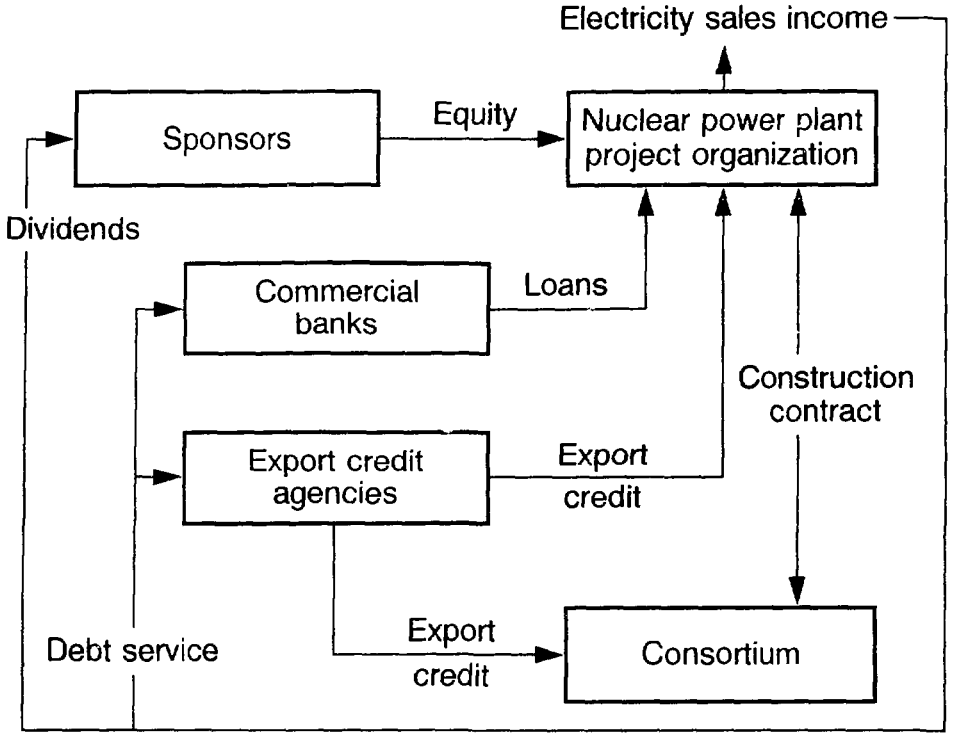

IAEA

Summary of a reference book on financing arrangements for nuclear power projects in developing countries

SUMMARY OF A REFERENCE BOOK ON FINANCING ARRANGEMENTS FOR NUCLEAR POWER PROJECTS IN DEVELOPING COUNTRIES

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FOREWORD

The IAEA has recently published a reference book entitled *Financing Arrangements for Nuclear Power Projects in Developing Countries* (Technical Reports Series No. 353). The book reviews comprehensively the main features and problems concerning the financing of such projects in developing countries and presents innovative approaches for power generation financing. It also discusses the special conditions and requirements of nuclear power projects and the complexities of their financing, focusing on the practical issues to be dealt with to achieve successful financing, as well as the constraints encountered by most developing countries.

This booklet summarizes the important features of the financing arrangements discussed in the reference book and was prepared with the aim of widely disseminating the results.

EDITORIAL NOTE

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CONTENTS

FINANCING: A KEY FACTOR FOR INTRODUCING OR EXPANDING NUCLEAR POWER IN DEVELOPING COUNTRIES

Owing to the convenience and efficiency of the use of electricity for a variety of tasks, consumption increased rapidly (at a world average rate of 3.9% per annum) during the period 1974–1991, while total energy use grew more slowly (at an average rate of 2.2% per annum). It seems highly probable that the future availability and use of electricity will be determining factors for both economic development and the setting of energy policies. According to a World Bank survey, *Capital Expenditures for Electric Power in the Developing Countries in the 1990s*, electricity use is expected to increase at an average annual rate of 6.6% in developing countries and the installed equipment capacity is expected to increase by 82%.

The electricity requirements of developing countries can only be met through the more extensive use of conventional thermal and hydro power sources, together with an increased use of nuclear power in those countries which already have nuclear programmes, and the introduction of such programmes in other developing countries. However, in spite of its demonstrated overall economic competitiveness and technological feasibility, nuclear power has so far been introduced only to a limited extent in a small number of these countries. At the 1990 IAEA *Topical Seminar on the Financing of Nuclear Power Projects in Developing Countries*, it was reaffirmed that:

> "a major requirement and constraint to the development of nuclear power projects in developing countries is the ability to obtain the considerable financial resources required on reasonable terms. Further, the financing of nuclear power projects presents a critical problem not only because of the very large amount of financing needed but also because of the low creditworthiness of countries as seen by various lending organizations".

PROBLEMS IN FINANCING NUCLEAR POWER

There are four primary characteristics of nuclear power projects which make the arrangement of adequate financing difficult. These are: high investment costs, longer construction times than those for fossil fuel power plants, a high degree of uncertainty with respect to costs and scheduling, which arises for various reasons such as regulatory intervention, and the significant extent of public opposition. The primary difficulty in financing a nuclear power project is the high capital "intensity" — the initial investment cost for a 1000 MW(e) nuclear power plant would range from US $1000

million to $3000 million. This large capital requirement may approach or even exceed the overall available credit limits identified by lenders for an individual developing country. Also, lenders may be reluctant to concentrate their financial risk in a single project of this magnitude. During the construction period, the owner is confronted with two problems which are more severe for nuclear power projects than for conventional power projects owing to the longer construction times:

— The lack of revenue from the project (since no electricity is being produced),
— The financial requirement to pay interest (debt servicing).

