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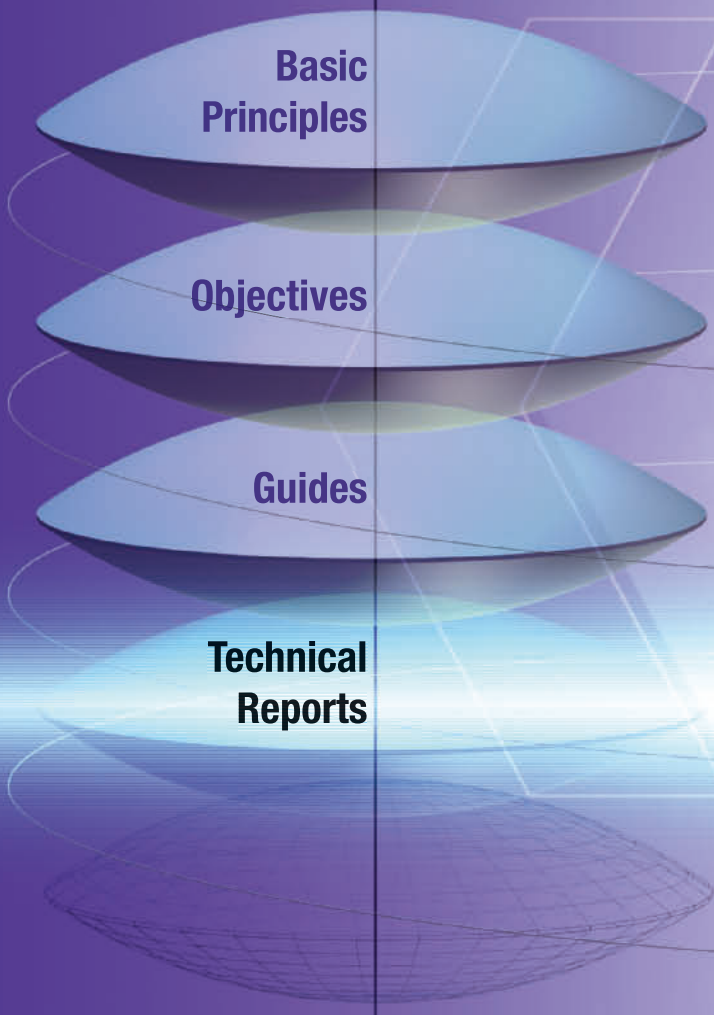

Financing of New Nuclear Power Plants

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FINANCING OF NEW NUCLEAR POWER PLANTS

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Sales and Promotion, Publishing Section
International Atomic Energy Agency
Wagramer Strasse 5
P.O. Box 100
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fax: +43 1 2600 29302
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FOREWORD

In the last five years, expectations about the future expansion of nuclear power have risen significantly. However, in the decades since nuclear power's last period of rapid growth, both the utility and financial markets have evolved in important ways. For these reasons, the IAEA General Conference in 2007 requested "...the Director General to provide in a timely manner a report on the financing of nuclear power as an option in meeting energy needs" (GC(51)/RES/14 Part B.I).

This report responds to that request. It summarizes the new situation in the utility and financial markets and is thus an important update of existing Agency publications related to nuclear power plant financing.

The report starts with a brief exposition of basic financing requirements, and then explores the roles, responsibilities and options for both government and industry with regard to nuclear power plant financing, as well as risk mitigation (for government) and risk management (for industry). Here, 'risk' refers to financial and commercial risks and not to engineering or nuclear safety risks. For both government and industry, the report looks first at traditional practices and approaches, and then explores new options and approaches that might facilitate new nuclear plant financing in today's environment. The report stresses that finance for new nuclear build can be secured in a number of ways; efficient risk allocation and proper assurances of loan repayment as well as returns on capital must be integral parts of any financing scheme. Good project management and careful contracting are the key elements in commercial risk allocation, ideally to the parties that can best manage or control the given risk.

A draft of the report prepared by the IAEA was circulated for comments to, among others, experts at the Asian Development Bank, the European Bank for Reconstruction and Development, the OECD Nuclear Energy Agency, the World Bank, the World Nuclear Association, and a number of major vendors, as well as to participants at an IAEA technical meeting on issues for improving the financing of nuclear power plants. The report has benefited substantially from the scrutiny and feedback of all reviewers. Their contributions are greatly appreciated.

The IAEA officers responsible for this publication were R. Clark and H.H. Rogner of the Department of Nuclear Energy.

