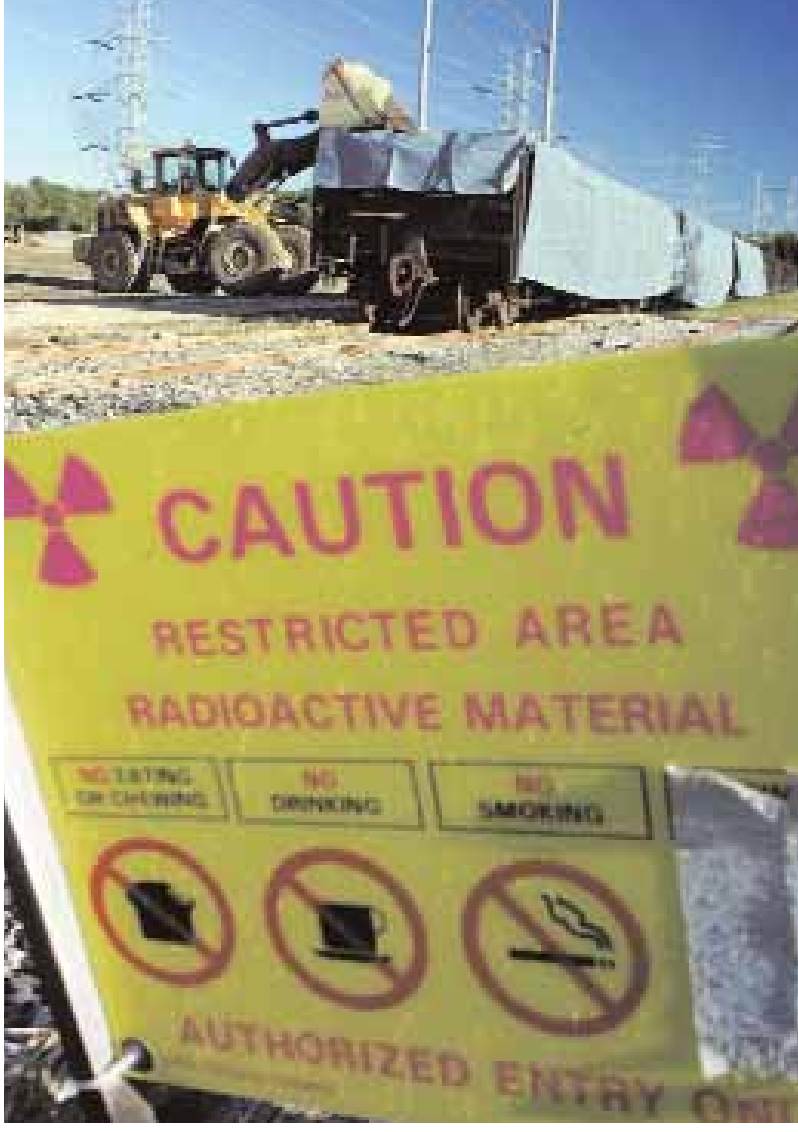
GENERATING POWER

Walt Patterson



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Long-time observers of the nuclear scene are watching with mounting alarm as yet another pathology becomes all too evident. One politician after another, one government after another, one journalist after another, one activist after another, seems to be succumbing to the insidious effects of nuclear amnesia. The symptoms are unmistakable. The sufferer expresses concern about, say, energy security, or rising electricity prices, or climate change – understandable concern, about issues immediate and pressing. Then, inexplicably, the sufferer asserts that the appropriate response is nuclear power. To any dispassionate onlooker even slightly familiar with history, such an assertion is incomprehensible.

Nuclear amnesia

Those suffering from nuclear amnesia have forgotten why nuclear power faded from the energy scene in the first place, how many times it has failed to deliver, how often it has disappointed its most determined advocates, how extravagantly it has squandered unparalleled, unstinting support from taxpayers around the world, leaving them with burdens that may last for millennia.

Consider Britain. Early in the new millennium the Labour government of Prime Minister Tony Blair set up a review intended to guide policy for energy and climate. After lengthy and wide-ranging deliberations, in 2003 it delivered a White Paper considered by many to be the most far-sighted government-level assessment of the issues. The White Paper paid little attention to nuclear power, for reasons most commentators saw as trivially obvious at the time. Yet less than three years later the government is rerunning the energy review, apparently to get a different answer, the one it wants. Why should this be so? Why is the government reportedly so keen to resuscitate nuclear power?