Experience in various countries has shown that a nuclear power project can face many uncertainties which can lead to construction times being longer than expected and, as a consequence, to large cost overruns and thus higher, more protracted financing requirements, as well as large debt servicing payments.

In addition to these cost related considerations, public acceptance of nuclear power has become an important issue. Especially since the 1986 Chernobyl accident, heightened public concern with regard to nuclear risks has had a direct and profound influence on nuclear power projects worldwide.

It is thus essential that every effort be made by all parties involved in the development of nuclear power to reduce the uncertainties and risks. This is important in order to improve the overall climate for the financing of nuclear power projects. In particular, the commitment of a government to a nuclear power programme, together with strong policy support, is of paramount importance. The owner organizations should prepare long term plans for a power generation system which include personnel development and also clearly deal with the role of nuclear power in the national energy plan. The investment climate is improved if the government and the owner organization achieve good records of consistent and fair dealing with lenders and investors, and if the electricity tariff is set at a level necessary for the financial strength of the utility.

In a period when most developing countries are facing difficulties in servicing their debt, commercial banks as well as the governmental organizations of exporting countries may be reluctant to lend these countries additional funds, especially to build a nuclear power plant which lending organizations view as a very risky project. Only countries with acceptable credit ratings would qualify for bank loans and other credits for financing such a project. The development of sound economic policies, good debt management and project risk sharing would all help to improve the credit ratings of the countries concerned.

ECONOMIC FEASIBILITY AND FINANCIAL ANALYSIS OF NUCLEAR POWER

The investment costs of nuclear power plants scheduled for commissioning in the period 1995–2000 are estimated to range from about US $1300 to $2500 per kW(e), and their levelized electricity generation costs from 20 to 48 mills/kW·h (in January 1987 US dollars, with a 5% real discount rate, a 30 year plant life and a 72% levelized capacity factor). The comparative electricity generation costs of coal fired power plants, scheduled for the same commissioning dates, are estimated to range from about 21 to over 60 mills/kW·h. These ranges are rather wide and overlapping and therefore do not permit general conclusions to be drawn about the comparative economic feasibility of nuclear power plants. Moreover, differences between countries in the relevant institutional and economic environments exert an influence.

Most countries involved in the surveys conducted by the IAEA and other organizations expect base load nuclear power to have a lower levelized generating cost than coal fired power. However, in some areas with low cost coal or hydroelectricity, in countries with small electricity grids and in countries with a scarcity of investment capital and creditworthiness problems, nuclear power plants are generally not economically feasible. The most important point for the economic feasibility of a nuclear power project is that its costs are estimated with reasonable accuracy and reliability and that it forms part of a least cost electricity system expansion plan.

Even if a nuclear power project appears to be economically feasible, a financial analysis has to be carried out in current money terms. Such an analysis will include general factors such as the design and construction period, current and projected escalation rates, current and projected currency exchange rates and the discount rate, loan specific factors such as the interest rate, fees (i.e. the management, commitment and guarantee fees), frequency of interest payments, grace period, and the repayment period. A financial analysis is essential because it can lead to conclusions quite different from those based solely on an economic analysis.

A particular characteristic of the financing of a nuclear power project is that it requires a large investment to be made over a long construction period. The foreign currency component of this investment could be 60–80 % of the total direct capital cost of the plant. A nuclear power plant will require higher disbursements in the early years of the project, and there is a long period before and after commercial operation during which the cumulative expenditures for building and operating the plant are larger than those for a fossil fuel plant. This is clearly a problem in the short term and in the decision whether or not to start a nuclear power programme it will be a very important

consideration for utilities in developing countries, which are generally short of capital for investment purposes.

CONVENTIONAL APPROACHES TO FINANCING NUCLEAR POWER PROJECTS IN DEVELOPING COUNTRIES

Developing countries need to expand their power generation systems in order to permit and support economic and social development. The magnitude of the required investment and the financing constraints involved generate a need for greater efforts in mobilizing power sector financing from all possible sources. The available financing sources for power generation systems in developing countries have been utilized to:

— Cover domestic investment using the utilities' own resources and, to the extent that these are insufficient, the government budget. In a limited number of cases the capital markets in the countries concerned have generated resources to cover or to contribute to the domestic financing requirements.
— Cover capital requirements in foreign exchange. Supplier's credits or financing arrangements through commercial banks guaranteed by export credit guarantee agencies have been used widely. Credits from multilateral or bilateral sources have become increasingly important.

There are various possibilities for a developing country to secure the financing of its foreign currency needs, provided that the proposed project is solidly founded and that the credit rating of the borrower and the country is acceptable. Although an increase in financing flows from multilateral and bilateral lenders would be desirable, especially because of their more favourable amortization conditions, including lower interest rates, it seems that in the future additional funds will have to come mainly from international capital markets, which have been expanding rapidly.

