child with leukemia at Gomel regional hospital. Chernobyl

□ Helen Snodin is a researcher for Friends of the Earth Scotland

Chernobyl: ten years on

Ten years after the accident at Chernobyl, Dr David Sumner reviews the scientific evidence emerging on the health effects of the disaster

BY an ironic coincidence the tenth anniversary of the Chernobyl accident falls just a few weeks after another important anniversary — the centenary of the discovery of radioactivity by Henri Becquerel, the scientist who gave his name to the unit of activity which the Chernobyl accident put on the map, both literally and metaphorically. The explosion at Chernobyl on April 26 1986, which lifted the 1,000-tonne lid of the reactor vessel, released about one third of the core inventory of caesium-137 and probably more than half the core inventory of iodine-131. The worst affected areas were Belarus and Ukraine; an area totalling 131,000km² was contaminated with caesium-137 levels above 0.04MBq/m², with levels over 1MBq/m² in places.

It's one thing to know what happened to the many millions of becquerels that were released, but quite another to unravel what the health consequences might be. Despite considerable research effort (with the World Health Organisation being particularly active), many parts of the picture are still confused, for a number of reasons: the lack of reliable data (particularly before the accident), dietary deficiencies (often because traditional foodstuffs are contaminated), the presence of other kinds of pollution, poor medical care, and lack of co-operation between the various national research teams wanting a share of the data. Perhaps most importantly, the large evacuation programme has superimposed enormous additional stress — after the accident about 115,000 residents were moved from the 30km radius exclusion zone surrounding the reactor, and there is the possibility that an additional 200,000 or more will be relocated in the future.

A-bomb studies

As often happens in studies of radiation effects, reference is made to the studies of the Hiroshima and Nagasaki survivors. (Although they are the largest group of people exposed to radiation, and therefore very important in the assessment of cancer risk, there are I think dangers in using this experience in situations of very different radiation exposure; but that's another story — see, eg, "Possible fallacies in present cancer risk estimates", SEJ107). The first disease to appear in the Japanese survivors — a few years after the bombs — was leukaemia, and it was expected that this might be the case following Chernobyl also. In fact, at present the consensus seems to be that there has not been an increase in childhood leukaemia (although there are

reports of a significant increase in the number of non-Hodgkins lymphomas, multiple myeloma and chronic lymphoid leukaemia among older people). As recently as the summer of 1994, the British Medical Journal was headlining its editorial on Chernobyl "Probably nothing to worry about".⁽¹⁾

Unfortunately there's plenty to worry about: everyone is now agreed that, although childhood leukaemia may not have increased, there is a dramatic and increasing incidence of thyroid cancer in the most contaminated areas. Before the accident in the regions surrounding Chernobyl the annual incidence in children under 15 years was 0.5 per million children (a similar incidence to the UK). 680 cases of thyroid cancer have now been confirmed in Belarus, Ukraine and Russia since the accident; the cases are concentrated in an area where rain deposited the heaviest iodine contamination, more than 200 kilometres north of Chernobyl. The incidence in the Gomel region of Belarus is more than 100 per million. The epidemic is likely to continue for decades and involve many thousands of children. According to Dillwyn Williams of Cambridge University, as many as 40% of the children exposed to the highest levels of fallout from Chernobyl when they were under a year old could go on to develop cancer as adults.⁽²⁾

Iodine deficiency

The exact cause of the increase in thyroid cancer is still not clear. The incidence in children born more than 6 months after the accident seems to be much lower, suggesting that early inhalation and ingestion of radioactive iodine were responsible. It is not clear at present whether iodine-131 is solely responsible, or whether other short-lived isotopes (iodine-130, 132, 133 and 135) are implicated too; the amount of iodine-133 released was almost a third of that of iodine-131. Uptake of radio-iodine was further increased because regions surrounding Chernobyl are deficient in iodine, and iodine deficiency disorders (eg, goitre) are common; and for the same radio-iodine intake, an infant would receive about ten times the absorbed thyroid dose as would an adult.

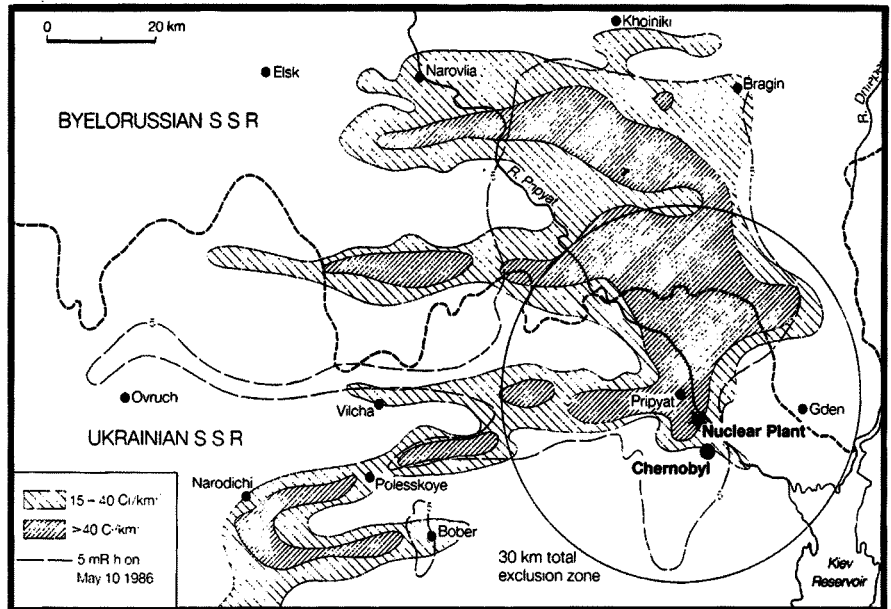
Some scientists assumed that the increase in thyroid cancer was just due to 'ascertainment bias' (ie, the harder researchers look for an effect, the more likely they are to find it). There has been a reluctance on the part of some scientists,

particularly in the US, to accept that iodine-131 is the cause, partly because there is no clear evidence of iodine-131 having caused thyroid cancer when used therapeutically, as it often is, to treat overactive thyroid. However, there may be a big difference between giving large doses of iodine-131 to an adult, diseased thyroid — with the object of killing as many of its cells as possible — and low doses to the normal thyroid of an infant or child, where the potential for mutagenic effects could be far greater. More worryingly, it has been suggested that government scientists in the US may want to play down the effects of the release of iodine-131 because of the large quantities released from the Hanford nuclear site in the 1940s.⁽³⁾

One reason that seems to make ascertainment bias unlikely is the aggressive nature of the disease; affected children quickly become unmistakably ill with secondary cancers in the lymph nodes of the neck and lungs. Treatment can be by high doses of iodine-131, but obviously administering yet more radioactivity is difficult. The alternative is surgery, but there is a problem here too: it is usual in thyroid cancer to remove the whole thyroid, but the scarcity of thyroid replacement hormone has made some surgeons reluctant to do total thyroidectomies; instead they remove only part of the thyroid, which may miss some of the cancer cells.

Whatever the exact mechanism responsible for the increase in thyroid cancer, at least one thing seems clear: the recommendations and arrangements for iodine prophylaxis in future accidents have to be looked at very carefully. For the thyroid, the National Radiological Protection Board specifies a lower 'emergency reference level' of 30mSv — if the predicted dose to the thyroid is likely to exceed this, administration of prophylactic iodine may be justified. If the predicted dose is above 300mSv, prophylaxis is deemed essential. As a result of the Chernobyl experience it has been argued that the lower limit should be reduced to 10mSv, at least in children.

What further cancers can be expected in those most exposed? The World Health Organisation (WHO) points out that the tissue most sensitive to radiation exposure, in addition to the thyroid and bone marrow, is the breast of young women; populations within 100km would be particularly at risk, and we may expect a rise in the incidence of breast cancer. Effects of airborne radioactive particles on the induction of skin and lung cancers is also a matter for concern. And the 'liquidators' — about half a million people, mostly young men, who cleaned up after the accident — are reported to have an increased incidence of cardiovascular disease, not normally associated with radiation exposure.



Areas of heavy contamination around the exclusion zone (marked by a 30km radius circle) with the caesium-137 as measured during 1988. Only two levels are indicated. The contour marked by isolines indicates the territory which was contaminated above 5 mR/h of gamma radiation on 10th May 1986.