EDITORIAL NOTE

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1. INTRODUCTION

1.1. BACKGROUND

Nearly all nuclear power plants operating today were financed and built in regulated utility markets. Thus, they were guaranteed both future customers and high enough electricity prices to ensure a profitable rate of return. Under these conditions, cost overruns and project delays were covered by higher electricity prices and were ultimately paid for by customers. In addition, much of the financing for these plants was provided by governments or with government backing or government guarantees of some kind.[1]

In the last three decades both the utility and financial markets have changed in important ways. On the utility side, the rules have changed substantially. The new conventional wisdom is that progress means deregulating quasi-monopolistic markets and unbundling transmission, distribution and generation so that there is full competition among electricity generators and full choice for customers. While full deregulation, unbundling and competition are not yet established in most countries, this model affects financing considerations for new power plants. Thus, the market risk for utilities has changed and will continue to change, even as demand for their product — electricity — continues to grow.

On the financial side, international capital markets have become increasingly global and competitive. A variety of new financial instruments and packaging schemes have evolved to better ensure returns on investments and attract investors to specific projects. Meanwhile, the availability of capital is not an issue: in 2006, some $4.2 trillion were raised in the global capital markets, of which 5%, or $230 billion, was invested in the power industry.

1.2. OBJECTIVE

The question examined in this report is whether the traditional approaches used to finance nuclear power plants are still compatible with current utility and financial market conditions. Will traditionally structured proposals based on historical assumptions be adequate to attract financing for new plants? If financing for new nuclear power plants is difficult, is it because nuclear power per se is not an attractive alternative in a given electricity market, or are the proposals for specific nuclear power plants not well structured enough to attract financing?

The economics of nuclear power depend on national or even local conditions, including the costs of capital, labour and materials, the regulatory environment, and the availability and costs of alternative generating technologies. Moreover, political opinions on nuclear power are often divided and strongly held. However, most currently operating nuclear power plants have very low generation costs, partly as a result of increased competition. Increasingly, the economics of new nuclear power plants can, depending on location and alternatives, compare favourably with non-nuclear alternatives. The overall comparison also depends on values assigned to possible external costs, such as air pollution, greenhouse gas emissions, import dependence, cost uncertainties[2] and the comparative risks of different alternatives.

[1] But not in all cases. For example, in the USA and Germany, commercial financing has been arranged by private sector sponsors. Some plants, for example in France and the United Kingdom, were built by government owned national utility companies, some of whose shares are publicly traded. And in some countries, like the Republic of Korea, nuclear plant financing has evolved over time from fully government financed to fully commercial private sector financing.

[2] A doubling of uranium prices increases nuclear generating costs by about 5–10% at current price levels. For coal a price doubling raises electricity costs by some 35–45%; and for gas the doubling results in a 70–80% rise in the electricity price.

1.3. SCOPE

This report is aimed at those states for whom nuclear power is a generally acceptable form of electricity generation. In these cases, any specific nuclear power plant proposal will then need to be economically profitable to attract private sector financing.

A brief exposition of basic financing requirements is presented, after which the report explores the roles, responsibilities and options for both government and industry with regard to nuclear power plant financing and risk mitigation.[3] For both government and industry, the report looks first at traditional practices and approaches, and then explores new options and approaches that might facilitate new nuclear plant financing in today's environment. The matter of risk management is treated in both cases as a separate issue from financing. However, since risk carries a cost, and since the cost of risk can significantly affect the total cost of a project, some overlap is unavoidable: risk mitigation and cost reduction are two sides of the same coin.

2. THE BASICS OF FINANCING

Equity and debt are the basic elements of capital finance. The proper conditions and incentives for attracting these elements would include assurances that the project is viable. This means: that revenues will cover costs[4] (which presumes careful market analysis[5]); profitable return of and on the investment is assured (i.e. no cost overruns that reduce returns over the life of the project, and a regulatory and fiscal climate that is reasonably stable and not expropriative); profits can be repatriated, if this is applicable; debt repayment is guaranteed; and risks are properly allocated and managed. Any financing scheme must include an efficient and proper allocation of costs, risks, rights and responsibilities among the responsible parties. This is essential for all successful ventures that are not deliberately exploitative. A project structure that imposes serious discipline in cost and risk management is a sine qua non of successful financing, whatever arrangements are made with regard to debt and equity.

Equity raises capital by selling shares of ownership in a venture. Sponsors may buy shares themselves (internal equity), or sell shares (external equity). Equity owners are attracted by the potential for profit compared with other investment opportunities; different equity owners may require different returns. Equity is completely at risk should the venture fail, and has different tax implications than loans and so is more expensive to attract than debt. Equity thus raises the weighted average cost of capital (WACC) and hence the project cost, but is needed to establish project credibility, especially if the sponsors have poor records at cost control or low credit ratings, or the plant is the first of a kind (FOAK) or first in a country.