A relatively large proportion (60–80%) of the total investment cost of a nuclear power project in a developing country is normally required to be in foreign currency because these high technology plants must usually be imported. However, the project, which will generate electricity to be sold to the local economy, will yield its earnings in local currency only. In such a case, both lenders and equity investors who have invested in the project in foreign currency will require firm assurances, in the form of a transfer guarantee by the host government, that their original investment, together with interest or dividends, can be recouped in a convertible currency.

All lending organizations display extreme prudence in the selection of borrowers to ensure that they will get their money back. Thus, these organizations wish to exercise a degree of control over the proposed investment projects which goes far beyond checking the financing requests and reimbursement guarantees. In general, during the course of project appraisal, the lenders' assessment of project risks will involve careful scrutiny of various risks of a technical, commercial/economic and political nature which may affect the project, during both the construction and operation periods. These are: credit risks, construction and development risks, operation and market risks, financial risks, political risks and legal risks.

On the basis of these considerations, it appears highly advisable that developing countries make every effort to become and remain reliable borrowers on the international capital markets, both by studying the loan conditions of lenders and by developing the managerial framework and expertise to put loans to the best use and to service them punctually.

However, many power utilities in developing countries do not generate enough revenue for their operating and capital expansion purposes. Owing to their financial difficulties, they often do not qualify for loans from international development or commercial banks. The low rate of return on invested capital in the power sector in a developing country also makes it very difficult to attract capital from private commercial investors.

One of the major sources of financial difficulties with utilities is their uneconomic pricing of electricity. In many utilities, electricity tariffs do not even cover the operating costs and debt service, and in most countries tariffs are below the long run marginal cost of supply. While social and political considerations must be taken into account, it is crucial that electricity tariffs should reflect costs. Other domestic factors which reduce the possibility of attracting financing are: inefficient operation, environmental concerns and shortfalls in the financing of local costs. Unless power utilities show good financial performance, it is unrealistic for them to expect support from financial institutions.

IMPORTANCE OF LOCAL FINANCING

If funding from the national budget or a sponsor's equity and cash flow were adequate to implement a project, there would be no problem in financing. If a country launching or expanding a nuclear power programme is creditworthy, it can obtain export credits and procure funds from international borrowings. If the capital market is relatively well developed in the host country, local financing may be easier. The reality, however, has proved to be different.

One of the most difficult problems to be faced with regard to financing nuclear power projects in developing countries is arranging for the funding of local costs, a task whose complexity is often underestimated. Experience shows that raising enough money for local cost financing from foreign sources, local capital markets or government budgets has often proved to be impossible and has been the main reason for delays in project implementation — at least after the initial and more technical problems of the projects have been solved.

Covering the gap in financing local costs by using foreign exchange funding from abroad often proves to be problematic. To avoid straining the foreign exchange balance of a country, with all the associated negative impacts, local costs should in principle be financed in local currency from sources within the host country itself (from the buyer's revenues from other projects, from the national budget or from funds raised in the domestic capital market). This is especially necessary as power plants are almost always operated for domestic use only, thus generating cash flow only in local currency.

Sound sources of local currency funding for investment in a public utility power project would be the government budget and the funds of the project's operating organization/utility, either from equity or from accumulated earnings set aside especially for such a planned investment. These sources could be supplemented by credits raised in the domestic capital market. Difficulties in financing local costs arise from shortages of government funds and constraints in local capital markets. The development of well functioning domestic capital markets is particularly important for organizing local financing. As foreign currency financing of local costs increases the debt burden and carries a foreign exchange risk, it is vital for successful project implementation to secure sufficient local financing.

As much as possible of the total project costs, but in any event the local portion of these costs, should be financed with domestic funds. Adequate local financing must be arranged in good time and, in the case of loans, for a reasonable credit period. Local financing should be secured in advance either through binding agreements or, for instance, by accumulating funds similar to escrow accounts and prohibiting the use of these funds for any other purpose. In this context, the importance of fixing reasonable electricity tariffs by the government concerned must be emphasized, for only in this way will the project executing agency achieve the sound financial strength needed to finance investments from its own resources or be considered creditworthy by banks.

EXPERIENCE OF SELECTED COUNTRIES WITH CONVENTIONAL APPROACHES FOR FINANCING NUCLEAR POWER PROJECTS

India — Domestic Financing

India has been promoting its pressurized heavy water reactor (PHWR) programme, with a plan to install 10 000 MW(e) of capacity by the year 2000, through funding from its national budget and from the cash flow of the operating organization. However, the financing will have to depend largely on market borrowings in the light of the limited availability of equity funds from the Government and the fact that substantial internal surpluses will not be generated until the late 1990s. Although the total borrowings, estimated at some 24 000 crores of rupees (1 crore = 10 million) between 1988 and 2001, appear large, the Indian capital market, and especially the public sector bond segment of the market, has been growing rapidly. India is seeking financing for its PHWR programme from within the country alone.