Clearly we have a lot still to learn. Meanwhile, the weak and unstable sarcophagus at Chernobyl, which contains 40,000m³ of long-lived high-level waste (including over 200 tonnes of the reactor's original fuel) could collapse, releasing radioactive material into the water table and possibly causing a severe accident at the neighbouring reactor three.

So how prepared are we for a nuclear accident? A recent WHO expert working group meeting has emphasised the importance of stable iodine prophylaxis for children even in areas remote from the vicinity of a possible source of exposure. In the UK, responsibility for distributing stable iodine in the event of a nuclear accident rests with the police. Will this be quick enough if and when the time comes? I leave the last word with the WHO: "A well formulated and harmonised contingency plan is essential ... local plans must be detailed and frequently reviewed and updated. The best way to test the functioning of contingency plans is by arranging exercises on a local, regional, national and international scale ..." □

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Jobs in wind energy

Dr Garry Jenkins
reports on
a study to
assess
levels of
employment
in the UK
wind
industry

THE wind energy industry in the UK is a small but growing source of employment. A whole range of jobs are associated with wind developments ranging from ornithologists doing bird studies on wind farms to factory workers fabricating steel towers, from laboratory technicians studying fatigue properties of materials to planning consultants working on future wind developments.

In order to obtain an up to date picture of employment in the UK wind energy industry, the British Wind Energy Association (BWEA), and ETSU — on behalf of the Department of Trade & Industry — commissioned North Energy Associates Ltd (NEA) to carry out a study.

NEA, realising that the data would have to be collected from scratch, designed a survey questionnaire which was sent out to every organisation they could find doing work in wind energy. Of 572 questionnaires sent out, 249 were returned; a very good return rate reflecting the enthusiasm in the industry.

The questionnaires asked all manner of questions relating to employment in each organisation. Because of the newness of the industry and the cyclic nature of the Non-Fossil Fuel Obligation (NFFO) support scheme, we decided to ask for information relating to the two financial years April 1993 to March 1994 and April 1994 to March 1995.

One of the difficulties in employment studies is defining a 'job'. In this case we asked for information on Full Time Equivalent (FTE) jobs, defined as being 1,800 hours of work per year. Many people in the organisations we contacted only carry out a portion of their

work on wind energy related topics. We were trying to find out the amount of time spent throughout the whole organisation on work related to wind energy.

Of the 249 questionnaires returned, 180 organisations carried out paid work in wind energy. These respondents reported 545 FTE jobs in 1993-4 and 721 in 1994-5. Scaling this up to the whole industry suggests that there were 1,300 FTE jobs, plus or minus 100, in the UK wind industry in 1994-5.

About 220 of these jobs are related to exports overseas, so there are just over 1,000 FTE jobs directed at domestic wind energy.

We looked at the main sectors of work within the wind industry, and the results are shown in Table 1.

Hidden within these sectors are some interesting facts. For example, many of the civil engineering jobs in the construction phase were in Northern Ireland, where a number of wind farms were under construction under the Northern Ireland NFFO.

We estimate that over 100 FTE jobs were taken up by project development work, mostly preparing bids for the English and Welsh NFFO, the Scottish Renewables Order and the Northern Ireland NFFO. The largest single category of work in the wind energy industry is consultancy, with about 160 FTE jobs in the UK.

The overwhelming proportion of jobs in the UK wind industry, some 74%, are in UK limited companies, followed by educational establishments, 9%, and UK plc's, 5%.

Table 1: Estimates of total employment in the main sectors of the wind industry 1994-5

Sectors of the wind industry	% of jobs in industry	Approx. FTE jobs
Manufacturing (including components)	23%	300
Consultancy and Contract R&D	21%	270
Project development, owners and operators	16%	210
Engineering services - construction phase	14%	190
Engineering services - operation and maintenance	8%	110
Finance, planning and professional services	6%	70
Educational sector	5%	60
Sales, Marketing and Publishing	4%	50
Government and Statutory bodies	2%	30
Other sectors (trade associations, etc.)	1%	10
Total (rounded figures)	100%	1,300

The makeup of the wind energy industry in terms of small, medium and large organisations is quite similar to the pattern in the UK manufacturing industry as a whole. Over 69% of all the jobs in the wind industry are in SMEs (small and medium enterprises) defined as having less than 500 employees.

28 organisations had more than 10 full time equivalent jobs in wind energy, making up well over half (56%) of the total employment in the industry.

The level of education and skills in the wind energy industry are very high, with over half (52%) of the reported jobs being in the Standard Occupational Classification (SOC) groups of managers and administrators, and professional occupations.

Table 2 shows the complete breakdown of jobs in the industry by SOC groups, with the highest skill levels at the top.

One further analysis we carried out was on the location of employment in the UK wind industry in 1994-5. Interestingly, the jobs are not in the windiest parts of the country. In fact some 33% of employment is in London and the South East. Over half (58%) of the employment is concentrated in four regions, Greater London, the South East, Yorkshire and Humberside and the South West. Whilst almost all (93%) of the employment in Yorkshire and Humberside is in manufacturing, only a little (12%) of the employment in the South West is in firms engaged in manufacture.

For comparison with other types of energy supply, an analysis of jobs created per unit of energy was carried out. In the two financial years studied from 1993 to 1995, 63.5MW of wind turbine capacity was installed in the UK. The numbers collected in the survey suggests that overall there is direct employment in the industry of 371 FTE job years per TWh produced, of which 278 FTE job years were in the UK. Almost 60% of the UK jobs were for long-term operation and maintenance of the wind turbines, the rest were in manufacture, construction and installation of the wind turbines.

Comparisons with other electricity generation technologies must be made with care, but the study indicates that job creation for operation and maintenance activities — which are essentially local in nature — are significantly higher than for coal fired power stations, excluding jobs in mining, by a factor of around 4 and for Combined Cycle Gas Turbine power stations by a factor of around 16. Even when allowances are made for the additional jobs associated with coal and gas extraction, it seems clear that wind energy still provides higher job opportunities. When similar comparisons are made across the industry as a whole, job opportunities in wind energy still appear to be substantially higher than in the conventional power sector.

One final aspect is the impact of the wind energy industry on total employment in the UK. The 1,300 jobs estimated for 1994-5 will have had a knock-on effect throughout the whole of the UK economy. The study suggests that about 2,200 jobs in the UK economy are currently dependent on the emerging UK wind energy industry. □

Reference

Copies of the report are available on loan from the ETSU Renewable Energy Enquiries Bureau, telephone 01235 433601, quoting Report Number ETSU/W/13/00354/47/REP.



Border Wind's Blyth Harbour wind farm, Northumberland

□ Dr Garry Jenkins is Technical Director of North Energy Associates Ltd., a specialist renewable energy company based in Morpeth, Northumberland

Table 2 : Estimate of employment by Standard Occupational Classification for 1994-5

Standard Occupational Classification	% of Total	Approx. number of FTE jobs
Managers and Administrators	16%	214
Professional occupations	36%	465
Technical & Associate professional	9%	115
Clerical & Secretarial	11%	137
Craft & Skilled trades	19%	250
Personal & Protective services	(0.2%)	2
Sales occupations	2%	32
Plant & machinery operatives	6%	78
Other occupations	(0.6%)	7
Total (rounded figure)	100%	1,300

Electricity industry power plays

Pooling apart

DECEMBER and January were turbulent months for electricity supply in the UK. Parts of the UK were hit by damage to overhead power lines from severe weather, and England and Wales came close to having widespread blackouts because of insufficient generating capacity during periods of cold weather. The main problems in meeting demand were outages at six of Nuclear Electric's reactors (totalling 2.5GW), the loss of the French interconnector and a shortage of gas for power stations.

The reduced capacity and the high demand saw the pool price peak at 5.30pm on 7 December at over £1/kWh, more than forty times higher than the average price of just over 2.4p/kWh.

Pumped storage

Bidding for the National Grid's two pumped storage schemes, with a combined generating capacity of 2,088MW, ("Pump storage sell-off", SEJ107) has been won by Mission Energy of the USA. In beating rival bidders Dominion Energy, also of the USA, and Scottish Hydro-Electric, Mission offered £652.5m, well in excess of the £350m price expected by the City and the £443m valuation by National Grid.

