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Learning from Chernobyl

As the accident that blackened the name of nuclear power fades from memory, openings present themselves for the technology to edge its way back into public favour.

The image is a resonant one and rests indelibly in the mind. The plant sits, fuming restlessly, while all around an inept Soviet bureaucracy crumbles into the ensuing chaos. No one knows how many will have died as a result of the radioactive cloud expelled by Chernobyl's number 4 reactor on 26 April 1986; the fact that people are still debating it (see pages 982 and 993) says enough.

Skip forward 20 years, and nuclear power is edging back into vogue. It wasn't just Chernobyl that drove it out of favour, of course: the Three Mile Island incident in Pennsylvania in 1979, a catalogue of economic and technical setbacks in several nations, and the surprising resilience of fossil fuels as a cheap and available source of energy had already seen to that.

As memories of these mishaps recede, other factors have arisen to bring nuclear power back into play. Energy prices are high again, and governments are seeking to tackle climate change by limiting fossil-fuel emissions. Economists from California to Calcutta are looking at pie-charts of their future energy supply and saying that nuclear power needs to play a role. Will it?

The answer is a qualified yes — provided that governments absorb the true lesson of Chernobyl. This is not that nuclear power is unsafe, but that it is unsafe in the hands of a corrupt, unaccountable, irresponsible political system that fails to take reasonable measures to protect its citizens. The future of nuclear energy does not hinge primarily on the development of a safer reactor or a more geologically reliable waste repository, but on the ability of states to build public trust in their ability to safely implement and manage the technology.

Building trust

This trust can be achieved in different ways. In France, where the public appreciates the centralized technocracy that brought it high-speed trains, Concorde and an independent nuclear deterrent, nuclear power is ubiquitous and widely accepted. Scandinavian nations have a different political tradition, in which inclusive decision-making may soon open the way for the world's first permanent nuclear-waste repositories. Elsewhere, however, the future of nuclear energy is uncertain. The mechanisms that will assure its acceptance are not yet in place.

The key elements of this equation are the same the world over: nuclear power's real and perceived links with nuclear weapons; the available technology for power generation; its safety and economics; and options for clean-up and waste disposal.

Recent events in Iran serve as a painful reminder of the interaction between nuclear power and nuclear weapons. From the days of the 'Atoms for Peace' movement in the 1950s, advocates of the former have sought to separate the two, but they are inextricably linked. Public acceptance of nuclear power in Europe, Japan and the United States would benefit from a credible strategy to contain the proliferation of nuclear weapons. Expansion of nuclear power elsewhere, on the back of further proliferation of nuclear weapons, could have disastrous consequences.

The technology of nuclear power plants continues to improve (see *Nature* **429**, 238–240; 2004). Chernobyl was a vastly archaic reactor whose safety systems, regulation and management were not close to acceptable standards. Modern working reactors are not susceptible to Chernobyl-style accidents, and some designs now under consideration could be safer still.

But safe reactor design, unfortunately, provides little protection against current fears — floated again this week in a sceptical report from a committee of British members of parliament — that nuclear plants may be vulnerable to terrorist attack.

Counting the cost

The economics of such plants are subject to fierce debate (see page 984). The deregulated power-generation markets that have taken shape over the past two decades have little appetite for nuclear power's combination of high build costs, low running costs and uncertain future liabilities. Old debates about how many cents it costs to produce electricity have been superseded by a more subjective discussion about what goes in the bucket labelled 'costs'. Restoring sites to a pristine state may be prohibitively expensive, as may the permanent disposal of waste and spent fuel. The construction of new plants will require either financial guarantees from the state (in Britain or the United States) or direct government involvement (in India or China).

Finally, nuclear-waste disposal remains the industry's Achilles' heel. For governments that advocate nuclear power to offer no solution — and leave spent fuel and other waste on the surface for future generations to deal with — is an abdication of responsibility. The threat of terrorist attack on nuclear power stations, as well as the risk that their spent fuel could be stolen and used for such an attack, renders the notion of long-term, localized waste storage at multiple sites even less tenable than it was before.

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Different approaches are being taken to the management of waste disposal. Yucca Mountain in Nevada is in grave danger of becoming an expensive monument to failure (see page 987). The site was selected by default when Nevada was too weak to remove itself from the process — a hopeless, unscientific approach that may now reap what it sowed. Scandinavian states are doing a little better; Finland is winning support for a repository on the basis of a continuing nuclear energy programme, and Sweden is doing so on a promise to wrap the whole thing up. France has made some headway in site selection and can be relied on to address the issue with its customary

determination. Britain has to start again from scratch, and is using its Committee on Radioactive Waste Management as an interesting, if not entirely convincing, experiment in public consultation.