Debt is borrowed money. Creditors are attracted by the creditworthiness of the project (potential for repayment) and the price (the cost of the loan and the risk–return ratio of the interest income offered to the creditor). If a creditworthy government or other entity guarantees the debt, the risk of non-payment, and hence the cost of debt, both fall significantly. By law creditors have priority over owners in case of project failure.

For any sizable project, some combination of debt and equity is generally required; for multibillion dollar projects like nuclear power plants, 100% equity or internal financing is highly unlikely. Debt will be preferred by project sponsors: the financing costs of attracting debt are lower than the costs of attracting equity, and debt puts someone else's money at risk. Lenders to the project will prefer a high equity component, to reduce their own

[3] Note that 'risk', here and in the rest of this report, refers to financial and commercial risks and not to engineering or nuclear safety risks.

[4] From an investor's point of view, the only exception can be if the government or some other credible entity provides an assured subsidy, possibly in terms of floor prices, to cover any shortfall in anticipated returns.

[5] This means that domestic and regional markets must be able to absorb/accept new capacity within an acceptable price range (with respect to current electricity prices and the costs of competing alternative technologies for new capacity additions), and the project sponsors need to be able to deliver the power within this price range and still make a profit.

exposure, and as a measure of credibility and project sponsor confidence or good faith. The split between equity and debt in the structure of any financing scheme will depend inter alia on the nature and financial position of the project sponsors, on the local conditions where the plant is to be built, and on the viability, structure and evolution of the electricity sector in which the plant will operate. Many financing considerations are the same regardless of whether a plant's sponsors are State owned companies or governments or private sector companies. However, the risks can be quite different.

There are three basic ways in which a plant construction project can be structured, all of which have been used in the power sector: government (sovereign), corporate (balance sheet) and limited recourse (including project) finance (shielding sponsors' non-project assets from liability for project obligations). The key differences among them are the ownership pattern they establish, which in turn governs the degree to which they protect the interest of investors and creditors, and the ways in which they allocate risk. Theoretically, any combination of entities, financing schemes and debt and equity could be considered for investment in the electricity industry, or for a nuclear power plant. In practice, this has not been the case. Non-recourse or limited recourse financing, for example, offers no recourse collateral to lenders except the future income and assets of the project itself, and so tends to be used for renewable energy[6] or less capital intensive projects with shorter construction times and more flexible assets (e.g. natural gas turbines), rather than for capital intensive investments like hydroprojects and nuclear power plants. Schemes like public–private partnerships (PPPs), build–operate–transfer (BOT), build–own–operate (BOO)[7] and their variations define the ultimate ownership of a project, but are not financing schemes.

Initial financing arrangements for a new nuclear plant might include some government funding for energy assessments and preconstruction studies or nuclear regulatory and legal infrastructures, as well as research and human resource development, and capital market issues of financial instruments (securities, stocks, bonds). For plants in developing countries, additional resources could include directly allocated development funds from international aid organizations and development banks, or other government sponsored aid programmes,[8] export credit agency (ECA) insurance schemes or institutions like the Overseas Private Investment Corporation (OPIC) and the Multilateral Investment Guarantee Agency (MIGA) (although these only ensure that the suppliers of the equipment but not the project sponsors get paid in case of delays or default), and equity investments and commercial loans. Many within the nuclear community assert that multilateral banks should become directly involved in financing nuclear plants. However, multilateral banks are required to balance the views of their Member States, which have strong and diverse views on nuclear power. Moreover, as banks, their investment criteria include demonstration that a proposed nuclear plant will be the least cost alternative for electricity generating capacity expansion, and/or cost efficient for solving environmental, security and other social problems, and if these are included in a government's project proposal.

An often overlooked source for power plant investments is infrastructure funding often acting on behalf of institutional investors such as pension funds or insurance companies (typically, these investors seek investments with long term, stable and predictable returns which nuclear power offers). Although relatively new on the financial scene, one of the largest funds (Macquarie Bank) has an overall capitalization of US $22 billion, and finances infrastructure projects ranging from roads, railways and airports to hospitals, schools and power plants. One of the essential features of this type of finance is the decoupling of owners and operators of infrastructure facilities, with ownership entrusted to the funds. In a related vein, the Van Eck Global Fund offers a more narrowly focused nuclear energy fund, comprising a basket of nuclear energy industry companies and tracking the performance of the Global Nuclear Energy Index. The basket contains largely uranium mining interests

[6] Such finance is often supported by subsidies, mandatory long term power off-take obligations, or portfolio obligations (e.g. European Union renewable directives).

[7] In the BOT model, a private or non-private entity is granted the right by the public sector to develop, finance, build, own, operate, and maintain a facility for a specified period during which the entity owns the project and retains the revenue and associated risk. At the end of the period, ownership of the facility is transferred to the public sector. BOO is like BOT, except the original entity owns the project outright and retains the revenue and associated risk in perpetuity.