Mission is also bidding for 4,000MW of generating capacity which National Power has been forced to sell off by the

electricity regulator, Offer. If successful, Mission will become one of the largest generators in the UK.

PowerGen

PowerGen is planning to build 700MW of combined cycle gas turbine (CCGT) generating plant at the former Gartcosh steelworks in Scotland. Scottish Power (SP), which clearly does not appreciate the possibility of an outsider coming onto its patch, has questioned the economics of the move given the massive generating overcapacity in Scotland, and has said the scheme would threaten the future of SP's 1,200MW Cockenzie coal-fired station and its 250 employees.

PowerGen, which hopes to have 350MW up and running by the year 2000 (employing 35 full-time staff), argues that it wants to offer a UK-wide service to its English customers with operations north of the border — at present it has just 40 customers in Scotland.

Both SP and Scottish-Hydro Electric (SH) have been expanding southwards since privatisation in 1991 — most notably with SP's £1.1bn acquisition of ManWeb, and SH's plans for a 755MW CCGT in Bristol (with British Gas), to follow up its 680MW Keadby CCGT joint venture with Norweb which came on stream in January 1996. By contrast, PowerGen's project would be the first large-scale development by an English generator in Scotland.

SP uses only around 40% of the capacity of its 2,400MW Longannet coal-fired power station, being tied to a must-take contract for 75% of Scottish Nuclear's output. The marginal fuel cost of electricity from Longannet has been put at 1.4p per unit, a price with which even CCGT can't compete.

Desperate to find a market for its electricity, SP has been upgrading the interconnectors to England and is planning a link to Northern Ireland. On the other hand, PowerGen, anxious to protect its market share in England and Wales has been vigorously opposing grid strengthening in the north of England which would allow Scottish Power to increase its exports ("Electricity industry", SEJ105). There is clearly little love lost between the two utilities.

Orimulsion

PowerGen's insurers have settled out of court over a claim for damage caused to hundreds of cars from the burning of orimulsion fuel at the generator's Richborough power station.

A claim by Prudential insurance for damage to crops in neighbouring fields ("Electricity industry", SEJ105) is still due to go to the High Court.

PowerGen plans to close the Richborough plant this March as it has reached the end of its operational life, but the company still burns Orimulsion at its Ince station. □

Renewable energy could do better

Embedded energy

A decision by electricity regulator Offer to call for cost reflective transmission charges will boost renewables developers efforts to get a fairer deal.

Sometimes faced with excessive connection and transmission charges, independent wind and hydro generators have long argued that by meeting local demand their electricity is supplied more efficiently. Some projects in England and Wales do receive a premium payment for supplying 'embedded' energy, where transformer losses are avoided.

The amount regional electricity companies (recs) pay for their use of the National Grid is based on their demand during three peak half hours in the winter (known as the Triad system). Charges based on the distance from the generation sources to the grid supply point (GSP) range from £5 to £17 per kW of demand per year. Each 1MW of embedded

generation supplied downstream of the GSP saves the recs between £5,000 and £17,000 a year.

A renewable energy investment fund is due to be set up soon by the Department of Trade and Industry's Energy Technology Support Unit (ETSU). Following a study and marketing programme by accountants Ernst and Young, ETSU is seeking a fund manager to carry out preparatory work for the fund to provide equity finance, particularly for smaller projects.

EU R&D

A supplementary call for proposals for European Union funding for renewables research and development was announced under the Joule programme on 16 January 1996. The move followed a minor scandal over underfunding of renewables in 1995 ("EC R&D funding", SEJ107) after the downgrading of many projects.

Funding of Ecu25m-30m will be available for wind power, photovoltaics and biomass projects. Applicants have until 14 May to make submissions. US cuts funding

US Energy Secretary Hazel O'Leary has accused Congress of ignoring voters' preference on energy. Her call followed cuts in funding for renewable energy and energy efficiency and an opinion poll, released in January, which showed popular support for renewables and energy efficiency. A majority of those polled wanted to see funding for fossil fuels and nuclear power slashed.

French support

A working group set up by the French Industry Ministry has recommended that France takes renewables seriously, particularly wind power. A target of between 250MW and 500MW by 2005 is likely to be set, with the group recommending a bidding system for projects. □

Energy saving works

EXPERIENCE from almost 200 energy efficiency schemes in the UK shows that they save money as well as energy. The schemes are funded by the regional electricity companies and run in conjunction with the Energy Saving Trust, with the approval of Offer, the electricity regulator. They show an average cost per kilowatt-hour saved of 1.35p compared with an average Pool price for electricity of over 2.4p.

In contrast to Offer, the gas regulator Ofgas has spent 18 months discussing what will be just the third such scheme in the gas sector.

The obstructive approach by Claire Spottiswoode, the gas regulator, has contributed to serious funding problems for the Energy Saving Trust. Even with the decision by the Department of the Environment to contribute £25 million in the year starting April 1996, £15m in 1997/8 and £10m in 1998/9, the Trust is still well short of its originally hoped for £400 million annual budget. The government, however, is no longer looking for the Trust to produce annual savings in carbon dioxide (CO₂) of 2.5 million tonnes, believing that its target of CO₂ stabilisation by the year 2000 will be achieved in other ways ("Berlin mandate", SEJ105).

The potential benefits of energy efficiency have also been shown in two other studies. The government's Building Research Establishment

estimates that up to 40% of CO₂ emissions arising from domestic energy use could be avoided using cost-effective energy efficiency measures. The findings of a two-year study by the Edinburgh-based Billsavers project on electricity used by



domestic appliances ("Energy saving pays off", SEJ106), showing the benefits of energy efficiency expenditure, are to be presented at a seminar in Edinburgh on 17 April.

■ It is expected that an attempt will be made this March by Labour MPs to amend the finance bill at the report stage to give "relief from the whole or part of VAT" on energy saving materials ("Efficiency move", SEJ107). The move

follows the decision to peg VAT on domestic fuel to 8%, and a 30% cut in funding for the Home Energy Efficiency Scheme, to £69 million, announced by the Chancellor late last year.

■ Labour leader Tony Blair has proposed improved government programmes on energy efficiency, creating up to 50,000 jobs. The policy is part of an environmental package which includes a target 20 per cent cut in carbon dioxide emissions by 2010.

Eco-labels

European Commission (EC) criteria for eco-labelling of single-ended light bulbs which came in to force on 15 December 1995 have not been well received by manufacturers.

The five main manufacturers (GE Lighting, Siemens, Osram, Philips and Sylvania) intend to boycott the scheme even though their energy-efficient compact fluorescent lamps (CFLs) all meet the criteria.

It is agreed that the vast majority of the impact of light bulbs is caused during use. The companies, which argue that the new label will confuse customers, prefer a simple energy label and are not convinced by the EC's suggestion of incorporating the eco-label as part of the energy label. □

Global climate change under way

A scientific report warning that global warming has already started ("Climate change", SEJ107) was officially adopted at a meeting of the Intergovernmental Panel on Climate Change (IPCC) meeting in Rome on 11-15 December 1995.

The meeting in Rome established that there is a definite and worrying link between global warming and human activity, and that there will be wide-scale impacts, hitting developing nations the hardest.

The report warns that greenhouse gas concentrations are continuing to rise and that the past few years have been the warmest since the 19th century. Particularly alarming is the prediction that the expected doubling of carbon dioxide levels in the atmosphere by the end of the next century will increase average temperatures by between 1 and 3.5°C. This compares with the increase in average temperature experienced since the last Ice Age of just 4°C.

The gloomy findings of the world's

leading climatologists was officially revealed alongside suggested solutions, laying the ground for international negotiations on reductions in greenhouse gas emissions at the Climate Change Convention in March.

The IPCC report states: "The balance of evidence suggests an appreciable human influence on global climate," and warns that global warming could accelerate out of control unless measures are taken to curb the level of greenhouse emissions released into the atmosphere.

At this politically sensitive time for climate change, a leading climatologist, Tom Wigley, of the University Corporation for Atmospheric Research in Boulder, Colorado, has released a controversial paper following the IPCC's report. Wigley has proposed that major cuts in the emissions of greenhouse gases should be delayed by up to 30 years until the full political and economic implications are clear. Only when more energy efficient technologies are developed should cuts in greenhouse gases get under way.

