

Construction Risks



Prohibitively high construction costs

Nuclear power plants have high capital costs and long construction times. Construction costs of nuclear plants completed during the 1980s and early 1990s in the United States and in most of Europe were much higher than predicted by the nuclear industry. In India, the last 10 reactors built have had completion costs of at least 300% over budget, on average¹. The current recession, squeeze on credit and fall in currency values adds further constraints for the financing of new plants.

Recent cost estimates for new reactors have risen at a rapid rate in the US and Europe. In 2007, overnight cost estimates (defined as construction costs without interest or real escalation during construction), from Florida Power and Light (FPL) in the US, ranged from \$ 3,108 (US dollars) per kilowatt to \$ 4,549 per kilowatt for two proposed nuclear plants.² FPL also put the total cost of the project, including escalation and financing costs, at between \$ 5,492 and \$ 8,081 per kilowatt. These estimates translate into a projected cost of between \$ 12 billion and 18 billion for just two 1,100 MW units.³ In 2008 a comparative estimate of overnight costs of \$ 5,000 per kilowatt was considered reasonable.⁴

The July 2009 tender for new reactors in Ontario, Canada, was put on hold when the bids were opened: Areva offered two 1,650 MW EPR units for \$ 23.6 billion (Canadian dollars), and AECL two 1,200 MW units for \$ 26 billion (Canadian dollars).⁵ This put the price tag for new reactors at \$ 6,600 (US dollars) per kilowatt and \$ 10,050 (US Dollars) per kilowatt respectively. However, the lower bid was found to be non-compliant, because Areva NP did not accept related economic risks.

Table 1.1. Construction time of nuclear power plants worldwide⁶

Period of reference	Number of reactors	Average construction time (months)
1965-1970	48	60
1971-1976	112	66
1977-1982	109	80
1983-1988	151	98
1995-2000	28	116
2001-2005	18	82

¹ Greenpeace. (2007), 'The Economics of Nuclear Power', p1.

<http://www.greenpeace.org/raw/content/international/press/reports/the-economics-of-nuclear-power.pdf>

² Harding, Jim (2008) 'Pre-filed Testimony - Overnight Costs of Nuclear Reactors', p2. Prepared for Ontario Energy Board.

³ Nucleonics Week, Volume 49 / Number 27, Platt's, July 3, 2008

⁴ Harding, Jim (2008) 'Pre-filed Testimony - Overnight Costs of Nuclear Reactors', p2. Prepared for Ontario Energy Board; see also Romm, Joe, (2008) 'The self-limiting future of Nuclear Power'. Center for American Action Progress Fund. June 2008.

⁵ '\$26B cost killed nuclear bid', Toronto Star, July 14th, 2009

⁶ Greenpeace, (2007), 'The Economics of Nuclear Power', p8.



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“Nuclear ownership entails a special set of risks that require an owner to adjust the corporate capital structure, liquidity sources and risk management procedures to address the financial exposure”

Fitch Ratings November 2006

image The construction site of Olkiluoto 3, Finland's fifth nuclear reactor. Greenpeace has called on TVO, the company that ordered the reactor, to make all the documents describing the 2,000 reported quality problems public, repay the state subsidies it has received for the project and drop any plans on new nuclear projects.

image Construction site of EDF's proposed new European Pressurised Reactor (EPR). Greenpeace activists blocked the entrance to the site and demanded an immediate end to construction at both Flamanville in France and Europe's other EPR site at Olkiluoto, Finland, calling the plants dangerous, unnecessary and uneconomic.



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In Europe, the new nuclear plant being built in Finland was initially costed as a 'turnkey' project of about €3 billion. Based on an output of 1600 MW, this represented a cost of about €1,875 per kilowatt, including interest⁷.

In the UK, the government white paper on nuclear power published in January 2008 assumed a construction cost of £1,250 per kilowatt (excluding interest, escalation during construction and decommissioning), which gives a total cost of £2.8 billion to build a first-of-a-kind plant with a capacity of 1,600 MW.⁸ The recent fall in the value of sterling against the euro will result in a significant extra cost of construction, since the core components of a nuclear power station are priced in euros. Some analysts have calculated this cost increase at greater than 40%.⁹ These developments suggest at least a slowing down in the financing of new nuclear by private sector utility companies on the grounds that costs are now truly prohibitive and hard to justify to the owners of that capital, i.e. equity investors and lenders.