[8] A new international nuclear fund could be modelled after the Global Environment Facility, which helps developing countries fund projects and programmes to protect the global environment through the expanded use of renewable energy technology and improved energy efficiency.

(47% versus 37% in plant infrastructure and 10% in nuclear equipment) with no exposure in France and virtually none in the USA.

There is also the Standard & Poor Global Nuclear Energy Index, evidence that the financial markets do recognize an interest for investment in the nuclear industry. It is comprised of 24 publicly traded companies in nuclear energy related businesses that meet certain investability requirements and is designed to provide liquidity to publicly listed companies in the global nuclear energy business from both developed and emerging markets. The index weight is distributed equally between nuclear energy production and energy materials, equipment and services. The top ten companies from Australia, Canada, Finland, France, Germany, Japan and the USA constitute approximately 70% of the index weight.

3. GOVERNMENT FINANCING

3.1. TRADITIONAL APPROACHES

Nuclear power cannot be introduced in a country without some government support. Governments make a political decision about the desirability or necessity of including nuclear power as part of their national energy mix. Governments have the power to establish general economic and institutional conditions conducive to external or commercial financing for large capital projects in general, and nuclear power plants in particular. They also have control over regulatory practices and policies and so have some control over uncertainties and delays associated with regulatory and policy factors (politically motivated or procedural) that lead to delays, cost escalations, and even project cancellations with financial losses.

More direct government involvement in a nuclear power project may take any of several forms: asset ownership, equity participation, risk sharing and provision of various incentives including loan guarantees. Each of these imposes on the government a certain degree of risk. The government may also incur indirect or non-finance-related risks, such as obligations to maintain infrastructure.

Governments have often taken the lead in promoting, developing and financing nuclear power. Some governments have funded or financed new nuclear power plants by themselves, or through national utility companies. They have also used regulatory power to permit utilities building new plants to partially finance construction through the electricity tariff during the construction period ('allowance for funds used during construction' (AFDC)).

Government support for debt consists primarily and traditionally of providing loan or other types of guarantees to facilitate the financing of large infrastructure projects. If structured to the benefit of the government as well as the recipient, loan guarantees can be a source of revenue rather than a subsidy/cost to the government. Using an insurance scheme or export credit approach, governments could, for example, charge interest on the size of the loan as the price of the guarantee. Guarantees can also include guaranteed power purchases (take-or-pay contracts), or even agreements to cover the costs of delay arising from government action or inaction. Each of these guarantees carries its own risks for the government, which then becomes liable for non-performance, perhaps as the result of something over which it has no control. Governments in Asia readily entered into highly optimistic purchase power agreements to secure project financing for needed power plants, only to find that slower economic growth after the Asian economic crisis of 1997 made fulfilment of these obligations impossible. Some Latin American countries in the 1980s secured loans in hard currency for projects whose revenues were in local currency, only to have exchange rates shift dramatically, forcing default on large loans. Such guarantees are not unique to government; they can also be — and have been — provided by utilities, other large corporations or consortia of companies. The risks would be the same, but the losses would accrue to private investors and not to the government.

3.2. NEW APPROACHES

What has changed? Governments in developed and developing countries alike have increasingly found their resources insufficient to meet all competing demands, and realize increasingly that they must turn to the capital markets for financing specific projects or programmes; construction of new nuclear power plants would most likely fall into this category.

Even if a government does not build and own a new nuclear power plant, it can still take an equity share. If national budget resources are unavailable for this purpose, a government can create and dedicate government equity. There are many ways that a government can create equity. It can, for example, pledge receivables from creditworthy government owned industries (or from industrial customers in the case of a government owned utility); dedicate a portion of a government revenue stream (e.g. from mineral exports or taxes); pledge an asset like uranium reserves; barter (e.g. trade financing for agricultural exports); or pledge a service (like waste management). To the extent that a government uses this equity for, or otherwise assists in the financing of, a nuclear power plant, this might be considered in some jurisdictions as a subsidy or an unfair advantage for nuclear power under competition or trade rules. Other types of incentives or penalties to achieve desirable results, for example through contracting, might be structured to avoid this complication. However, to the extent that government participation involves government procurement, project costs will escalate. One World Bank estimate suggests that public procurement can add up to 40% to the cost of a project.

Other examples of possible government funding mechanisms include earmarked surcharges on all electricity sales, use of the national funds (for example, infrastructure funds or postal savings), creation of a government run private bank to help finance 'clean energy projects' (including nuclear), banks to finance infrastructure, asset pooling (in countries or by utilities with other significant power generation assets), and (in developing countries) use of remittances from expatriates. Regional approaches, involving more than one government or utility, may also be used for financing nuclear power plants. Clearly, innovation and government financing are not mutually exclusive, nor are government and commercial financing.