Analysing the economic implications of alternative strategies to reduce emissions is the only viable way ahead to curb the trend towards global warming, according to Wigley.

However, scepticism of Wigley's paper centres on how energy efficient technological innovation will occur without political impetus; investment for cleaner technologies is unlikely to happen without government pressure, which is equally unlikely unless international targets are agreed.

This may well soon occur: the IPCC's report has been submitted to the signatories of the Climate Change Convention which meets in March, in Geneva, to negotiate targets for cuts in greenhouse gas emissions. It is hoped that participating countries will reach a consensus on how much industrial nations should reduce their emissions after 2000, providing governments with the necessary go-ahead to pressure industry to develop more climate friendly technology. □

European hydropower roundup

Austria

A planned 14MW Austrian hydro scheme has been delayed following environmental opposition, while a 40MW project has been abandoned.

Austria already meets over two thirds of its electricity generation from hydro power and opponents of the Traun river development in Upper Austria argue that it is not needed. Demonstrators have occupied the site since early January, and work has been suspended by the utility Oberösterreich Kraftwerke AG pending a project review, ostensibly because of the uncovering of several human skeletons dated to 1945.

Environmentalists believe that the controversy over the Traun river project is linked to the decision by the southern Austrian utility ÖDK/Draukraft to cancel their plans for a scheme on the Upper Drau river.

Portugal

Four mini-hydro projects in Portugal, with a combined capacity of 30MW, are to benefit from loans totalling Esc1.1bn by Programa Energia, a European Union-backed government fund promoting diversification, expansion and improvement of energy production and use.

It is hoped that the fund will boost the mini-hydro sector which has suffered from falling electricity prices, a shortage of funds and lack of municipal authority support.

■ Seven consortia are bidding to construct the main wall of a hydroelectric and irrigation dam on the Guadiana river at Alqueva in south-western Portugal. The contract is to be adjudicated in July.

At a recent summit meeting between the Portuguese and Spanish prime ministers, further studies on the environmental impact on the Guadiana were agreed.

Turkey

Two large hydro-electric projects planned for the Euphrates river in Turkey are progressing. The dams, close to the border with Syria, are the final part of a programme to turn an arid and poverty-stricken region of Turkey into an agricultural and economic powerhouse.

Contracts for the larger, 189MW, Karamis dam, were awarded on 7 December 1995 to an Austrian and Turkish consortium. Construction is expected to take four years. A financing package for the smaller project, the 672MW Birecik dam, was also signed recently.

Slovenia

Slovenia is hoping to build a dam on its Save river to generate around 1,000GWh annually. The dam was originally one of a series of seven planned, only two of which were built. Development of the other five dams had been blocked, partly because of environmental concern: it was feared

that the water quality of the Save was so poor that restriction of flow would turn it into a sewer. The effect on the turbines of the high levels of pollution had also been raised.

However, Austria is keen to see Slovenia develop more hydro capacity in the hope that it will hasten the closure of the Krsko nuclear power station.

Norway

Calls for the closure of the Alta hydro-electric plant in northern Norway followed an earthquake in the region in late January. The epicentre of the quake, which registered 4.2 on the Richter scale, was 50km from the 120m high dam which retains 138 million cubic metres of water.

Late last year, the Norwegian director of public prosecutions called for the plant's closure, claiming it had damaged one of the country's best salmon fishing rivers.

United Kingdom

A 660kW hydro scheme on the Manchester ship canal, with an expected annual output of 3,200MWh, has been operating successfully since its opening in November last year.

The first hydro scheme operating under the Scottish Renewables Obligation is expected to be a 660kW project at Ardtornish Estate near Oban, Argyll, due to begin generating in April. □

Wood-fuel for heat and power

SWEDISH interest in using wood-fuel for combined heat and power (CHP) plant is high despite recent setbacks.

One project, using pressurised fluidised bed technology has closed because of long-term costs and a lack of commercial interest. And an experimental plant at Studsvik, considered by some government energy experts as the most successful attempt at gasification, is facing financial uncertainty because of higher than expected construction costs.

However, a number of other projects are planned. These include: a 170MW, SKr200m district heat and power plant for the city of Sundsvall, north central Sweden; a SKr300m CHP scheme in the north east; and a SKr200m plant to produce wood pellets for otherschemes.

CHP projects receive support from the Swedish government as part of its policy of phasing out nuclear power.

■ Switzerland has built 137 new wood-fired plants in the last three years with the help of subsidies from canton governments. As part of the federal Energy 2000 Programme, the Swiss Wood Energy Association is aiming to increase the importance of wood fuel as a source for the Swiss heating market, by up to 6% by the year 2000.

A wood-fuel project commissioned in the Russikon commune in Zurich Oberland, part funded by federal subsidies totalling Sfr458,000, appears to be successful. The 900kW, Sfr2.3m woodchip-fired heating furnace connected to the school's district heating system has replaced an oil-fired unit.

The process replaces 540 tonnes of heating oil with 6,800 cubic metres of woodchips. Many similar installations are being constructed throughout Switzerland. □

Geothermal

TURKEY'S geothermal energy resource has been assessed at 31,500MW by the state Institute of Mining Research, and approximately 1,045MW of this could be exploited at 600 suitable sites, according to the state Institute of Turkish Scientific Research (Tubitak)

Although there are several schemes using geothermal energy for district heating, most of the potential has remained untapped. According to the Tubitak, there are technical, financial and administrative hurdles. The main hindrance is administrative: there is no government department with responsibility for utilising the country's geothermal resource.

As Turkey imports around half of all the energy it consumes, it is important that the situation is resolved, Tubitak concludes. □

Wind power world league

EUROPE has overtaken the Americas in the world league table for installed wind power capacity according to a survey by the Riso National Laboratory in Denmark. Europe had an estimated 2,311MW at the end of 1995 compared with 1,872MW in the USA and a further 35MW in Latin America.

Germany is top of the table in Europe with an estimated 932MW — 1,130MW according to a more recent report by wind institute DEWI — however, its highly successful wind support programme finished at the end of 1995.

Installed wind power capacity in the UK rose 30% to 190MW in 1995 from 145.5MW in 1994, keeping it in fourth place in Europe, behind Denmark (614MW) and Netherlands (202MW). Seven new wind farms, five of them in Northern Ireland, were completed during last year, bringing the UK total to 29.

Spain, where Don Quixote tilted at windmills, is now Europe's fifth largest generator of wind-powered electricity with around 90MW of installed capacity. Endesa, Spain's major electricity utility, set a target of 750MW by the year 2000.

The regional government of Galicia in north-west Spain issued licenses for 2,550MW of wind power development at the end of 1995. It intends to issue further licenses until the region's estimated ceiling of 5,600MW is reached.

UK news

Developer Windcluster is to spend £100,000 establishing a community ownership scheme for its proposed 1.28MW (DNC) wind farm at Laggan on the Scottish island of Islay.

Half the cost of setting up the scheme is to come from the Department of Trade and Industry (DTI) Energy Technology Support Unit.

It is hoped to provide "a blueprint for community involvement in small wind farms," says Windcluster's Euan Cameron. Islanders will be offered the chance to buy shares in the wind farm.

A similar scheme, also backed by the DTI, is planned for Harlock Hill in Cumbria. A five-turbine project by The Wind Company will include community involvement along co-operative lines.

■ Scotland's most remote youth hostel, Glen Affric, Inverness-shire, is now supplied with heat and light by its own wind turbine. The hostel, which is ten miles from the nearest road or mains power, has installed a 2.2kW turbine manufactured by Proven Engineering, Ayrshire.

Romania

Four different versions of a Romanian-designed Eoltim vertical axis turbine, with a combined output of 3MW, have been erected at a site in the Carpathian Mountain region of Romania. The Romanian Wind Energy Association hopes that the most successful design will be used for 15 wind farms of 4.5MW.