Republic of Korea — Supplier's Credits

The Republic of Korea provides a typical example of financing through supplier's credits. The country set the issue of energy in general, and nuclear power in particular, as one of its top priorities, since it imports all of its oil and possesses few coal reserves. The Government has a strong commitment to the nuclear power programme. This provides favourable conditions for the Korea Electric Power Corporation (KEPCO), the national electric power utility, which was until recently completely state owned, to manage the programme and to promote increasing levels of national participation in successive nuclear power projects. This has resulted in a steady increase in domestic financing of the local cost component of the nuclear power projects. Financing experience from the previous nine reactor units in this country indicates that even for one of the most vigorous developing countries in the world, public financing arrangements were the main sources of financing, with commercial loans providing supplemental financing only. The creditworthiness of KEPCO at that time facilitated these financing arrangements. More recently, however, the partially privatized KEPCO has obtained funding for the Yonggwang Nos 3 and 4 project now under construction (2 × 950 MW(e) pressurized water reactors (PWRs), with financing of US $3100 million) mainly through its own financial resources, supplemented by commercial borrowing ($100 million).

China — Export Credits and a Joint Venture Approach

China's Guangdong Daya Bay nuclear power project (2 × 900 MW(e) PWRs, with financing of about $4000 million) is another example of the use of export credits, with additional arrangements. The main features are:

— The project is based on a policy of importing from foreign suppliers;
— Of the net electricity generated, 70% is to be sold to Hong Kong (United Kingdom) for foreign currency;
— A joint venture company established by Chinese and Hong Kong companies will operate the project.

The Bank of China concluded loan contracts for the project with 17 foreign banks (seven in France and ten in the United Kingdom). The credit lines are: F.Fr. 13 000 million and UK £420 million, reimbursable in 30 semi-annual installments for the principal and 20 semi-annual installments for the interest capitalized during the construction period at a rate of 7.4% per annum, in accordance with the Organisation for Economic Co-operation and Development (OECD) Consensus (*Arrangement on Guidelines for Officially Supported Export Credits*, agreed upon in 1976). It was a difficult task to resolve such important problems as security arrangements and loan guarantees and this is reflected in the length of time needed to negotiate the contract (seven years). Another feature of the contract is the arrangement for technology transfer to China. The Guangdong project is considered by China to be not only a project for constructing nuclear power plants, but also an opportunity for acquiring advanced technologies from industrialized countries. In the course of various phases of the project, Chinese engineers are to participate in such activities as design and safety analysis in France and they will be trained for operations and maintenance tasks, as well as for equipment manufacturing.

Brazil — Export Credits and Commercial Loans

Construction of Brazil's Angra 1 nuclear power plant (a 657 MW(e) PWR) started in 1972 and commercial operation began in 1984. Loans amounted to US $1117 million, of which $371 million were supplied from foreign sources and $746 million provided domestically. Locally financed funds were used for construction work, while the internationally financed portion was devoted to covering foreign equipment and engineering costs. For the 1970s, both the construction period and the magnitude of the investment for Angra 1 were exceptionally large.

Brazil currently has two nuclear power units (Angra units 2 and 3, 2 × 1325 MW(e) PWRs) under construction. For these units, German export credit and insurance agencies have provided half of the financing, the other half coming from a syndicate of German commercial banks. However, because of financial difficulties, the construction work is behind schedule. There are many reasons for the delays in the Brazilian nuclear power programme, in particular with respect to Angra units 2 and 3. The site selection initially caused problems and the construction permit procedure continued for so long

that there was an almost total suspension of construction work for three years. In addition to these reasons, there was a drastic change in the financial position of Brazil, which became severely handicapped by a debt crisis, so that after approximately two years financing in foreign currency to cover local costs could no longer be raised in the market. Owing to budgetary constraints, the national budget could be used only to a very limited extent to fill the financing gaps. Thus, the domestic infrastructure investments, in particular, had to be stretched out over an extended period.

In addition to the negative effects on the national economy caused by power shortages and the delayed accrual of earnings for the project and its sponsors, delays in project execution normally resulted in higher delivery prices because of the application of price escalation clauses and in higher interest payments for the period up to commissioning. In the case of Angra units 2 and 3, the buyer and the exporter agreed to keep to the originally envisaged manufacturing and delivery schedule and to store the German components until they could be installed. This meant, of course, that interest during construction increased enormously; on the other hand, there have been no increases in the delivery prices apart from extra costs for storage and preservation of components. The export financing community has responded to all of these problems in a very flexible manner, with many amendments to various loans. However, this has involved a great deal of extra and costly work.

CONSTRAINTS ON EXPORT FINANCING FOR NUCLEAR POWER PROJECTS

Financing for nuclear power projects in developing countries is currently limited primarily to export credits, commercial bank loans and supplier credits. The OECD Consensus and its annex, *Sector Understanding on Export Credits for Nuclear Power Plants* (agreed upon in 1984) spell out the guidelines, terms and conditions for such financing. Under this arrangement, developed country creditors (Canada, Japan, the United States of America and western European countries) have agreed *not* to provide tied aid credits, aid loans, grants or any other kind of financing on credit terms that are more favourable than those set out in the Understanding. The World Bank and the regional development banks have traditionally *not* made loans for nuclear power projects in developing countries. Thus, except for export credits, commercial bank loans, supplier's credits, funding from the national budget and equity and borrowings by the owner, there are no other sources of financing for nuclear power projects in these countries.