One of the most important considerations, and a crucial government responsibility, is the need for efficient and rational electricity pricing. Investors and lenders would like guaranteed revenue, but they at least need sufficient revenue. Revenues from electricity sales of the plant, either directly or indirectly, must cover costs as a necessary prerequisite for any private sector involvement, and should be a requirement for any government financing as well. Whether for barter, equity or loans, in the end investors and lenders expect to be repaid on time and in full, and require that they receive their share of profits. Sharing revenue streams from other plants helps reassure investors and lenders, as do up front payments, escrow accounts and 'ring fences', and long term power purchase agreements. But an assured revenue stream from electricity prices that covers the costs of generation provides the strongest reassurance. Whenever government has a say in electricity pricing, this is a key government responsibility.

3.3. RISK MITIGATION

A large part of government's role in nuclear power financing, if the government is not directly a sponsor of the project, revolves around risk reduction. Political risk is a major concern for investors and lenders in developed and developing countries alike. It is not necessarily a question of unrest or civil war, but rather concerns about what happens to a project (and specifically to repayment of loans and return of and on investment) if a government fails to live up to commitments it has made in support of a project. Here the government has a clear and unique role for establishing stable regulatory, policy, legal and fiscal regimes. In assessing country risk relative to nuclear power plant development, banks and equity investors will also consider: (1) rule of law; (2) commitment to non-proliferation and IAEA safeguards; and (3) commitment to substantial international nuclear liability regimes. Government has the lead role in all of these areas.

Stable and efficient regulatory and tax regimes are deemed to be essential elements of political stability. These include not only nuclear specific regulation, but also taxation or currency regulations affecting repatriation of profits, and environmental regulations. For example, upstream oil companies decided that Norway was politically risky as long as its oil and gas tax regime was changing frequently. In several countries deregulation of the electricity markets resulted in stranded generation assets. It is argued in the United Kingdom that if nuclear

power is to be regarded as a potential generation option, then the rules of the United Kingdom's power market need to be altered so that long term contracts — related to long run costs — become available. As for nuclear specific regulation, regulatory uncertainty is cited as one of the main deterrents to investment in new nuclear plants. While some regulation is needed, inefficient, changing, or delayed regulatory responses for required permits, clearances and licenses can be costly for project sponsors. So too can retroactive regulatory requirements, as happened after the Three Mile Island accident in the USA, or inefficient regulation (requiring disproportionate remedies). Sometimes investors and lenders may simply be deterred by statements, even from within the nuclear or regulatory community, that nuclear plants can never be 100 per cent safe, implying infinite risk.

The US Nuclear Regulatory Commission (NRC) has recently established a licensing framework that reduces some of these risks. It includes pre-approval for site selection, and pre-certification of reactor design, both of which are ultimately incorporated into a single license issued to cover both construction and operation of a prospective plant. Regulatory, safety and licensing issues can thus be addressed before any significant capital investment is made, thus reducing the risks of delay, regulatory uncertainty and prolonged public hearings resulting in regulatory changes or disputes. Potential investors thus have some protection against potentially spiralling costs during construction.

Other uncertainties arise from shifts in government commitments, or failure to deliver in timely fashion on exclusively government responsibilities such as managing proliferation and back end of the fuel cycle risks (for example, Yucca Mountain in the USA and Gorleben in Germany), or establishing liability schemes. Frequent policy reversals, or committing to obligations that are impossible to fulfil, can lose credibility with investors, lenders and vendors. This may happen because obligations were not initially transparent, or the respective roles of government, commercial investors and lenders, and project sponsors were not clearly defined and agreed. Or, in the case of subsidies needed to keep investors and lenders solvent, the government (or the utility under government regulatory obligation) may not be able to afford to maintain the subsidies. The latter was the case in the USA in the 1990s, where utilities entered into purchase power agreements with independent power producers at fixed prices designed to subsidize diversity of supply, only to have average system prices fall far below these levels with industry restructuring. A further complication for governments caught in this financial bind is that the end of subsidies may lead to price increases that result in popular discontent. Political risk may also include debt relief that sends a negative signal to investors and lenders when their repayment is written off with the debt.

Yet another form of regulatory uncertainty stems from changes in government policy in political response to protests, including, for example, the nuclear phase-outs voted in several European countries where anti-nuclear politics have forced serious asset devaluation through the premature closing of viable plants. While this may be unavoidable, it does affect the willingness of investors to commit funds in such countries.

Some political risks are not easy to assign or manage. In global currency and financial markets, exchange rate and currency risks are not completely within the purview of a government to control; the same is true sometimes for inflation.

