

The financing of nuclear power plants

by M. Taylor*

Existing nuclear generating capacity plays an important role in providing secure, economic and low-carbon electricity supplies in many OECD countries. At the same time, there is increasing recognition that an expansion of nuclear power could play a valuable role in reducing future carbon dioxide emissions. However, in recent years only a handful of new nuclear power plants (NPPs) have been built in just a few OECD countries. An important reason for this is the challenges associated with financing the construction of new NPPs.

The just-published NEA report entitled *The Financing of Nuclear Power Plants* examines these challenges. In addition, recognising that any expansion of nuclear power programmes will require strong and sustained government support, the report highlights the role of governments in facilitating and encouraging investment in new nuclear capacity.

The major challenges to financing NPPs

While there are many common characteristics between building new NPPs and building other types of large infrastructure, there are a number of special characteristics and circumstances which make investment in new NPPs different in several important respects. These include:

- the high capital cost and technical complexity of NPPs, which present relatively high risks during both construction and operation;
- the relatively long period required to recoup investments or to repay loans for NPP construction, which increases the risk from electricity market uncertainties;
- the often controversial nature of nuclear projects, which gives rise to additional political and regulatory risks;
- the need for clear solutions and financing schemes for radioactive waste management and decommissioning, which only governments can formulate;

- the need for NPPs to operate at high capacity factors, preferably under baseload conditions.

The higher capital costs of an NPP mean that its overall economics are more dependent on the cost of capital, or discount rate, which applies to the investment in its construction. With any investment, higher risks demand higher returns. Thus, the cost of capital will depend on potential investors' assessment of the risks involved.

During the previous major expansion of nuclear power in the 1970s and 1980s, many nuclear projects suffered very large construction delays and cost overruns. Moreover, given the lack of recent experience with new NPP construction in most countries, the legacy of such problems increases the risks perceived by potential investors. With high capital costs, any delay during construction will have a significant impact on total costs.

Several different factors could lead to delays in entering operation. As well as technical issues with construction and supply chain risks (including the availability of skilled labour and professional staff), they include legal challenges, regulatory or licensing issues, and political and policy risks.

There are also financial risks during the operating phase. These include fuel costs, electricity market prices, plant reliability and performance, as well as political and policy risks. These risks exist for most power generation projects, but in differing proportions. Table 1 summarises some of the main types of risks involved in investing in a new NPP as well as possible options for mitigating them.

Since most existing NPPs were built, the electricity markets in many OECD countries have been re-structured to introduce competition. Whereas in the past utilities building nuclear power plants

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could pass on the costs to electricity consumers, in a competitive market there is no guarantee that electricity prices will provide an adequate return on investment. However, there are some countries and regions where strong, vertically integrated utilities remain, or where electricity price regulation remains in force. Financing new NPPs may prove to be more straightforward in such cases.

Impact of the present financial crisis

The global financial system has recently experienced its worst crisis for several decades, with a number of major banks having failed or requiring large-scale government support. This is having a significant near-term impact on the ability to raise commercial finance for any purpose, including large-scale infra-