Specifically, the present terms of the OECD Consensus rule out the use of bilateral soft loans. This ban on mixed credits penalizes nuclear power projects in comparison with fossil fuel power projects, since the ban does not apply to the latter. Although it is recognized that the financing of nuclear power projects represents risks for lenders of a different degree than those of other industrial projects, the OECD Consensus provides a 1% higher interest rate for nuclear power projects in developing countries for a period of up to 15 years following the completion of plant construction and startup. The cost of money for a nuclear power project is high and runs between 10 and 12%, depending on the country category. Other financing costs can also be added. These terms apply to virtually all aspects of new nuclear power projects, including equipment, materials, services, training and commissioning. Official export financing to cover local currency costs and capitalization of interest may not exceed 15% of export value, assuming that the export credit agency (ECA) is willing to finance such costs. It is in their own interest for ECAs to comply with the OECD Consensus. Thus, given the Consensus, it is clear that if funding is made available for financing nuclear power projects in developing countries, it will probably be on a limited basis and the cost of money is unlikely to be much lower than commercial terms.

NEW FINANCING APPROACHES

The task of arranging financing for nuclear power development must deal with additional constraints and problems as perceived by various lending organizations, such as the creditworthiness of developing countries, recent stringent regulations on capital and mandatory reserve requirements and risks incurred during construction and operation.

Of course, the situation varies from country to country and project to project. However, in general, as long as the debt servicing situation of a given country is a cause for concern, lenders, exporters and governments of developed countries will remain hesitant to finance nuclear power projects, with their high degree of uncertainty in costs and scheduling. In view of the increasing need for foreign exchange in most developing countries and the difficult situation of the present international financing environment as regards meeting the financing requirements of a nuclear power project in these countries, additional approaches and complementary mechanisms are being sought.

Thus, developing countries are turning increasingly to more innovative financing options for energy projects. These include non-recourse, or limited recourse, financing techniques for mobilizing additional external financial resources for power development; the World Bank's partial guarantee

approach; and other ideas. To date, *no* large power project in developing countries has been implemented using these new approaches. However, some countries (e.g. Turkey and Pakistan) are now involved in the lengthy process of negotiating innovative financing approaches for development of their power sector.

THE BUILD–OPERATE–TRANSFER MODEL

The basic framework of a build–operate–transfer (BOT) approach is as follows. A number of foreign investors form a consortium, the consortium establishes a joint venture company (JVC) with a local utility and this JVC sells the electricity generated to the utility. These foreign investors procure most of the funds for the project, which are used to:

— **Build** a power plant with foreign engineering expertise;
— **Operate** the plant with foreign investor/operator management for a certain period until all costs, debt service and equity are recovered by means of an electricity tariff; and then
— **Transfer** the ownership of the plant to the country in which it is built.

A variant of BOT is the BOO (build–own–operate) approach, which does not involve transferring the plant to the host country. A BOO plant can, in principle, continue in private hands throughout the useful life of the project or up to an earlier date agreed upon by the host government and the private owner.

Advantages of the BOT Approach

When a power plant is constructed in developing countries using a BOT approach, the following advantages may generally be expected:

— Attraction of foreign capital in the form of non-government debt for power plants,
— Reduction of risks related to construction and operation as a result of the consortium's expertise and experience,
— Provision of practical opportunities for training and technology transfer during the course of construction and operation.

However, it should be noted that there are a number of serious arguments against the BOT approach: such projects are immensely complicated and time consuming undertakings, both from the legal and financial points of view, and the overall costs of a BOT project would be higher than for a project financed directly by sovereign borrowings.

Issue of Debt Service Guarantees

The most important factor in implementing a BOT project is procuring the large amount of funds required for construction. Usually, most of these funds will be borrowed from prime rated international financial institutions and such institutions almost always require some type of security arrangement by which debt service is substantially guaranteed.

In the BOT approach, the host government does not formally guarantee the project company's loans for executing the project, but instead generally gives some guarantee to buy the electricity generated from the project, as project financing in the BOT model involves a non-public debt transaction. The host government's aim is to ensure that its guarantee to purchase electricity is not treated as a sovereign debt so that its international debt is not increased. However, financial institutions are hesitant to extend favourable loans on a non-recourse basis and this will often push up financing costs.

A power purchase agreement can be concluded with the JVC by a competent organization in the host country, usually a public utility, which pays for an agreed upon amount of electricity generated at an agreed upon price. The organization guarantees to purchase the agreed amount of electricity and to pay for it even in the event of inability to purchase, under a so called "take-or-pay" clause. Purchasing prices are calculated on the basis of a method involving a basket of currencies, which means that the host government basically bears the foreign currency exchange risk. The government ensures that the debt servicing, payment of dividends, equity repatriation and other financial transactions are made in hard currency.

For lenders, the concerns relate not only to securing payment of the electricity tariff, but also determining who guarantees the debt servicing in case the JVC fails to earn revenues. Since for lenders the creditworthiness of a JVC established in a developing country is unsatisfactory, they would naturally wish that the host government itself guarantee the repayment of the loan. In the case of the Turkish Aliaga thermal power project under negotiation (2 × 500 MW(e) coal fired power plants with financing of US $1200 million), there have been long and intensive negotiations between the lenders and the host government, which will not guarantee debt servicing under the BOT scheme.

The BOT contingencies are:

— Default by the host government entity (e.g. non-payment for the agreed upon amount of electricity);
— Force majeure (e.g. inability to generate electricity because of war);
— Default by the JVC (e.g. inability to generate electricity because of faulty operation).

