Nuclear Energy at Half the Cost

Last year, Toshiba's nuclear project at Moorside failed to find funding. Now, Hitachi has suspended its £16bn ($22bn) plans to build two ABWRs at Wylfa, also for lack of funding. These are harsh reminders of the problems of nuclear development. Even supporters of nuclear power now recognise that large nuclear power plants are:

- Too expensive to be competitive.
- Taking too long for utilities and customers.
- Too big to fund by anyone other than Governments.
- Too risky for both investors and energy suppliers

Prices for energy from new nuclear plants are well above the market price of energy for two main reasons. They have very high capital costs and the time required to develop and to build projects – is too long, 15-20 years.

The key issues are risk and funding. These large reactors require huge amounts of capital. EDF's Hinkley Point C station is currently estimated to cost £20bn ($28bn). Also, such projects are too risky for the private sector. No utility, or reactor vendor has the financial capacity to fund these projects. Some level of Government involvement is required.

If the prospects for nuclear power are challenging, are there new ideas and alternative approaches?

New evidence from the UK Energy Technology Institute (ETI) on the Cost Drivers of Nuclear (2018) shows that there are some different strategies which could transform the economics of nuclear energy. These approaches mean a different mind-set for nuclear and the reshaping of the industry, while maintaining the paramountcy of safety.

Constructing nuclear power stations is a complex activity - similar in complexity to a large commercial aircraft. Nuclear construction demands very high quality standards, in difficult and constrained conditions. Large teams work in sequence to create, connect and assure: hundreds of thousands of tons of concrete, thousands of miles of piping and millions of miles of electrical cables.

In the past, there was little hard evidence of the importance of 'know how' – the craft of construction. Tacit knowledge is built-up in project managers, foremen, crew chiefs and craftsmen by experience. The ETI study has shown that 'know-how' is much more important than previously thought. Based on the most recent 33 new nuclear projects, it identifies the strategies that reduce costs and quantifies their different contributions. It shows how to cut capital costs by 50% from current levels - closer to those achieved by the French programme of 1980s. It was these French costs that were the basis of the UK's Nuclear New Build decision. However, it was not the strategy that the UK adopted.

Many of the new projects were from East Asia. Capital costs in the East, are low, a third of those in the West. Even discounting their lower labour costs, it is clear that their more experienced teams deliver higher productivity. In many cases, the productivity was double the Western equivalent. Furthermore, it is significant that construction schedules in the East are almost half those of the West, even for the same design of reactor.

Many best practices can be adopted here:

- Series of standard reactor designs,

- Design completed in detail before the start of construction,
- Construction by a consistent group of contractors and suppliers,
- Multiple units built on each site.

Repeated construction of a single design delivers both lower costs and higher cost certainty - hence lower investor risk. Three cases show the scale of savings:

Case	Conditions	Specific Capital Cost $/kWe	Energy Cost $/MWh @ 9%
Benchmark	Single project proven reactors built conventionally	$6,826	$108
Conventional Start-up	Single projects built where 'know how' is lost	$10,500 (54%)	$148
Western Target	Best practices realised in the West	$4,386 (-33%)	$81

Total Cost of Construction Cases

US reactors built in the 1980s provide the baseline, updated into 2017 economics. It assumes experienced contractors, using an established design, managed in a conventional manner - one project at a time.

Differences in cost between the cases is large. In the West, we need to re-learn nuclear construction. Costs are 54% above the benchmark. Adopting best practices could yield a 57% reduction. Energy costs would also be lower: $81/MWh (£57/MWh at PPP). Regular delivery of projects could reduce the risk premium, with energy costs 58% less than today: $61/MWh (£44/MWh) @ 7%. At this level, nuclear would be competitive with other forms of generation. Nuclear power's dependability would make it an attractive part of a low-carbon energy system.

None of these strategies are technically radical. They depend on a consistent long term programme of build using the same design, with a commercial structure that incentivises the supply chain to plan, design and deliver a continuously improving series of nuclear power projects. The objective of construction should be to shortening the build schedule, improving the way the work is done, one project after another.

Nuclear is at the crossroads, but there is a way forward. The prize is: Energy costs being halved.

The right policy choices need to be made now.

The $64 billion question remains - How would such a multi reactor programme be funded in a Western market-orientated country?

Tony Roulstone **January 2019**

Reference: ETI (2018). Nuclear Cost Drivers project – Summary report. ETI April 2018