Table 1: Main types of risk when investing in a new nuclear power plant

Risk type	Description of principal risks	Primary risk taker(s) and possible mitigation
Design risks	Misspecification of design, or design does not meet specification, possibly requiring redesign during construction, licensing amendments, additional work and replacement equipment.	Owners and/or vendor, according to fault. Avoid first-of-a-kind risks by using established design, use experienced project managers.
Construction and supply chain risks	Delays by contractors or subcontractors in completing on-site work or in supplying equipment; substandard work or equipment, requiring replacement; costs of work or equipment greater than expected; delays in commissioning of plant; etc.	Vendor and/or other contractors, also owners. Use appropriate contractual arrangements, with experienced contractors and established design.
Regulatory and licensing risks	Unexpected delays in obtaining construction and operating licences and permits from national and local agencies; unreasonable delay or failure in renewing operating or other permits during plant operating life.	Owners and government. Need to establish an efficient and predictable regulatory system; risks will be reduced once system is fully demonstrated.
Political risks	Change of government and/or policy towards nuclear: could result in impaired fiscal, financial or contractual arrangements; additional regulatory requirements; forced abandonment of construction or premature closure of operating plant.	Owners and government. Establish a broad political consensus on the role of nuclear power, with clear legal and contractual cover for political risks.
Financial risks	Changes in interest rates and taxes; inability to refinance loans on favourable terms; foreign exchange risks; costs and availability of nuclear liability and other insurance.	Owners. Risk reduction through use of financial instruments; need for government to establish legal framework for nuclear liability.
Natural disasters, force majeure	Earthquakes and other natural disasters (according to region), which could cause damage to plant and forced outages; security risks and threats of terrorism, which could add to costs.	Owners. Licensing and design requirements for seismicity, etc.; insurance; avoid politically unstable regions; physical security measures.
Operating risks	Equipment failures and incidents during operation, leading to reduced electrical output, unplanned outages, additional repairs and maintenance, etc.; delays and incidents during planned maintenance and refuelling.	Owners, also vendor and/or other contractors (including warranties). Use experienced contractors, skilled operators, proven equipment design.
Fuel supply risks	Delays in the supply of fabricated fuel elements resulting in reduced electrical output or even closure; fuel quality issues resulting in handling difficulties; unexpected large increases in fuel cycle costs.	Owners. Long-term fuel cycle contracts; use competing suppliers; government may need to establish nuclear agreements with supplier countries.
Electricity market and carbon-trading risks	Failure to be dispatched by system operator; unexpectedly low electricity prices in market; failure of customer for power purchase or off-take contract(s); unfavourable changes in electricity market regulation or carbon-trading regime.	Owners. Electricity market with suitable provisions for long-term contracts, price setting, dispatch, etc.; stable system for carbon trading or pricing.
Waste management and decommissioning risks	Failure to establish national facilities in expected time frame with inability to move spent fuel and waste off-site; higher than expected costs due to policy uncertainty and delays; increased requirements for decommissioning cost provisions.	Owners and/or government. Need for government to establish clear and consistent policies, and suitable measures to implement them.

structure. Public finances are also highly stretched in many OECD countries. At the same time, the resulting economic slowdown is reducing demand for energy and electricity, making investment in any energy infrastructure less attractive. Oil and natural gas prices have also fallen, reducing short-term incentives to invest in non-fossil energy sources, including nuclear power.

It is difficult to estimate the precise effect of the current situation on nuclear investments in the short to medium term, since most prospective nuclear projects are not yet firm commitments and their construction schedules remain subject to other uncertainties. In the longer term, the case for investment in new NPPs, and the obstacles to that investment, will remain fundamentally unchanged. The main concern is that important investment decisions will be delayed. Given the long timescales needed for nuclear projects, this could mean that short-term options will have to be adopted when economic growth and energy demand pick up.

Main issues and findings

It is clear that strong and consistent government support is an essential prerequisite for initiating or expanding any nuclear power programme, as part of a long-term national energy strategy. Given the long time frame involved in nuclear power projects, a broad-based political consensus is likely to be needed. Otherwise investors will be open to the risks of sudden policy shifts as governments change, potentially jeopardising their investment.

Many of the risks presented by the special factors noted earlier can be mitigated by appropriate government actions. Other risks, including those inherent in any large construction project, can be transferred to or shared with other parties by appropriate structuring of the project, in order to reduce the risks to investors.

Specifically, governments need to put in place an efficient regulatory framework, which allows appropriate opportunities for public involvement but allows clear and definite decision making within a reasonable timescale. Additional legal frameworks dealing with liability issues, radioactive waste management and decommissioning are also necessary. Furthermore, governments have an important



Tomari Nuclear Power Plant, Japan.

role in providing public information and leading national debate on the role of nuclear power.

Electricity market risks can be mitigated by long-term agreements with large consumers or electricity distributors. In some cases, direct involvement of such consumers in the structure of the project may be an attractive option. Governments have a role here in that they set the regulations which govern electricity markets, and which if badly designed

can unduly favour short-term investments.