4. INDUSTRY SPONSORED FINANCING

4.1. TRADITIONAL APPROACHES

Nuclear power has many perceived advantages, but the history of nuclear power plant construction has some very discouraging aspects for the commercial investor. These are primarily construction delays (that raise financing costs and delay revenue streams), a great disparity in cost estimates, and cost overruns (that reduce returns over the life of the project). Nuclear power plants are acknowledged to be capital intensive, which by itself is not a problem for financing. But high capital intensity carries with it consequent high capital costs, and especially a high level of sensitivity to interest rates, to construction delays, cost overruns or to inflation, all of which can quickly multiply financing costs.

The onus for managing construction delays and cost overruns lies clearly with the industry — with project sponsors. It is here that a critical view must be taken on the need for change, in the context of financing new plants. Virtually all the vendors and sponsors of existing plants, as noted above, financed those plants in an environment of government sponsorship and traditional cost of service rate regulation that essentially assures full cost recovery from captive or guaranteed markets. Such arrangements engendered confidence — perhaps even a degree of complacency — about cost overruns and the cost of construction delays, since the revenue shortfall could readily be recovered from consumers or absorbed by the government.[9]

A revenue shortfall generally can result from poor financial planning, lack of foresight or inadequate provisions for unforeseen market, economic or currency changes; or miscalculated or mismanaged risks. In the USA, for example, in the early 1970s, project sponsors were reluctant to address the potential consequences of double digit inflation on financing costs, only to be faced in a few years with precisely this case. Many nuclear power plants then under construction incurred major cost overruns. Nuclear plants were not the only investments to be affected, but the competitive position of nuclear power generation suffered disproportionally. In this case, the risk to investors was not loss of equity but a requirement for additional costs and investment for overruns or delays, all of which reduced overall return on equity over the life of the plant. Even so, these losses were less than those suffered by investors in both coal and nuclear power plants which were discontinued or cancelled before completion.

It is true that risk can now be allocated and traded in more ways and in more liquid markets than ever before. But creative risk allocation may not be sufficient to compensate for potential losses to investors in the absence of more realistic cost estimates or better cost control. There is often still a great divergence in cost estimates made by vendors and utilities, for example: even for a given plant the two estimates may differ by 50–100%. No serious investor can afford, or be expected to participate in, a project on this basis. The lack of recent experience with nuclear power on the part of investors and lenders may not be so surprising in this context. Utilities, vendors, builders and project managers also lack experience with nuclear power plant projects. Good project management is the sine qua non of a successful project, delivered within budget and on time. Complacency can have no place in this exercise. Investors consider the track record of the company, government or country for delivering successful projects to be a key aspect of project evaluation. Even the new Olkiluoto-3 plant in Finland, considered a model of creative financing, is suffering from both cost overruns and construction delays.

Lack of familiarity can also sometimes increase the possibility of financing innovative, FOAK or first in a country plants. In this climate, without a clear learning curve, investors are likely to consider any new plant as new technology (FOAK) even if its components are all proven technology.[10] Any new plant would therefore most likely be financed on the basis of conservative and conventional capital structures, and newcomers to nuclear power are generally advised to use proven designs. Measures to mitigate technology risk include standardization of reactor and plant design, global fleets and managed evolutionary design changes.

This leads to the question of whether there is in the eyes of investors or lenders a 'nuclear premium' and, if so, for what reason? Do investors require higher returns for investing in nuclear power to compensate for a greater risk of losing one's investment? If so, is it because of the technology? Or a history of cost overruns? Or perceived generic financial risk? Or regulatory uncertainty? There seems to be no consensus on this. Insurance companies have found insuring nuclear plants to be a profitable business (though with a cap on liability). Financial analysts and investment bankers have found no empirical evidence of an obvious nuclear premium for financing nuclear power plants, and tend to consider investment in the nuclear sector as no different from investing in any other large up-front capital cost project, as evidenced, for example, by the creation of nuclear investment funds.

However, there are experienced industry experts who suggest that a premium does exist, attributable variously to regulatory concerns, unknown costs, lack of experience, licensing uncertainties, long construction times, concerns about public opinion or public acceptance, and legal conditions in some countries, all of which

[9] The new Olkiluoto-3 plant in Finland was structured to provide the same kind of traditional assurances by creating essentially a customer–owner consortium that would absorb the cost overruns beyond those covered by the turnkey contract (which is the risk of the contractor/vendor) by taking power output at cost.

[10] In this regard, the European Bank for Reconstruction and Development (EBRD) notes that even third generation reactors, though some are being built, are still not market tested.

may be legitimate, but none of which is unique to nuclear power. One industry source suggests that the history of construction delays for nuclear power plants may in some countries add 3–5% in financing costs for nuclear power over other generation technologies. Other industry sources suggest that even if there is no premium attached directly to the cost of financing, cost uncertainties may result in heightened scrutiny for nuclear projects, and lenders may request additional protection or take more conservative positions relative to other forms of power generation. These might also be considered as a 'premium'. According to one major development bank, the country premium for developing countries is considered to be the important and relevant risk premium factor, with no need for an additional nuclear premium.