India goes Danish

India has installed 200 turbines designed by Danish manufacturer Nordex and manufactured in India under license. □

Scottish renewables problems

SCOTLAND'S first wind farm, at Hagshaw Hill near Douglas, Lanarkshire, has been generating under a Scottish Renewables Order (SRO) contract since November 1995, but until mid-February was not being paid for its electricity. Delays in reaching agreement between the Scottish Office (SO) and the utilities, Scottish Power and Scottish Hydro-Electric (SH), on how funds to pay the premium price for SRO projects should be raised meant that contractually the utilities were under no obligation to pay the tender price of around 4p per kWh to Hagshaw Hill's developer, Trigen.

This has left a shortfall of around £500,000, forcing Ecogen, one of the three companies involved in Trigen, to lay off staff. Even if the money is paid at the end of the 15-year contract period, under commercial discount rates it will be worth only a fraction of its present value to the companies. The SO believes that backdating of the full contract price would require primary legislation and Trigen, if it is paid at all, may get just 1.4p/kWh for the electricity generated up to mid-February.

Ever since the plan for a SRO was first proposed, several years after its English and Welsh Non-Fossil Fuel equivalent, the enthusiasm of the SO for the scheme has been questioned, and SH

is opposed to any significant development in its area by other companies.

The current Secretary of State for Scotland, Michael Forsyth, has been described by one renewables developer as being "open" on renewables, a more positive position than his predecessor Ian Lang, now President of the Board of Trade. Although environment minister Lord Lindsay appears to be supportive of renewables, industry minister George Kynoch is considered "lukewarm".

The SO has always dragged its feet on renewables, with the SRO seemingly being set up out of embarrassment at the progress being made south of the border and developers applying for NFFO contracts to supply England and Wales from sites in Scotland.

Unlike the rest of the UK, projects in Scotland have not only to go through the local planning process but are automatically sent to the Secretary of State, Michael Forsyth, for SO consideration. As with the rest of the UK, they also face the possibility of being 'called in' for a public inquiry.

The Hare Hill wind farm near New Cumnock, south-west Scotland, was inexplicably called in April 1995 ("Scottish wind developments", SEJ106) but with no major objectors, the hearing was concluded in a day with no-one contesting the scheme.

Another wind project to have recently got through the planning process without a public inquiry was Fred Olsen Ltd/National Wind Power's 20MW project at Windy Standard, near Hare Hill, which was granted approval by the SO this February, with construction starting in March.

■ With only one wind farm up and running and many proposals at the planning stage, Scotland is suffering from a renewable energy backlash.

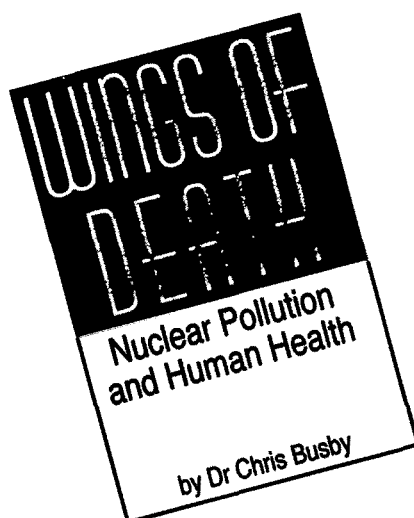
Two wind farm proposals at Helmsdale, Sutherland, to be considered by Highland Regional Council planning committee on 20 March, have received around 400 letters and a 1,279 signature petition in objection. Given the size of the local population, this level of opposition at first appears incredible. However, anti-wind group Country Guardian has been active in building up opposition and asking its members throughout the UK to write to the council.

While this is a well-recognised campaigning technique, Country Guardian suggests: "If you can make them feel that you will not be spending your money as a tourist in Sutherland if this goes ahead, they may think twice!" As *Windpower Monthly* put it: "This begs the question: how many of Country Guardian's members are indeed planning to spend their holidays in Sutherland?" □

Is strontium-90 the cancer villain?

Wings of Death: Nuclear Pollution and Human Health
by Dr Chris Busby

Green Audit Books,
1995, 340pp, £10.99



THIS is a challenging book which deserves close attention. The title sets the agenda: "life on earth is suffering a silent and frightening attack on its genetic integrity." For Chris Busby the major villain of this attack is not plutonium or any of the alpha emitters, but the fission product strontium-90, released in large quantities during the period of atmospheric nuclear weapons tests and also in reprocessing.

Why strontium-90? Chris Busby's thesis is that ionising radiation is much more damaging to a cell if there is a second damaging event within the short — 10 hours or so — period when the cell is repairing itself. He argues that strontium-90 is possibly the most dangerous example of a second-event emitter, because it produces a daughter isotope (yttrium-90) which is also a beta emitter. He estimates that there is a significant probability that this second decay will further damage cells already affected by the initial strontium-90 decay, and therefore that conventional doses from strontium-90 have been seriously underestimated.

This is not an entirely new idea; Busby goes back to a number of cell culture and animal studies done in the 1970s, which he says show the effect but are not accepted as such today by the radiation establishment. Busby claims that this is because split dose experiments—splitting a dose into two portions several hours apart—were incorrectly bracketed with experiments in which dose protraction was continuous. In the latter case there does seem to be general agreement that more protraction (ie, a lower dose rate) leads to a reduced effect.

My knowledge of radiation biology is not extensive enough to assess how plausible the 'second-event' theory is. But whether or not the concept is plausible in radiobiological terms, ultimately the idea stands or falls by the reality (or otherwise) of effects attributed to it. Busby claims that many diseases have increased as a result of strontium-90 in fallout and

discharges: ischaemic heart disease, infant mortality and still births, cot death, and of course cancer, which forms the main thrust of his book. He claims that the effects are more pronounced in Wales, because of its higher rainfall and therefore higher fallout.

Unfortunately, in his single minded pursuit of the strontium-90 villain, Chris Busby (in my view) misreads some of his sources and is selective in his use of data.

To take one example — from many — in some detail: in the very first chapter, Busby quotes a *British Medical Journal* paper of two years ago (by Coggon and Inskip) which, he says, answers no to the question: Is there an epidemic of cancer? In fact Coggon and Inskip say there is a "slowly evolving epidemic" of cancer—lung cancer due to smoking. Busby claims that the epidemic of cancer is self-evident, but shows a diagram of an increasing trend in cancer which I suspect must be dominated by lung cancer (and even Chris Busby doesn't attribute that to strontium-90). Coggon and Inskip show cancer death rates by year of birth on a logarithmic scale, a method that Busby describes as 'incomprehensible' — but this method is commonly used simply because it enables a wide range of death rates to be shown on one diagram.

He claims that Bentham's 1991 paper supports his contention that there was an increase in infant mortality in Wales following Chernobyl, but on consulting the original paper I find that Bentham drew the opposite conclusion. And in Bentham's later (1995) study the results, according to the authors, "might be explained by survival and

registration changes, or chance in the case of registrations, but do not exclude the possibility that low doses of radiation from fallout were responsible for an increased risk of leukaemia in young children in Great Britain," Chris Busby claims that the results demonstrate a "clear effect", even though his own diagram which reworks their results shows that the difference in death rates between the second periods of low and medium fallout (the rate in the 'low' period being *higher* than that in the 'medium' period) is comparable with the difference between the 'medium' and the 'high' periods.

The last example is an illustration of some general statistical problems in the book: too much weight is put on selected point estimates, and there is virtually no mention of confidence intervals; doing lots of significance tests will inevitably throw up some spurious false positives; and a significant correlation coefficient denotes association but never tells us anything about causation.

Having said that, there is much here with which I sympathise and agree: the increasing proportion of research driven by vested interests, the facile conflation both of internal and external exposures and natural and artificial radiation, the strong establishment tendency to seek explanations other than radiation for childhood leukaemia. Challenging accepted wisdom is hard going and although some (but by no means all) challenges to dominant paradigms have subsequently been vindicated, I fear that Chris Busby may be trapped in the mirror image of the same delusional state as the nuclear industry, where all the evidence fits into a preconditioned view and there are conspirators under every bed.

Nevertheless, some of Busby's hypotheses can and should be investigated. Curiously, Scotland is almost absent from this book; one important project would be to examine cancer rates in the West of Scotland, where the rainfall is high and the quality of the cancer registration is good—unlike the England and Wales cancer registries which are highly variable in their completeness of registrations. I hope it can be done, preferably in as independent a way as possible.

David Sumner

Power changes in South Africa

Poverty and power: energy and the South African state

by Anton Eberhard
& Clive van Horen

Pluto Press, 1995, 227 pp, £ 11.95.