EMBARRASSING

Britain has never built a nuclear power station on schedule, or within budget, or that worked to its original specifications – not once. Almost all the stations built have overrun schedules by years, at costs often at least twice those initially anticipated. Performance has at best been modest, sometimes embarrassing.

When in 1989 Prime Minister Margaret Thatcher's government tried to privatise the country's electricity system, investment analysts in the City of London refused to play, unwilling to risk the track record and open-ended liabilities of the nuclear stations. The government was forced to withdraw all the nuclear plants from the sale.

The nuclear generators, assigned to a new company called Nuclear Electric, still government-owned, then proved unable to compete in the new electricity market, even though for all but the newest, the original capital costs were already written off, and nuclear fuel costs are always claimed to be low. Electricity users were compelled to pay a ten percent surcharge, to contribute a subsidy of more than $1.5 billion a year to Nuclear Electric.

It was not called a nuclear obligation, although that was what it was. To conceal its intent, the government called it a non-fossil-fuel obligation. The embryonic renewables industry immediately declared

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that it, too, was non-fossil; and the government adopted this fig-leaf with alacrity, eventually giving as much as three percent of the total subsidy to renewables.

By 1995 the European Commission decreed that the obligation, as paid to Nuclear Electric, was illicit state aid, and it was terminated. The subsidy was left to renewables in a severely truncated form, a totally unintentional but effective support for what was becoming a significant industry in its own right.

Prime Minister John Major's government then succeeded in selling off Nuclear Electric, renaming it British Energy – what some wags called 'The power that dare not speak its name'. Explicitly nuclear or not, British Energy rapidly lapsed into its old habits, requiring bailouts in nine figures from taxpayers almost up to the 2003 White Paper.

ALL WILL BE WELL

Despite the common impression to the contrary, Britain has never had a ban or moratorium on nuclear power. Any who want to build a nuclear station can. They just have to find somewhere to put it and someone to pay for it. No-one wants to, for entirely sensible reasons. So what could possibly have persuaded Blair and his advisors, notably the government's Chief Scientific Adviser, Sir David King, that the nuclear basket-case was the best place to look for relief from climate change?

If you ask, you will probably be told that of course they will not do it that way next time. They will choose different technology, and different organisations, and next time all will be well. Well, maybe. As has been the case since the 1960s, not only in Britain but all over the world, the cheapest reactor has always been a paper reactor. Once you start pouring concrete and welding steel, the numbers tend to look less attractive.

In the United States, for example, through the nuclear order-boom decade from the mid-1960s to the mid-1970s, costs frequently doubled and sometimes trebled, crippling many purchasers. That was why no nuclear power station has been ordered there since 1978, and all plants given the go-ahead after 1974 have long since been cancelled.

The situation in Britain was yet more extreme. The latest cost estimates from nuclear advocates all conform to this time-honoured pattern. All the major vendors have spanking new paper reactors eager to spring from drawing-boards at truly mouth-watering, if hypothetical, prices – provided someone else will pay and insure them.

Indications are that the Blair administration and most other governments will choose the pressurised-water reactor, another concept some five decades old. Those who ought to know the history of that type of reactor appear to have succumbed to nuclear amnesia.

Originating in the US Navy in the 1950s, as a propulsion plant for submarines, the pressurised-water reactor became a power station by default. When Britain opened Calder Hall in 1956 – the 'world's first nuclear power station', for making weapons plutonium – the US hastily requisitioned an unused submarine unit and set it up at Shippingport, Pennsylvania, as what became the progenitor of the most widely-adopted power reactor design worldwide.

The key requirement on which it was originally based and that determined all the others was that it had to fit inside a submarine hull. All the modifications in intervening decades have been to cope with scaling up this concept, to make its economics at least tolerable and its safety at least plausible.

The problem is that a small pressurised-water reactor is prohibitively costly per unit of output; but a large one requires safety systems, on the safety systems, on the safety systems. The trade-off of size versus complexity historically meant that in general the larger the reactor, the poorer its performance. Many electricity companies suffered accordingly.