4.2. NEW APPROACHES

In the past, project sponsors could ensure the return of and on equity by virtue of government guarantees, guaranteed rates and captive electricity markets. Under current conditions, and without such protection, sponsors of new nuclear power plants may not be able to pay the yield needed to attract equity holders. For commercial investors and lenders, concern about delays and cost overruns in the face of the industry track record is a major factor. Any consequent revenue shortfall would jeopardize their sole interest — the viability of the project — and diminish both the assurance of their return on investment or repayment of their loan and the value of their return on investment or loan compared with available alternatives.

Project sponsors do have some options for generating equity among themselves, either as good faith money or to supplement available investment. One source of equity could be balance sheet financing. Another possibility could be to expand the number of equity partners to include partners who could provide equity in kind, or for principal customers to become major shareholders as a way of ensuring security of supply. For Olkiluoto-3 in Finland, this latter approach made possible a 25% equity share. Another mitigating option is for sponsors to recruit local equity financing for local content.

One suggested hedge for containing construction cost overruns is phased financing. This approach (already implemented in China and proposed for new plants in the USA) involves financing a project in tranches, starting with construction. The cost of capital for each phase would reflect the risks only of that phase, so that the high costs of construction risks are not carried over throughout the project. During construction, the main risk is completion on time and within budget. As construction proceeds and completion risks diminish, the cost of capital can also fall. Once completed, investor risks are essentially reduced to operational and market risks (revenue stream). Different financing phases may also have different capital structures: for example, shareholders would generally be at risk for the construction phase, but non-recourse financing might be introduced with the onset of commercial operations. Phased financing is deemed to be especially effective with a phased asset transfer and, where applicable, a phased sell-out of government interests. Phased financing may thus facilitate government participation in a private sector project, since a government could choose to finance or guarantee only a part of the project and then privatize its share of the plant. The concept of phasing may also help to manage supply bottlenecks and the need for trained personnel, regulators and other project inputs.

The same concept of phasing applies on a broader scale to the start of a nuclear programme. The first unit will carry a higher risk of successful completion — and higher costs — than subsequent units. However, once a few units are built and are operating successfully, the financing model can change, with revenue from operating units being used to finance new construction.

5. RISK MANAGEMENT

The decision for any investor to participate in a project comes down to the risk–reward ratio.[11] A wholly government sponsored plant will have different risks, a different risk profile, and different costs of risk than a plant being built by the private sector. Plants built in a country from which repatriation of profits is difficult, or in a developing country, or in a country where fiscal and regulatory changes are unpredictable, will have different risk profiles and hence different financing requirements. A plant being planned for an electricity sector where power is not priced efficiently, or by sponsors with a poor track record of cost discipline, may find it difficult to assure investors and lenders of the viability of the project.

Commercial capital participation requires a rigorous assurance of returns. No one likes adverse surprises when it comes to investment. Government guarantees are not the only source of such assurances. Providing assurance of returns (through cash flow certainty or loan guarantees, for example) is a major aspect of a business plan, an important prerequisite for successful financing. Financing, however, is no guarantee of quality, and finance will not make a poorly designed project better. Other functions of the business plan are: specifying a clear and transparent, logical and efficient allocation of risk to the parties that can best manage or control the risk; transparent specification of private and government roles and gains; designating legal recourse for arbitration; clear specification of stakeholder returns in ways that do not damage the health of the project; and providing some form of recourse and assurance that all parties can/will fulfil their contractual obligations. Even exit strategies, though at first glance perhaps more complex for a nuclear project, are not unmanageable and should be included. Government sponsored projects are not immune from this.

Careful contracting and strong project management are the key elements in commercial risk allocation and mitigation, even for governments. In principle, risk is most efficiently allocated to the party that can best control the risk. The cost of risk tends to vary with the efficiency of this allocation. Experience has shown that if the risks are not allocated properly at the outset, it is difficult to reallocate them later. How much risk is acceptable, and with what kind and level of compensation, varies with the sponsor and investor, and depends not only on risk aversion, but also on perceptions and on the actual ability to manage, mitigate, secure or shift the risk.