A lot has been written about South Africa lately. Nelson Mandela has become the celebrity of our time as stories of racial reconciliation in South Africa have excited the global public.

Certain themes have been ignored in the discourse on South Africa, however. The environment — perhaps not surprisingly — has been one. Unfortunately, South Africa's environmental problems nevertheless are most severe. South Africa, for example, produces more greenhouse gases per capita than any other country in the world (2 % of the world's total!).

The energy sector plays a crucial part in this devastation — as Eberhard and van Horen amply demonstrate. South Africa's energy supply is notoriously unsustainable. Sub-Saharan Africa's only nuclear power station is at Koeberg, South Africa. The attending nuclear waste dump is situated at Vaalputs on the west coast. The Atomic Energy Corporation has received between 40 and 89% of the state funding for the energy sector since 1970. Most of the rest has been invested in coal. To make things worse,

most coal-fired power plants are situated on the Transvaal Highveld where there is little air circulation. Poor, black communities live 'down-wind' from these plants. And — like two thirds of the population — they are not connected to the national power grid. They thus depend on coal (or paraffin) for personal use. The health costs are extreme, with levels of respiratory diseases and infant mortality several times higher than those of electrified (usually white) households.

One could go on. Indeed, Eberhard and van Horen do; and it makes fascinating, if often depressing, reading. Their book brings together several years of research on energy policy conducted by the Energy for

Development Research Centre, University of Cape Town. It is thus packed with information. It also, thankfully, allows easy access to data which was 'hidden away' in conference papers and internal memos in the past. *Poverty and Power* is the well-written manifesto of two academics who have never been confined to their Ivory Tower. Indeed, Eberhard and van Horen have played a crucial role in devising the Energy Policy Discussion Document of the new Government (June 1995). Their book thus gives clues (and hope) on South Africa's future energy policy.

Unfortunately, the two authors occasionally laps into technocratic managerialism. They have an overdeveloped belief in cost-benefit analysis, cheerfully discussing the 'most rational' distribution of the social costs of energy production (including deaths). Overall, however, they show a keen social conscience. They successfully link question of sustainable energy use with those of social justice (eg, through the demand for electricity access for all).

Poverty and Power, therefore, is not only the best available study of the South African energy sector. It can also help all of us in thinking about the possible convergence of ecological and social agendas for energy policy worldwide.

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9 - 12 July 1996

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Country Guardians



Little Black Rabbit would like to point out that a former director of the rabidly anti-wind group Country Guardian, Eddie Wren, has denied the quote attributed to him by *Clean Slate* magazine and reported in SEJ103.

Be warned, repetition of the quote may result in the threat of legal action from Mr Wren. As to the accuracy of the quote? LBR couldn't possibly comment!

Country Guardians 2



In an interesting move, Country Guardian, those "protectors of the countryside", have appointed a US representative. He is Raymond Suitor, a real estate developer and a former executive with the Exxon oil company. LBR's saying nothing.

Mewtations



Four black kittens were found abandoned in San Onofre nuclear plant, California. A stray pregnant cat had apparently sneaked into the plant under a boundary fence, evading infra-red beams, before giving birth. The mother fled from the site leaving her offspring to fend for themselves.

Plant workers who found the kittens have named them Alpha, Beta, Gamma, and Neutron; rather appropriate as they were found to be radioactive. It is believed that they became contaminated after drinking radioactive water from leaking pipes.

Nuclear films



Ever since its closure in 1991, people have been wondering what to do with the Sir Basil Spence-designed Trawsfynydd nuclear power station. The UK's only inland nuclear station, set in a national park on the shore of a now radioactive lake, it is not due to be entirely dismantled for 135 years. The nuclear plant was previously the subject of a BBC Wales-backed architecture competition to try and make it look nicer. Now, a consortium of Welsh local councils has come up with another idea. They propose that the turbine hall be used as a movie studio.

The power station did after all make an appearance as Camelot in the film *First Knight* - strange but true.

Tartan reactors



Pre-privatisation merger of Scottish Nuclear with its English and Welsh counterpart to form British Energy (BE) caused concern north of the border that the Scottish generator would be subsumed by the larger Nuclear Electric. The sop to these concerns was that the BE HQ would be in Scotland and its Chairman would have Scottish credentials.

This has duly come to pass with the appointment of John Robb and the opening of an office in Edinburgh. But the possibility of a private sale to an overseas company makes all this seem rather hollow.

Undeterred, Scottish Nuclear has set about demonstrating its Scottishness and autonomy. It now has its own tartan, which will be worn by tour guides at the Torness and Hunterston power stations. The director of production at Torness, Bill Doig, explained: "we feel that a tartan in the Scottish Nuclear corporate colours of red and blue will get across the message to visitors that we are a Scots company with a strong identity and successful track record."

Car wars



General Motors' launch of the first production electric car may seem like good news, but on closer inspection, cynics have reached a different conclusion.

Despite denials of any deal, the GM announcement suspiciously coincided with a decision by Californian Air Resources Board to drop its target for 2% sales of zero-emission cars by 1998.

Although the Board's 10% sales by 2003 target remains in place, LBR wonders for how much longer. *Automotive News* in the US reported that the big car and oil companies had jointly commissioned the Rand Corporation to produce a critical study of zero-emission vehicles.

The GM two-seater coupé is based on lead acid batteries. While this doesn't put it in the Sinclair C5 category, it does limit the car's range to just over 100km, less in cold weather.

Hardly the performance one is looking for from a \$35,000 car.

Could this be a ploy to kill off the electric car before improved battery technology becomes commercially available?

Labour labours over labour



Labour's employment spokesman, Ian McCartney, recently criticised "the latest utilities' jobs massacre" at ManWeb and Northern Electric: "Cutting staff may give a quick fix to the balance sheet, but it does not necessarily improve services to the customer, who also ends up paying for the former utility employees to be unemployed."

However, Geoff Norris, chief industry adviser to Tony Blair, is espousing a rather different Labour line. He has attacked critics of the 42,000 job losses in the electricity industry since 1990, and argued that further cuts are needed if the British electricity industry is to match the manpower efficiency levels of US utilities.

LBR wonders which line represents Tony Blair's position.

Ad-versity



In a move to avoid the possibility of a Labour government imposing a windfall tax on the electricity utilities, their trade body, the Electricity Association, has asked Saatchi & Saatchi to prepare a £6m promotional campaign "to have the Labour Party feel there is less public demand for intervention in the electricity industry." However, some utilities fear such a blatant and profligate move may be somewhat counter-productive.

Another company with advertising cold feet is Nirex, the government's nuclear waste disposal company. After its less than convincing showing at the recent 'rock lab' public inquiry in Cumbria, Nirex has withdrawn a Saatchi & Saatchi ad campaign promoting underground disposal of radioactive waste, deciding that the timing was wrong.

Punk rock lab



One of the witnesses for Friends of the Earth at the Nirex rock lab inquiry was David Smythe, professor of geology at Glasgow University, who was highly critical of Nirex. LBR can remember back to 1977, and a very different Mr Smythe. In those days, he played bass guitar for the Rezillos punk rock band. And his views of anti-nuclear groups were somewhat different too. Being in favour of nuclear power, he refused to join the band in a benefit concert in Edinburgh for this journal's founder, the Scottish Campaign to Resist the Atomic Menace.

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Wylfa long-term safety review - A pointer to the AGRs?

FACED with the government's lack of enthusiasm for public financing of new reactors, the nuclear industry is trying to extend the life of its older power stations. With the publication of the Nuclear Installation Inspectorate's (NII) findings on Wylfa in December 1995, the long-term safety reviews (LTSRs) of the magnox stations have now been completed. Attention will now pass to the future of the advanced gas-cooled reactors (AGRs). Closure will convert a nominal asset into a massive liability. At the heart of the judgement that prospective purchasers of the AGRs must make is how long they will last. Wylfa shares certain characteristics with the AGRs and there are lessons for the forthcoming AGR safety reviews.

When Wylfa, the last and the largest magnox nuclear power station, was ordered in 1963, it was designed to supply 1,180MW. This proved to be the limit for 'scaling up' low power-density magnox reactors.