Another important factor affecting electricity markets is the cost of carbon dioxide (CO₂) emissions. Doubts about long-term political commitment to such policies and carbon price uncertainty may limit the benefits for nuclear investors. Again, governments may be able to take steps to reduce these uncertainties. Fully recognising the potential role of nuclear power in a new UN agreement to cut CO₂ emissions could be an important step in this regard.

However, it is the construction phase of a nuclear project which is generally considered the most risky for investors. This is especially true for “first-of-a-kind” plants and for new nuclear power programmes. Large amounts of capital must be invested early on, while returns will not begin to flow for some years. Traditionally, construction risk was passed on to electricity consumers through regulated prices, but in liberalised markets this is no longer possible.

To some extent, construction risk can be shared with NPP vendors and other contractors actually building the plant, either through fixed price “turn-key” contracts or through performance-related contract clauses, but in practice contractors have only a limited capacity for such risk taking. Debt investors will also not normally accept such risks.

Thus, in most cases the risks of delays and cost overruns will fall mainly on equity investors. They can only reduce these risks by choosing standardised NPP designs that are already in operation elsewhere, built by experienced and well-managed contractors. This is a possible area for targeted government support to reduce the risk to investors to acceptable levels, at least for a limited number of plants in order to start or restart a nuclear power programme.

Corporate finance is the most likely generally applicable model for new NPPs. Large, financially strong utilities will be best able to finance new NPPs,

especially if they are vertically integrated. They will be able to attract loans as required, backed by their existing assets. In countries where such utilities do not exist, the need for direct government support to share in the construction risks is likely to be all the greater.

It appears that there is very little likelihood in the foreseeable future to finance a new NPP by using non-recourse or “project” financing (i.e. using only the NPP project itself as collateral). Even for schemes which include a significant proportion of equity, debt investors are unlikely to be willing to provide significant funding for a nuclear power plant without recourse against the balance sheet of a strong and creditworthy utility.

It is important to note that the financing of an NPP need not remain static over its lifetime, and in particular that refinancing is likely to be possible once the plant has successfully entered operation. At that stage, with construction risks removed and with the plant expected to generate steady revenues over several decades, an NPP could be an attractive investment opportunity for investors with a long-term perspective.

Possible government actions to support NPP financing

Key actions that should be considered by governments that wish to see investment in new NPPs include:

- Provide clear and sustained policy support for the development of nuclear power, by setting out the case for a nuclear component in energy supply as part of a long-term national energy strategy.
- Work with electricity utilities, financial companies and other potential investors, and the nuclear industry from an early stage to address concerns that may prevent nuclear investment and to avoid mistakes in establishing the parameters for new NPPs.
- Establish an efficient and effective regulatory system which provides adequate opportunities for public involvement in the decision-making process, while also providing potential investors with the certainty they require to plan such a major investment.
- Put arrangements in place for the management of radioactive waste and spent fuel, and show progress towards a solution for final disposal of waste. For investors in NPPs, the financial arrangements for paying their fair share of the costs must be clearly defined.
- Ensure that electricity market regulation does not disadvantage NPPs. Long-term arrangements may be necessary to provide certainty for investors in NPPs, reflecting the long-term nature of nuclear power projects.

- Where reducing CO₂ emissions is to act as an incentive for investments in nuclear power, the government may need to provide some guarantees that policy measures will keep carbon prices at sufficiently high levels.

In countries where there are large utilities with the financial strength to invest directly in new NPPs, or where there are well-resourced foreign utilities willing to make such investments, fully commercial financing may be possible. However, in other cases it may prove impossible for a nuclear power plant project to go ahead without direct or indirect public sector financial support, which would reduce the investment risks to acceptable levels.

Public sector financial support could involve supporting a state-owned utility in making nuclear power plant investments, providing support to private sector utilities through loan guarantees, tax credits or other measures, or establishing public-private partnerships. However, governments should ensure that, overall, investment risk remains appropriately shared with the private sector. ■