For example, contractors are generally best equipped to absorb the risk of construction delays, and some nuclear power plant construction contracts do attach certain incentives and penalties to fixed construction schedules and fixed price, instead of providing for full cost-plus reimbursement as generally preferred by engineering, procurement and construction (EPC) contractors. With some other party absorbing all risks of delay and the costs thereof, contractors would have little or no incentive to minimize construction delays or cost overruns.[12] Some EPC contractors suggest, however, that they will take even less risk for new nuclear plant construction than they have under the traditional cost reimbursable model, with this risk likely to be reallocated among other contractors, suppliers, sponsors, equity owners and government. They argue that forcing the contractor to take all completion risks will significantly raise the cost of a plant, whereas using a cost reimbursable model, instead of a lump sum, drives down the price, specifically by shifting risk back to the plant owners. This assumes, however, that the cost of risk for contractors is higher than for utilities. This may not be entirely unreasonable. Successful completion of the plant results in ownership of a profitable 60 year asset for the utility, for which it is appropriate to take key risks. Lenders, vendors and EPC contractors, by contrast, end up with no asset: they view construction of the plant as a 'one shot' contractual opportunity for profit, with no later opportunity to recoup losses.

Even with careful contracting, project management — from initial proposal to grid connection — will be the ultimate key to reducing delays and cost overruns. In the end, even allowing for attenuating or mitigating circumstances, delivery of the plant as contracted, on time and within budget, is the responsibility of the project

[11] This ratio incorporates not only investor preferences and requirements, but also reflects the cost of equity needed to attract long term investment versus the cost of short term equity financing. One should not, however, overemphasize the need for long term investment, as commercial paper (bonds or stocks) is routinely traded and not generally held by the same owner for 30–60 years.

[12] Nevertheless, where construction delays are the result of government decisions or other exogenous factors, public authorities might appropriately absorb some of these risks and costs.

manager. An efficient allocation of risk in the project structure can provide strong incentives for efficient performance by the various parties, and can facilitate the job of project management. But transferring risk does not make it disappear. Ultimately, the project owners carry the risk of project completion.

Demand and market risk also fall clearly (though sometimes tacitly) onto the project sponsors. They are not always easy to control, particularly when part of a larger economic slowdown, when investments made in projected capacity needs turn out to be superfluous or less profitable. This especially underlines the need for careful market analysis, pricing and operational flexibility, and for making the most conservative demand and revenue estimates for a project, as well as the most conservative requirements for policy changes needed to attain that revenue.

Exchange rate risk can be a major consideration for nuclear power plant construction, especially in countries that import nuclear technology or reactors and foreign experts. Currency hedging is standard practice in trade as a protection against exchange rate fluctuations. Responsible project managers importing goods and services would be expected to hedge against the consequences of drastic price changes for such imports. Project managers also commonly mitigate exchange rate risk by financing labour, procurement, infrastructure construction and other local contributions through local banks, and by denominating such contracts in appropriate, usually local, currencies.

6. CONCLUDING OBSERVATIONS

Conventional government and commercial financing packages have successfully funded most nuclear power plants built to date. Will this approach suffice with a growing dependence on commercial financing if there is a new upswing in nuclear power plant construction?

Ultimately, the decision for any investor or lender to participate in a nuclear power plant project is based on the risk–reward ratio. Debt and equity financing can be secured in a number of ways. Efficient risk allocation and proper assurances of loan repayment and of return of and on capital must be integral parts of any financing scheme. Good project management and careful contracting are the key elements in commercial risk allocation, ideally to the parties that can best manage or control the given risk. Experience has shown that if the risks are not allocated properly at the outset, it is difficult to reallocate them later.

Governments may also make a political decision to have nuclear power, for example, as part of larger energy supply security objectives, for environmental protection, to benefit from technology spin-offs, or as part of national socioeconomic goals, and aspirations. Such government values may initially lie outside the purview or interest of a company. But ultimately the cost of compliance with national regulations or taxation schemes designed to further such objectives shows up on the corporate balance sheet.[13] Companies then seek to find ways to minimize or avoid such costs. Nuclear power has much to offer in this regard, for example in the area of air pollution or green house gas (GHG) emission reduction, energy security and diversity, and fuel cost volatility. Future international GHG reduction schemes may also recognize the mitigation potential of nuclear power, and thus increase its attractiveness to investors and lenders, particularly schemes that award emission credits for environmentally benign investments abroad.[14] But even here, economic viability is inescapable; no one is likely to invest in a financial black hole, nor build nuclear power plants for environmental reasons, unless they are demonstrably profitable and among the most cost efficient solutions.

[13] In this way, the costs of decommissioning nuclear facilities and spent fuel management are already included in the cost of the facilities and the fuel, and so already show up on the bottom line.

[14] The financing of nuclear power plants as part of the flexible mechanism under the Kyoto Protocol, the Clean Development Mechanism (CDM) and Joint Implementation (JI) for the purpose of acquiring GHG emission credits is currently disallowed. If governments wish to utilize such financing mechanisms, this needs to be reflected in the post-2012 international environmental agreements currently being negotiated under the aegis of the United Nations Framework Convention on Climate Change.

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