As a result of delays in construction and problems in operation, Wylfa has generated only 46% of the maximum electricity output from its scheduled start. However, its very size means that its operators will try to keep it running.

The use of prestressed concrete to form both the pressure vessel and the biological shield meant that Wylfa could be scaled up to over twice the size of the steel pressure vessel magnox reactors, making it almost a prototype of the AGR. In 1965, the first AGR station to be ordered, Dungeness B, had a design output of 1,200MW.

A massive concrete structure allows the heat exchangers (boilers) and the fans that circulate the cooling gas to be contained within the pressure vessel. There are no gas ducts to leak or break, reducing the chances of an escape of the coolant gas. To protect the concrete there is internal insulation and a 20mm thick 'leak proof' steel lining.

Down below the charge face is the outside of the massive prestressed concrete pressure vessel, and in amongst the rows of bolts clamping the ends of the tension cables that give the concrete the strength to withstand pressure, is an access hatch through which employees enter the fiercely radioactive environment from time to time to inspect its contents.

The NII has said that with certain provisos Wylfa can continue to operate until the year 2004. The provisos relate to the need for increased inspection and surveillance of the reactor internals, because of the degradation of graphite and steel through oxidation, ageing and corrosion.

At Trawsfynydd, and the older magnox stations with steel pressure vessels inside the concrete biological shields, inspection is only possible using remote control cameras and techniques. But at Wylfa and other reactors with concrete pressure vessels more maintenance and inspection will directly increase the radiation exposure of station staff. The NII have made it

clear that they will require the net benefit of longer-term plant operations to take this additional dose into account and show that it is justified.

Wylfa's Problem - Its Design

Vibration

Before Wylfa was completed it was found that the insulation could not withstand the hurricane force flow of coolant gas. The fans were capable of setting up a "mode of vibration which had not been anticipated which dislodged a plate securing the insulation." ⁽¹⁾

High temperature

Because Wylfa runs at higher temperature and pressure, this increases the possibility of damage. Corrosion problems related to temperature led to the magnox stations being 'downrated' ⁽²⁾. Wylfa's output had to be reduced more than the others, by 29%.

High pressure

A secret internal document stated that Wylfa could run for only 20 years because of "higher gas coolant pressure causing increased steel and graphite damage." ⁽³⁾

Graphite corrosion

In 1984 the Central Electricity Generating Board claimed that its concern about "the effects of radiolytic corrosion of the graphite moderators at Oldbury and Wylfa" and the early operating experience at Wylfa that "raised doubts about the economic lifetime of the boilers" ⁽⁴⁾ had been overcome.

Boiler tube failure

It is known that there have been at least 109 boiler tube failures at Wylfa. Because the boilers are inside the pressure vessel, they cannot be replaced, so the failed tubes are blanked off permanently.

"With the publication of the NII findings on Wylfa, attention will now pass to the future of the advanced gas-cooled reactors"

AT 28.1 kg/cm² the gas pressure at Wylfa exceeds all other magnox stations, and is three times as great as Berkeley. It was designed to operate with a coolant gas outlet temperature of 414°C, higher than any other magnox station. Wylfa had to be 'downrated' to 840MW before it was even commissioned in 1971, in order to try to avoid the rapid corrosion that affected all the magnox stations after Berkeley.

When Nuclear Electric took over the CEBG nuclear stations in March 1990, John Collier, the new Chairman, set out his goals: "Continued increased electricity generation; increased turnover and, as a result; increased profit ..." ⁽⁵⁾

And in October 1990, just three months before the 20 year safety review was due, the Nuclear Inspector gave the go-ahead for Wylfa to run at higher temperature. Periods of maintenance at Wylfa during which the reactors are shut down have been reduced in duration, and the station has been run harder than it had ever been before.

By April 1993 the manager of Wylfa, Mike Williams, could boast that "This is the third year in succession that we have succeeded in improving on our generation performance and completing a reactor overhaul in record time." ⁽⁶⁾

Wylfa has now been running for 25 years and there is increasing concern that design problems, ageing components and commercial pressures are combining to threaten safety.

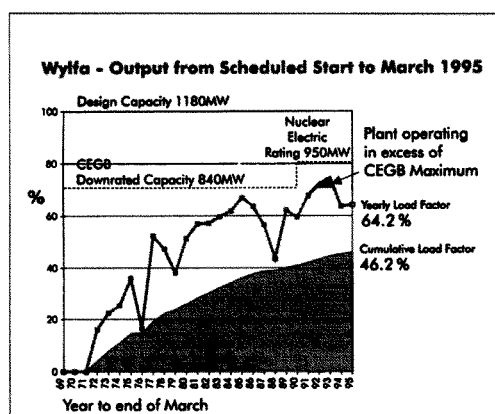


Fig 1 (Performance load factors etc.)

ONLY in September 1995 did the British public discover the gravity of an incident at Wylfa which had occurred in July 1993. Britain's Chief Nuclear Inspector said in prosecuting Nuclear Electric that it was potentially the most serious incident he had encountered in his career.

The NII's use of the term 'melt-down' at the Wylfa prosecution was challenged by Nuclear Electric as only one fuel channel would have been affected. The problem at Wylfa is that it is difficult to predict the outcome of even a single fuel channel fire and melt-down. Molten uranium metal fuel if it burned through the metal base plate at Wylfa would come into contact with concrete which contains enough oxygen to sustain combustion.

The NII claimed the nine-hour delay in shutting the reactor down on 31 July 1993 "may have been affected by commercial considerations". The graph (Fig 1) confirms that the station was being run at well beyond its pre-1990 limit when the refuelling grab broke.

The nuclear industry was born in secrecy, and this has protected it, but it is known that there have been at least 30 other incidents at Wylfa. (See back page of this briefing)

Sir John Cullen, former Chairman of the Health and Safety Commission, has commented that although many such incidents appear trivial: "... almost all such incidents reveal a failure in quality management, a sign that all is not well, and perhaps a symptom of something more serious waiting to happen." ⁽⁷⁾

The Human Factor

The ability of operators to perceive dangers and act promptly is essential for nuclear safety. In practice it is compromised by: failure to recognise the warning event, human reluctance to fear the worst, excess, ambiguous or complex information, institutional assumptions and rigidities of belief, and performance targets that can eclipse formal rules and regulations.

It is not just the accidents that cause concern. Reactors designed to last 20 years have now been operating for 25 years, yet we are not allowed to see the safety documents upon which continued operation depends.

Trawsfynydd, the other Welsh magnox station, was 26 years old when it stopped generating electricity in February 1991. Doubts about the integrity of its steel pressure vessel could not be resolved.

Wylfa's concrete pressure vessel withstands the temperature and the intense pressure of the gas coolant because it has steel cables wound tightly around the outside. These were tensioned during construction and cannot be 're-tensioned'.

Gas-cooled Reactor Design Temperature & Pressure

Civil Nuclear Station: (Closed plant shaded)	Pressure Kg/cm ²	Design Outlet Temp °C	Downrated Inlet/Outlet Temp °C
Berkeley	9.8	345	160/350
Bradwell	10.3	390	170/360
Hunterston A	10.6	396	194/380
Hinkley Point A	14.1	373	180/360
Trawsfynydd	17.9	390	180/360
Sizewell A	19.6	410	220/360
Dungeness	19.9	410	220/360
Oldbury	24.6	412	220/360
Wylfa	28.1	414	230/360
Dungeness B AGR	34.3	673	
Hinkley Point B AGR	42.4	634	
Hunterston B AGR	42.4	639	
Heysham I AGR	42.2	639	
Hartlepool AGR	42.4	639	

WYLFA LONG-TERM SAFETY REVIEW

THE problem is that over the decades concrete shrinks, cracks, and, in an intense carbon dioxide environment, carbonises. Steel cables, on the other hand, creep and progressively lose their tension. The life of the Wylfa power station may eventually be determined by the failure of its pressure vessels. We have been told that "more optimistic assumptions" have been made that: permit Wylfa to continue to operate beyond 20 years; permit it to operate at higher output; and justify the intention to operate Wylfa until it is 40 years old.

In 1986 the Secretary of State for Energy was asked whether he would deposit in the House of Commons Library the current updated safety case for one of the magnox nuclear power stations subject to a 20-year safety review.