Advocates claim the latest designs will be an improvement. Historically, however, the best performance has always come from paper reactors. Building and operating a single plant of a new design, to get practical experience of its idiosyncrasies, would be the most sensible, albeit most expensive, approach. But advocates appear to be proposing yet again to build a whole series of plants before accumulating any operating experience at all – a misjudgment that became a key factor in the troubles besetting the previous generation of reactors of every kind.

SPARE CAPACITY

Experience of actual operating performance also casts a different light on the security of supply associated with nuclear power. Nuclear advocates make much play with what they call the intermittency of renewables such as wind energy and solar power. But wind and solar are variable, not intermittent. A thousand megawatt nuclear station that can and may shut down in two minutes is 'intermittent'. Losing that much generation in such a short time could easily crash an entire electricity system. That is why a system with traditional large generating units, especially nuclear units, has to carry so much redundant standby generation, so-called spinning reserve, ready to come onstream quickly if a major unit has a fault. Wind power presents no such problem.

Once a nuclear unit shuts down, restarting it can take not just hours but days or indeed weeks. The blackout of August 2003 in the northeastern US and Canada shut down nine nuclear stations with a total capacity of nearly eight gigawatts, according to the Rocky Mountain Institute in Colorado. Five days passed before their collective output was back to four gigawatts; eleven days before it returned to its usual level.

In 2003, the average US nuclear outage, planned or forced, lasted 37 days – more than a month – at zero power. For major outages, lasting more than twelve days at zero power, as of November 2005 the average US nuclear plant had a mean latest-major-outage duration of 35 days, and a mean time since the previous major outage of sixteen and a half months. Now that is intermittent.

BURY IT

The track record of government decision-making on nuclear power worldwide does lead to a certain functional amnesia and a desire to bury the past. For instance, the fast breeder reactor, a plutonium-fuelled power station, preoccupied governments in the US, Britain, France, Germany, Belgium, the Netherlands, the Soviet Union, Japan and elsewhere from the late 1950s onwards for more than three decades. In Britain alone it mopped up over $7 billion of taxpayers' money, at 1980s prices, almost the whole of the government budget for energy research and development until the end of the 1980s. The payoff was utter futility, and a radioactive mess at Dounreay that will take decades and probably further billions to clean up.

No fast breeder anywhere ever succeeded; but the plutonium fuel technology involved has delighted dubious regimes everywhere. Even US President George Bush apparently proposes to revisit the concept of reprocessing, long since abandoned in the US although stoutly defended by British Nuclear Fuels.

That company has yet to restart its vast Thermal Oxide Reprocessing Plant, THORP, at Sellafield, after overlooking for eight months a leak that released many cubic metres of viciously radioactive process liquid into an inaccessible cranny of the plant. As far as can be ascertained, THORP has never worked properly. It may already be the world's largest radioactive white elephant.

All told, if we really had to rely on nuclear power to save us from climate change, we would be doomed. Fortunately, of course, we do not. The portfolio of more attractive opportunities both for using and for supplying energy is abundant, and expanding rapidly. People say 'If not nuclear power, what?' The answer should be obvious: if not nuclear power, not nuclear power.

If governments do not arbitrarily divert vast amounts of money, resources and time into a nuclear black hole, other more promising options will eagerly seize them. In the January edition of Nuclear Engineering International, Amory Lovins of the Rocky Mountain Institute argues that small-scale low-carbon and no-carbon generation and cogeneration already produce more electricity than nuclear power worldwide, and that the lead is increasing rapidly. Improving performance of end-use technologies – buildings, lighting, motors, refrigeration, electronics – gives even faster and more certain payoff.

Governments could take the lead. To begin with, they could upgrade their own vast estates of buildings. They could install high-performance equipment and local generation, to prime the pump for energy service companies. They could set an educational example, bring down unit costs of innovative technologies, and – of course – save taxpayers money.

History offers plenty of reasons to steer clear of nuclear power and opt instead for the abundant quicker, cheaper and safer opportunities. But if nuclear amnesia carries the day, and we make the same mistakes all over again, let us at least be sure that our children know who to blame. In Britain, let us call the first one the Tony Blair nuclear plant.