In the Turkish BOT case, the host Government does not require the JVC to repay the debt for the first two contingencies. However, the Government believes that the JVC should bear the responsibility for repaying the debt for a contingency brought about by the JVC itself, such as in the case of a JVC default. An idea was discussed during the negotiations whereby even in such a case the host Government would bear the responsibility for repaying the debt to lenders within a limited period of time after the start of commercial operation. Although the Turkish Government is to help cover the debt service by providing a government loan, this has to be repaid by the project company from its future cash generation.

It is important for lenders to know to what extent the host government will come forward to bear the obligation to repay the debt. The position of the lenders is presumably that as long as the debt service is initially covered by the host government, a final sharing of the debt service obligation between the host government and the JVC is of secondary concern and can be settled on the basis of conditions pre-agreed by them. If the debt servicing obligation is not honoured by the host government, the JVC has to ask the government to take over the project. Lenders in this case will ask the government to assume the debt and the government will have to accept the transfer of this debt (or make it a sovereign debt).

In summary, if the above mentioned conditions can be agreed upon, then lenders can act as if the host government practically guarantees the debt service under certain conditions, while the government can act on the basis of two main BOT principles which, in the case of the Turkish project, are that the:

— Turkish Government does not issue a conventional payment guarantee,
— Project company basically assumes the financial risks associated with its responsibilities/obligations.

Implications for Nuclear Power Projects

The BOT approach appears to provide a new way to tap the resources of private sector financing for a capital intensive power plant that may otherwise not be available to the host country through its budget or from financing institutions. Nuclear power plants are very capital intensive and the larger the plant size, the more complicated are the BOT financial and commercial structures. Investors, the host government and financial institutions may have competing interests regarding the protection of their investment and the structuring of an appropriate security arrangement.

In developing countries, the key determinants of the debt to equity ratio are the project's economics, which establish the debt servicing capacity, and the project's risk profile. A project with strong economic and credit structures typically requires less equity. However, given the construction and startup risks for a nuclear power plant, it is likely that ECAs and commercial banks will require an equity participation level somewhat greater than that required for a conventional power plant, unless sovereign risk guarantees are available from creditworthy governments. Lenders (i.e. ECAs and commercial banks) will be looking not only at project revenues as a means of repayment, but also at the type of security structure which ensures that, under certain risks or contingencies, the debt will continue to be serviced. There may also be a requirement, particularly by ECAs, that the host country provide sovereign risk guarantees under certain circumstances (e.g. force majeure or political risks). Escrow and reserve accounts will also be sought by the lenders.

Other aspects to be dealt with when the BOT approach is applied to nuclear power projects are the following:

— Nuclear third party liability must be channelled exclusively to the operator of the plant and must be strictly limited to amounts compatible with available insurance coverage; any exposure beyond such coverage must be covered by corresponding governmental indemnity schemes.
— Activities related to decommissioning and the back end of the fuel cycle have to be arranged by the host government.
— Assurance of nuclear fuel supply requires the host government's involvement.

In addition to these aspects, the BOT approach for nuclear power projects is likely to involve additional complexity and time, and a costly development process because licensing, siting, environmental and financing considerations are more complicated for a BOT system than for conventional power projects. Thus, investors/sponsors should be prepared to accept long lead times and large project development expenditures.

A NEW PROGRAMME FOR A PARTIAL GUARANTEE BY THE WORLD BANK

Various schemes for project financing have been developed recently to finance large infrastructure projects in developing countries. However, foreign investors and private financial institutions often hesitate to take part in such projects because of concerns over the developing country's political stability

and country risks. The World Bank has recently developed a new co-financing programme, "Expanded Co-financing Operations" (ECOs), for solving this structural problem.

Expanded Co-financing Operations incorporate the objectives and principles of the World Bank's "B-Loan" programme, but widen its scope. They are intended to promote increased private financial flows by providing enhanced coverage of risks that would not otherwise be assumed by private lenders. They are to be made available to eligible borrowers to attract private financing for specific projects or investment programmes that are identified and appraised by the World Bank, and that are normally accompanied by World Bank loans.

The first project under this new co-financing approach would be the Hub Power Project in Pakistan, which is under negotiation and for which the use of a BOO approach is proposed. The project comprises four 323 MW(e) oil fired power plants, with financing of US $1560 million. The new co-financing approach applied to this proposed project has the following innovative features:

— The project would be undertaken by a private JVC established by local and foreign investors.
— The project would be undertaken on a BOO basis.
— A subordinated debt fund, or seed money based on an official fund, has been established.
— The World Bank would guarantee various supporting obligations of the host government (including political and country risk coverage) for the JVC's loans from commercial banks.
— The Export–Import Bank of Japan (JEXIM) would provide a co-guarantee with the same coverage as that of the World Bank.
— In addition to the World Bank and JEXIM, the aid agencies of industrialized countries and ECAs would participate in the project to structure an international project syndicate in major international financial markets.

Of the total financing required, about US $320 million would be provided by equity, and $1240 million equivalent would be the debt portion. The latter would be financed on a limited recourse basis using electricity sales revenues as debt servicing resources. For project financing, an international syndicate of commercial banks ($360 million), ECAs ($300 million) and a Pakistani private financial institution ($150 million) would participate in the project as senior lenders.