He replied: "I understand this would be impracticable. The cases comprise a very substantial amount of documentation much of which is commercially confidential ..." ⁽⁸⁾

Aims of review

The purpose of the long-term safety review is:

- to confirm that the plant is adequately safe for continued operation;
- to identify and evaluate any factors which might limit the safe operation of the plant in the foreseeable future;
- to assess the plant's safety standards and practices and introduce any improvements which were reasonably practicable.

All structures, systems and components susceptible to ageing or wear-out are examined and failure mechanisms, together with life limiting features, identified. These factors have to be evaluated, particularly for aspects which may eventually result in an unacceptable safety case and, ultimately, dictate the safe working life of the power station.

A summary of the Inspectorate's findings on the long term safety review for Wylfa is not enough.

The consultation period on relicensing must be opened up to the public, extended, to allow examination of the LTSR, and all the documents upon which public safety depends published in full.

Wylfa long term safety review - the salient points

Components in the reactor cores are susceptible to deterioration through such ageing mechanisms as oxidation and in-service wear, and cannot be renewed should they become deficient. Monitoring, inspection and regular safety assessment are consequently important.

Degradation of graphite means that the long-term integrity of these complex structures will be checked through enhancing the surveillance programme and more detailed structural analysis. Mild steel ageing degradation processes include oxidation by the coolant gas, fatigue, fretting and creep. Safety related components located within each reactor pressure circuit are monitored and inspected.

The core restraint is a complex system which is essential to maintain the overall stability of the reactor core. It cannot be inspected, so we have to depend on the original design safety case and predicted effects associated with oxidation, creep, fatigue, irradiation, common mode failure and fault conditions. In contrast to the steel magnox stations, which have boron ball shutdown devices, there is no alternative means to shut down the reactors at Wylfa. Rapid depressurisation is regarded as a fault that is "beyond the design basis". If the core is distorted by an earthquake (there are tell-tale diagonal cracks in the turbine hall wall from an earthquake in 1984) the rigid control rods might not be able to shut down the reactors. They are to be replaced by articulated control rods.

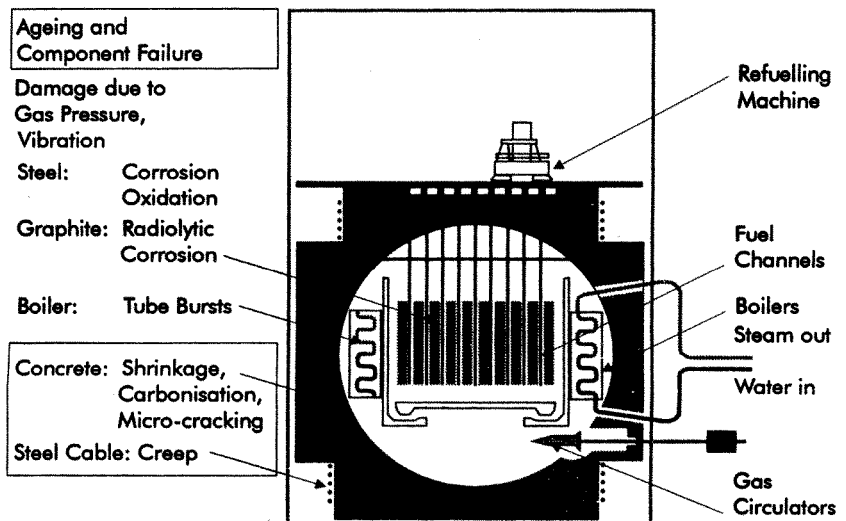
Radiation exposure arising from maintenance operations such as vessel inspection will increase as the reactor ages, and the inspections have to be more frequent. ⁽⁹⁾

THE history of nuclear power in Britain is one of official optimism, based on unsubstantiated assurances, followed by cover ups, the belittling of adversity, and occasionally, grudging recognition of real problems. At Wylfa, we have come full circle with official optimism replacing earlier secret doubts.

Unless there is far more openness about the entire safety case for Wylfa, and its assumptions, there is no basis for the public to trust the experts. As Sir John Cullen points out: "History, I am afraid, tends to support the public's suspicion that the unexpected may just happen." ⁽¹⁰⁾

Now we can glimpse the future: commercial pressure to extend the lives of AGRs (whether privately owned or not) may put workers at increasing risk, as personnel carry out greater numbers of increasingly hazardous inspections and repairs.

Wylfa - Old Problems and New Doubts



Known incidents at Wylfa nuclear power station (with source in brackets)

1976, June 8	Release of Carbon Dioxide coolant gas reported as a 'serious incident' under the Dangerous Occurrences Regulations 1965
1976, Dec 21	Empty used nuclear fuel flask returned from Windscale with external contamination higher than permitted levels. (NII)
1977, June 30	Small fire in No. 2 building when work on ventilation ducting set the floor and external wall alight. Fire brigade put out fire in 15 minutes. (NII)
1977, Dec 5	Small fire in oil-soaked lagging on a main turbine, put out by staff. (NII)
1978, Jan 7	Coil in an electrical panel in the cooling water pump house overheated. (NII)
1978, Feb 5	Seeping of reactor coolant gas from valves contaminates four workers. (NII)
1978, April 17	No. 2 reactor shut down for 5 weeks. Insulation plates and trunking within the pressure vessel were displaced, due to failure of fixings, disabling thermocouples. (NII)
1978, July 16	Turbo-alternator shed blade, and heavy vibration fractured oil filter releasing 2,000 gallons of lubricating oil. (NII)
1979, Jan 7	Design fault with the refuelling equipment led to damage to one of the standpipe assemblies, through which fuel is put into or taken out of the reactor. (NII)
1979, July 9	Turbo-alternator fire, brought under control by station staff. (NII)
1980, May 5	Worker contaminated, principally with cobalt, which was ingested. Source of contamination not found. (NII)
1980, Oct 15	During modification of the 'irradiated fuel reception area' a maintenance engineer was contaminated, principally with cobalt, which was ingested. (NII)
1986, Feb 10	Uncontrolled discharge of radioactivity — no significant effect on local produce (PQ 30/6)
1986, Aug 29	30,000 gallons of unsampled radioactive water leaked into the sea. (Press)
1986, Oct 29	Reactor shut down after a leak of 'mildly' radioactive carbon dioxide. (Press)
1987, Jan 9	Reactor shut down after a control rod was dropped into the reactor core due to an electrical fault. (Press)
1988, April 28	Loss of cooling to Dry Store No. 5 (Wylfa News - WN)
1988, July 27	Fuel element grab became detached from the hoist rope. Grab recovered Aug 2. (WN)
1988, Aug 13	Refuelling grab and solenoid detached from the rope of the hoist. Reactor shut down "later that day" to recover the grab and solenoid. (WN)
1990, July 30	Ingress of water into Dry Cell No. 4 found to have badly corroded some fuel elements (46 elements) (WN)
1990, Sept 5	Carbon dioxide gas leak during operation to purge reactor 2 with air for scheduled overhaul. (WN)
1990, Dec 14	Fault found in Pile Cap Crane. INES level 1 because "there was a potential for damage to reactor equipment". (WN)
1991, Feb 9	Faulty relay found which could have hampered gas turbine supply in an emergency. INES level 1. (WN)
1992, Nov 18	Damaged control rod found in Reactor 2. (WN)
1993, July 31	Part of a grab used for refuelling became detached "and was missing". Initially rated INES 0, later upgraded to INES 2. (WN)
1993, July 31	Unauthorised discharge of sulphur-35 following shut down. INES level 1. (WN)
1994, March 18	Two new fuel elements stuck in charge chute of standpipe. INES level 1. (WN)
1994, May 8	Charge chute in reactor 2 not located properly within standpipe. Gas leaked. INES1. (WN)
1994, June 13	Air admitted to fuelling machine reactor 2, breaking the rules. INES level 1. (WN)
1995, Aug 24	Drum of low level waste inadvertently incinerated ahead of schedule breaching monthly active waste limit. Breach discovered Jan 1996. INES level 1. (WN)
1995, Nov 6	Liquid CO ₂ entered the reactor 1 CO ₂ ring main during outage, causing rapid cooling. INES level 1. (WN)

Key: PQ = Parliamentary Question. WN = Wylfa News. NII = Nuclear Installations Inspectorate INES = International Nuclear Event Scale

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