Difficulties of forecasting

The message for nuclear new-build that is reinforced by the recent volatility in commodity price and currency exchange is that the costs of nuclear power plant construction can be notoriously difficult to predict. For example, the cost of Sizewell B was 35% higher in real terms than the price quoted when it was ordered in 1987¹⁰. This unpredictability in forecasting is further borne out by the construction of the new Olkiluoto-3 nuclear power station in Finland, which has been described as having 'descended into a farce as costs have ballooned and progress slowed'¹¹. The Finnish reactor is the first of the new advanced reactors to be built in the west. Still halfway through construction, it is more than 50% over budget and over three years late¹². In August 2009, reactor supplier Areva announced that estimated costs had increased by €2.3 billion, and admitted that it was impossible to determine the final costs.¹³

⁷ Thomas, Steve (2005) 'The Economics of Nuclear Power', p11. Heinrich Böll Stiftung, December 2005.

⁸ UK Government (2008) DBERR, 'Meeting the Energy Challenge: A White Paper on Nuclear Power', p61. January 2008. p61, <http://www.berr.gov.uk/files/file43006.pdf>

⁹ Goodall, Chris. Guardian, January 2009. <http://www.guardian.co.uk/environment/2009/jan/05/nuclear-energy-rising-cost>

¹⁰ Performance and Innovation Unit (2002) 'The economics of nuclear power', p15. Cabinet Office, London, quoted in The Economics of Nuclear Power by Steve Thomas, p15.

¹¹ Goodall, Chris. Guardian, January 2009. <http://www.guardian.co.uk/environment/2009/jan/05/nuclear-energy-rising-cost>.

¹² Romm, Joe, 'The self-limiting future of Nuclear Power' Center for American Action Progress Fund. June 2008

¹³ 'Provisions on Finnish reactor wreck Areva profits', Financial Times, 1 September 2009.

¹⁴ Katz, Alan (2007), 'Nuclear Bid to Rival Coal Chilled by Flaws, Delay in Finland', September 2007. <http://www.bloomberg.com/apps/news?pid=20601087&sid=aFh1ySJ.YQc&refer=home>

¹⁵ Nuclear Engineering International. 2008. Construction costs to soar for new US nuclear power plant. August 2008.

¹⁶ Comments of Ray Ganthner, Areva, in Nucleonics Week (2007) 'Supply Chain Could Slow the Path to Construction, Officials Say', 15 February, 2007.

Some new-builds in the Far East have also fared badly. *Bloomberg* notes, 'The June commercial start-up of China's Tianwan project came more than two years later than planned. The Chinese regulator halted construction for almost a year on the first of two Russian-designed reactors while it examined welds in the steel liner for the reactor core....In Taiwan, the Lung-men reactor project has fallen five years behind schedule. Difficulties include welds that failed inspections in 2002 and had to be redone'¹⁴.

An article in *Nuclear Engineering International* on escalating nuclear building costs explained that "What is clear is that it is completely impossible to produce definitive estimates for new nuclear costs at this time. The fact that the USA and other leading nuclear nations have not been building plants for some time, and also that most current reactor designs have not yet been built to completion, suggests that there is considerable uncertainty with respect to the capital cost of new nuclear and other generating technologies."¹⁵

Supply chain issues

Additional factors that cause forecasting difficulty include supply chain issues such as labour cost volatility and material shortages. The absence of recent large-scale nuclear new-build in the US, for example, has led to a significant reduction of suppliers in the industry. Two decades ago, the US had about 400 suppliers and 900 nuclear - or Nstamp - certificate holders (sub-suppliers) licensed by the American Society of Mechanical Engineers. These numbers have shrunk to 80 and 200 respectively¹⁶. Limited worldwide forging capacity and a shortage of skilled labour also characterise the current industry, with for long lead-times, a dependence on foreign suppliers and longer construction schedules. Contract prices may also be subject to escalation clauses that can result in the final price being significantly higher. Therefore, bids can be underestimated.

Summary

Historically, projections of construction costs of nuclear plants have changed over time, presenting significant investment risk. Mitigation measures (such as loan guarantees) and non-recourse financing (which shifts the economic risk to a third party) remain questionable. The global economic collapse has increased the appetite for transparency of asset valuations, highlighting the importance of timely identification of impairment and imposing stricter financial criteria and loan covenants. Construction costs of the new Generation III plants are proving more uncertain, with longer construction times associated with unproven new reactor designs and increasing volatility in commodity costs posing a challenging risk of dilution of investment returns and the investment's NPV. At the very least, the risk premium should rise, reflecting the higher cost of capital.