So far, India and China, the biggest likely builders of nuclear power stations in the next 20 years, don't have much to say about waste disposal. Time will tell if either of them can handle the issue in an environmentally responsible way. However, if national pride in nuclear technology is a significant factor, the French example suggests that nuclear power has a solid future in Asia, with or without a waste repository.

In the West, however, the future options for nuclear power are far narrower than the heat of the current debate would suggest. Abandonment, as embraced fleetingly by the previous German government, isn't going to happen. The kind of major build-up envisaged before Three Mile Island and Chernobyl (see *Nature* **244**, 392; 1973 and *Nature* **257**, 346; 1975) isn't coming either.

Instead, nations are likely to tread a path somewhere between replacing some existing nuclear power capacity and its mild augmentation. Given global warming, high energy costs and doubts about the reliability of the oil supply, the latter approach has much to commend it, although it should not be pursued at the expense of renewable energy.

Nuclear energy's technical elegance has always appealed to the hearts and minds of scientists and engineers, who have been unusually prominent among its public advocates for half a century. Throughout, these advocates have promised to present to the public a clean and complete nuclear fuel cycle. Now it is time to stand and deliver. ■

Drugs tests on trial

Britain's clinical-trial regulator has no good options.

Following an alarming episode in London last month, in which six drug-trial participants needed emergency treatment, the UK Medicines and Healthcare Products Regulatory Agency (MHRA) says it will change the way it regulates clinical trials, at least temporarily. But this may prove more easily said than done.

In the trial on 13 March, six healthy subjects suffered violent reactions within minutes of ingesting an antibody drug candidate, TGN1412, which was being developed to treat autoimmune diseases such as rheumatoid arthritis. Initial investigations suggest that the antibody itself was responsible for the side effects (see *Nature* **440**, 855–856; 2006). On 5 April, the MHRA said it will seek advice from outside experts in determining whether drug candidates with novel modes of action should be allowed to enter clinical trials.

The incident at London's Northwick Park Hospital has drawn attention to the limitations of preclinical animal trials in determining the safety of drugs in humans, especially for 'humanized' antibody drugs that are targeted at mimicking human biological processes. It has also sparked some debate about whether the participants were sufficiently aware of the dangers they faced.

For the regulator, the immediate question is whether the existing rules strike the right balance between safeguarding trial participants and promoting the study of potentially valuable cures. Previously, the MHRA allowed initial, small-scale human safety trials to go ahead on the basis of successful animal trials and a description of how the compound works.

Now the agency says it will allow such trials to proceed only after review by a panel of outside experts. However, companies that have drug candidates up their sleeves don't want information on them to be shared, and any outside panel worth its salt is bound to contain people who work with rival companies. So such a provision could lead drug developers to turn their backs on Britain as a location for early-stage clinical trials.

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The best approach is probably that practised by the US Food and Drug Administration (FDA), the only drug regulator in the world with the in-house expertise to conduct such reviews by itself in strict confidence. The FDA, which is partly supported by fees levied on drug-makers eager to enter the lucrative US market, has 9,000 staff compared with the MHRA's 800 (although the FDA does handle food as well as drug safety).

One theoretical option would be a Europe-wide body set up to regulate and approve clinical trials, but the practical problems of constructing and operating such an agency would be daunting. In the interim, the MHRA may struggle to perform additional screening while satisfying confidentiality requirements. ■

Mentoring award 2006

Last year we inaugurated the *Nature*/NESTA awards for creative mentoring in science, co-sponsored by Britain's National Endowment for Science, Technology and the Arts. This year we are pleased to announce that *Nature* will be sponsoring awards for high-achieving mentors in two regions: the United Kingdom, again co-sponsored by NESTA, and, later this year, Australasia.

The UK awards are now open for nominations. The closing date is 19 June.

In each region, two prizes will be awarded: one for a lifetime's achievement in mentoring, and another to an individual in the middle of his or her career. Every nominee has to be nominated by five individuals who between them were mentored over different periods of the mentor's career.

The prizes are intended to celebrate a scientific activity that otherwise tends to be taken for granted. There are many heads of labs whose students have turned into outstanding scientists, but all too often such cases have exemplified survival of the fittest rather than being the product of deliberate nurturing. *Nature* has chosen to favour the latter approach.

Nomination forms and details of the awards can be found at www.nature.com/nature/nestaawards. ■