The World Bank would guarantee 100% of the principal in the event of debt service default on the loan if the default is due to the failure of the

Government of Pakistan to fulfil its obligations, as defined under security package agreements, for the amount of $240 million equivalent out of the total $360 million equivalent. The JEXIM would provide a co-guarantee (in the ratio of 2:1) for the remaining $120 million equivalent.

The World Bank's guarantee is different from a conventional 100% financial guarantee, but it is ingeniously devised, utilizing its ECOs. It is not a guarantee of a redemption of principal at maturity, but a newly developed approach to guarantee against debt service defaults arising from risks that are difficult for commercial banks to take when financing a project in developing countries. These risks include: foreign currency exchange risks, repatriation risks, political risks and default arising from breach of contract by a host government. It takes the form of a partial guarantee by the World Bank to cover defaults with respect to principal payments. However, the ECO guarantee in project financing is more like partial insurance covering political risks, rather than a comprehensive guarantee against all risks, in the sense that ECOs cover only selective risks of the project, leaving the remaining risks to the private sector.

The Government of Pakistan would conclude a project implementation agreement which would guarantee the performance of certain critical public sector entities, such as those fulfilling their obligations to supply the fuel and to purchase and pay for the agreed upon amount of electricity generated from the project. In addition, the agreement would provide for various support obligations by the Government, such as a guarantee of foreign exchange convertibility to meet the JVC's foreign currency debt service obligations to senior lenders. The World Bank's guarantee covering the JVC's defaults on principal payments arising from the Government's failure to fulfil its obligations under the implementation agreement would be extended to debt servicing to the commercial banks. The co-guarantor, JEXIM, would guarantee debt service default due to sovereign risks along the same lines as the World Bank.

Generally speaking, if the host government does not provide any guarantees to cover lenders for project risks due to the sponsor's failure or force majeure events, foreign lenders and ECAs may hesitate to finance the project in the absence of a security package that essentially insulates the senior lenders from project risks. However, with this comprehensive security arrangement, project risks assumed by ECAs and other co-financers would be limited to minimum commercial risks related to the implementation of a turnkey project by a prime rated international consortium.

Although the Hub Power Project involves a completely private company, the World Bank's guarantee of the host government's obligations to support the project and the World Bank's policy guidance or other measures involving

the host government would tend to diminish political risks, thus reducing substantially the risks assumed by the sponsor and participating lenders. The ECO approach could be effectively applied to support privatization programmes in many developing countries in the future.

Because of its high capital intensiveness, long period for project implementation, public acceptance and other nuclear energy related issues, nuclear power project implementation in a developing country will require further study of the associated risks and risk sharing among the parties involved.

INVESTMENT GUARANTEE PROGRAMME

To encourage the flow of private foreign investment to developing countries by mitigating the political risks associated with a project, the Multilateral Investment Guarantee Agency (MIGA), the most recent member of the World Bank group, provides:

— Investment guarantees against the risks of currency transfer, expropriation, war and civil disturbance, and breach of contract by the host government,
— Advisory services to developing countries on ways and means to improve their attractiveness for foreign investment.

Eligible investments include contributions in cash or in kind in the form of equity, loans made or guaranteed by equity holders and certain forms of non-equity direct investment.

During its brief history, MIGA has not yet insured a power project in a developing country and, given its relatively modest coverage limit of US $50 million per project, its role is likely to be in close association with other commercially available investment insurances. It was set up primarily to cover equity and it can provide political risk insurance to investors in private sector power projects. Taking into consideration the fact that public utilities prevail in the power sector in most developing countries, together with the traditional position of the World Bank on nuclear power, it is still very unlikely that MIGA will give significant support to nuclear power projects in developing countries.

OTHER APPROACHES

Some additional mechanisms could be envisaged to improve the present situation for financing nuclear power projects in developing countries.

However, each of these requires careful analysis by lenders, suppliers and potential buyers.

Countertrade Arrangements

For countertrade or barter arrangements, the financing and supply sources are expected to come from the same country. Such arrangements can easily be applied in cases where the products have an external market and can be sold outside the host country. However, electricity is not usually such a product and therefore other products or services have to be marketed by the suppliers. The problems with countertrade arrangements concern:

— The types of commodities or services the host country can provide;
— The types of commodities or services the supplier country can accept;
— Setting the prices of such commodities or services;
— Balancing price against the quantity to be supplied, especially in the case of low priced products from light industry or agriculture.

The supplier country will have to bear the market and price risks of the products received and must very often involve professional companies for this purpose, which results in additional expenses. If the host country has existing commodity exchange arrangements with the supplier countries, a countertrade arrangement could be utilized. In practice, financing plans involving countertrade appear to be complicated and economically unfavourable compared with other conventional financing approaches and would probably contribute only a part of the foreign currency requirements.

"Whole to Coal" Model

The "whole to coal" concept is one in which the purchasing utility and its customers are assured of the same economic and financial situation as would be the case if the utility had constructed a coal plant rather than a nuclear unit. The nuclear unit would be owned by a supplier entity. During the construction and early operating periods, the utility's financing requirements would be equal to the coal alternative. Buy-out would be mandatory (subject to plant acceptability and performance tests) at a pre-agreed time. On the basis of an agreed upon schedule, the utility would pay back all earlier amounts of financing from the supplier entity, including any losses from selling power on a coal basis, together with interest.

