3

Operational Risks

Over the five-decade-long history of building nuclear power plants, industry watchers assert that 'there has consistently been a wide gap between the performance of existing nuclear plants and the performance forecast for new nuclear plants. These expectations have almost invariably proved overoptimistic. The gap in expected performance is as wide as ever between current forecasts of the economic performance of the next generation of nuclear power plants and that of the existing plants…..it does suggest that forecasts relying on major improvements in performance should be treated with some scepticism.' [1]

New Technologies – Will new designs work?

The nuclear industry has a limited track record in developing and building new-generation nuclear plants. Of five new designs proposed for the United States, developers have only actually built and operated the Advanced Boiler Water Reactors (ABWRs) in Japan - a reactor design that, because of its lack of sufficient protection against malevolent attacks, is in any case controversial - and the great majority of proposed US plants would be very different.

© GREENPEACE / ROBINSON

image The Sizewell nuclear plant in the UK, occupied by 150 Greenpeace volunteers for over 30 hours. During the occupation, activists painted '72% Say No' in large letters on the outside of one of the buildings. This reflected the findings of a UK opinion poll that showed that 72% of respondents said they preferred clean, renewable energy from sources such as wind and solar rather than new nuclear power stations.

Generation III and III+

New nuclear plants planned for the next decade, particularly in the West, appear to be the Advanced Reactors, incorporating new designs, and which are known as Generation III and Generation III+ reactors. The main distinction between these two types is a greater level of 'passive'[2] safety in the Generation III as opposed to the engineered safety of the Generation III+ designs[3]. No Generation III+ plant has yet been completed, and only two are under construction in OECD countries[4].

According to research carried out in 2005 there is no clear definition of what constitutes a Generation III design apart from it being designed in the last 15 years[5]. The descriptions of the new designs, as quoted by the nuclear industry, are given in general terms and the new designs are broadly aimed at mitigating the common problems that are at the core of nuclear power technology, namely:

- high capital costs;
- long construction time;
- operational complexity;
- short operating life;
- core melt-down accidents;
- high fuel use; and
- high waste and environmental weaknesses.

The lack of greater precision in the definitions of these new designs has led researchers to conclude that 'until there is much more experience with Generation III and III+ plants, any figures on the generation cost of power from these designs should be treated with the utmost caution.'[6]

1 Steve Thomas (2005), 'The Economics of Nuclear Power: Analysis of Recent Studies', p25. Public Services International Research Unit (PSIRU) PSIRU. July 2005. http://www.psiru.org/reports/2005-09-E-Nuclear.pdf

2 A nuclear reactor is described as being passively safe if it doesn't require an operator to shut it down in the event of an accident.

3 'For example, Generation III designs would rely less on engineered systems for emergency cooling and more on natural processes, such as convection'. See Steve Thomas, 'The Economics of Nuclear Power', p10. (2005) Heinrich Böll Stiftung. December 2005.

4 These are the French European Pressured Reactor (EPR) units Olkiluoto 3, in Finland, and Flamanville 3, in France. Two other EPR projects have been launched in China in late 2008, where also two AP 1000 units, designed by Westinghouse, are under construction.

5 Ibid. p10

6 ibid. P10

image Greenpeace action against the under price export of nuclear energy, at the Temelin nuclear power plant in the Czech Republic.

© GREENPEACE / PAVEL HOREJSI

Performance risk – will the plant operate efficiently?

Due to the capital-intensive nature of nuclear power technology, high utilisation is key to lowering the unit costs of generation. In addition, nuclear power plants are physically inflexible and output levels cannot be easily varied. Therefore, plants are generally operated at 'base-load'. Load factors[7] are an important indicator of operating efficiency and the economics of nuclear power. In the 1980s, the average load factor for all worldwide plants was around 60%. This has improved, and load factors now average more than 80% worldwide. However, only 7 of the 436 currently operating reactors, which have at least a year's service and which have full performance records, have a lifetime load factor in excess of 90% and only the top 100 plants have a lifetime load factor of more than 80%.

Interestingly, the skill and management of the plants, rather than the technology and the supplier, may be a decisive factor in the operating performance of plants. This is evidenced by the top 13 plants with high-load factors being sited in only three countries; six in South Korea, five in Germany and two in Finland[8].

Out of 130 commercial units in the US fleet of reactors, one-third of them have seen outages lasting longer than one year. The total number of shutdowns lasting longer than a year reached 51, of which seven lasted for more than two years[9].

Another example is the Temelin nuclear power plant in the Czech Republic, which has two reactors that were put into operation in 2000 and 2001 respectively. So far, both units have been struggling with serious teething problems, such as massive vibrations of turbine, repeated leaks of water from the reactor, and cracking and bending fuel rods with potential implications for emergency safety systems. Unit 1 was put into operation despite the fact that whistleblower allegations – of illegal welding repairs to one of the main cooling pipes to the reactor – were not seriously investigated. Overall performance has been low, with the cumulative load factor of Unit 1 reaching only 64.76%, and Unit 2 reaching only 74.95%[10].

According to experts, 'an assumption that the reliability of 90% or more seems hard to justify on the basis of historic experience.'[11]

Financial risks triggered by a plant's operating performance are not inconceivable. Such risk was vividly illustrated when British Energy suffered financial collapse in 2002 because its income from the operation of its plants barely covered the operating costs. Operational complexity and the vulnerability of unproven new designs add to the challenges of an industry struggling to justify itself in a competitive, market-driven energy industry.

"In the case of a nuclear plant, considerable complexity and highly specific engineering both add to the problem of limited understanding of those risks by external investors. In theory, investors should demand a very high premium for informational asymmetry arising from limited understanding of these risks; in practice, investors may be unwilling to assume these risks at all."

Finon, Cired and Larsen - 2008

image Temelin nuclear power plant, Czech Republic.

7 Load factors, or capacity factors, are calculated as the output in a given period of time expressed as a percentage of the output that would have been produced if the unit had operated uninterrupted at its full design output level throughout the same period.

8 Greenpeace, (2007) 'The Economics of Nuclear Power', p21.

9 David Lochbaum , Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages, Union of Concerned Scientists, September 2006; http://www.ucsusa.org/assets/documents/nuclear_power/nuclear_tightrope_report-highres.pdf

10 International Atomic Energy Agency's on line database of Power Reactor Information System (PRIS), http://www.iaea.org/programmes/a2/index.html

11 ibid. p21.