Viewed from the perspective of a small utility, the advantages of this model are:

— It keeps the initial capital investment and early power generating costs for the buying utility at the level of an equivalent coal plant;
— It spreads the financing requirements over a much longer period of time, thereby making a nuclear unit financially more feasible;
— The nuclear unit has a demonstrated track record before the buyer raises the bulk of the financing.

This model is being used in negotiations between a Canadian utility and the supplier of a 450 MW(e) CANDU-3 unit.

CONCLUDING REMARKS ON ALTERNATIVE AND NEW FINANCING APPROACHES

Since the use of the alternative approaches discussed here for financing nuclear power projects in developing countries is more complex and risky than for conventional power projects, investors, host governments and financial institutions will be looking very closely at the track record for developing and implementing these new approaches. This scrutiny will encompass a review of all phases of existing projects, including final settlement of financing arrangements and plant completion/operations, before these parties will pursue new approaches for a nuclear power project in a developing country. In particular, the outcome of the Turkish coal fired power project and the Hub Power Project in Pakistan will no doubt influence the attitude of investors to the BOT or BOO options for large size projects. The BOT/BOO approaches for financing nuclear power projects in developing countries by no means provide a panacea; they are possible but untested alternatives for revenue earning power projects, particularly for complex nuclear power projects. The results of negotiations over the projects in Turkey and Pakistan could, but may not necessarily, give an indication of the potential for these approaches to be applied to nuclear power projects in developing countries.

GENERAL CONCLUSIONS

A major requirement for and constraint on the development of nuclear power projects in developing countries is the ability to obtain the considerable financial resources required on reasonable terms. Furthermore, the financing of nuclear power projects presents a critical problem not only because of the very large amount of financing needed, but also because of the low

creditworthiness of countries as seen by various lending organizations. In addition, the low rate of return on invested capital in the power sector in a developing country makes it very difficult to attract capital from private commercial investors.

The financing of nuclear power projects in developing countries involves complex issues that need to be fully understood and dealt with by all parties involved, namely, high investment costs, generally long construction times, a high degree of uncertainty with respect to costs and scheduling and public acceptance issues.

A financial analysis is essential because it can lead to quite different conclusions from those based solely on an economic analysis. A nuclear power plant will require higher disbursements in the early years of the project and there is a long period before and after commercial operation during which the cumulative expenditures for building and operating a nuclear power plant are larger than those for a fossil fuel plant. This is clearly a problem in the short term and, in the decision whether or not to start a nuclear power programme, it will be a very important consideration for utilities in developing countries, which are generally short of capital for investment purposes.

In a period when most developing countries are facing difficulties in servicing their debts, commercial banks as well as governmental organizations of exporting countries are reluctant to lend them additional funds, especially to build a nuclear power plant, which lending organizations view as a very risky project. Only countries with acceptable credit ratings would qualify for bank loans and other credits for financing such a project. The development of sound economic policies, good debt management and project risk sharing would all help to improve the credit ratings of the countries concerned.

A nuclear power project operated solely for domestic use will generate cash flow only in local currency. Both lenders and equity investors who have invested in the project in foreign currency will require firm assurances, in the form of a transfer guarantee by the host government, that their original investment, together with interest or dividends, can be recouped in a convertible currency.

Conventional schemes of financing include export credits, commercial bank loans, supplier's credits, government budgetary funds and the owner's equity. Canada, Japan, the United States of America and western European countries have agreed to comply with the OECD Consensus, which prevents supplier countries from giving soft loans and other credit inducements for the export of nuclear power plants. Thus, there will be limited sources available for financing such a project in a developing country and the cost of money is unlikely to be much lower than commercial terms.

In view of the need of most developing countries for more foreign exchange and the present difficult international financing climate, including constraints on export credits, creditworthiness problems of developing countries and the recent stringent regulation of the risk exposure of financial institutions, innovative financing approaches are being sought and tested, including the BOT and BOO approaches.

To date, however, no large power project in developing countries has been implemented using these new approaches. The results of negotiations for conventional thermal power projects in Turkey and Pakistan using the BOT/BOO approaches could, but may not necessarily, give an indication of the potential for these innovative financing approaches to be applied to nuclear power projects.

For successfully financing a nuclear power project in a developing country, it is essential for the host government/utility to:

— Commit itself to the nuclear power programme with necessary government support;
— Make a thorough financial analysis, together with an economic analysis for evaluating the feasibility of the project;
— Maintain generally acceptable credit ratings in order to obtain investments and debt financing;
— Finance as much as possible of the local cost component of the project in local currency from sources within the host country itself — the importance and complexity of this is often underestimated;
— Utilize thoroughly a full range of expertise to deal with the technical, financial and legal complexities;
— Set electricity tariffs at a level necessary for sound financial strength, since one of the major sources of financial difficulties in utilities is the uneconomic pricing of electricity.

In general, as long as the debt servicing situation of a country is a cause for concern, lenders, exporters and governments of developed countries will remain hesitant to finance nuclear power projects, with their high degree of uncertainty in costs and schedule. It is, therefore, highly advisable that developing countries make every effort to become and remain creditworthy; this would eventually qualify them for the financing which is needed for such projects.