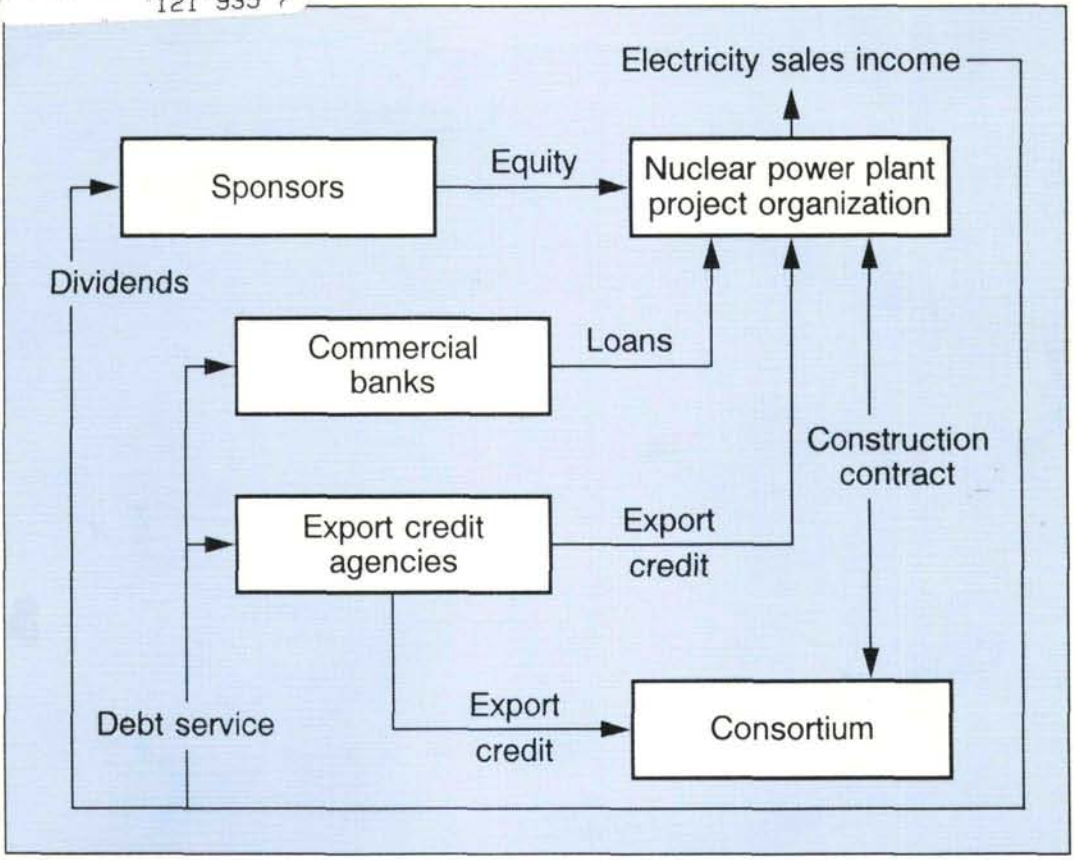

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Financing Arrangements for Nuclear Power Projects in Developing Countries

A Reference Book

INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA, 1993

FINANCING ARRANGEMENTS FOR NUCLEAR POWER PROJECTS IN DEVELOPING COUNTRIES

A Reference Book

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The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

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FOREWORD

This reference book reviews the main features and problems or difficulties involved in the financing of nuclear power projects with special reference to developing countries. It provides basic information and advice to developing countries interested in nuclear power projects as part of their power sector planning.

The book outlines the general characteristics of financing a nuclear power project and presents innovative approaches for power generation financing. It discusses the special conditions and requirements of nuclear power projects and their financing complexities. The focus is on the practical issues that need to be dealt with in order to successfully finance these power projects, as well as the constraints faced by most developing countries. Possible ways and means of dealing with these constraints are presented. The main topics covered by the book are the:

- Special circumstances related to the financing of nuclear power projects,
- Costs and economic feasibility of nuclear power plants,
- Conventional approaches for financing power generation projects in developing countries,
- Experience gained and lessons learned,
- Alternative approaches for mobilizing financial resources.

A recurring theme in the book is how the problems and difficulties associated with the need for more foreign exchange in many developing countries can be solved, and the inadequacy and complexity of the present international financing system for supporting financing requirements in the magnitude needed for a nuclear power project. Alternative approaches should be considered to overcome constraints on financing nuclear power projects in many developing countries. However, it appears that new financing approaches in the power generation sector have not yet proved to be successful for nuclear power.

The book reflects experience gained from the Agency's two seminars on the financing of nuclear power projects in developing countries held in Vienna (1985) and in Jakarta (1990), the latter in co-operation with the Government of Indonesia, and from a 1987 study conducted by a Senior Expert Group on the Promotion and Financing of Nuclear Power Programmes in Developing Countries. This reference book was prepared by the Agency's Division of Nuclear Power with contributions from experts within and outside the Agency. The responsible officer was Y. Tatsuta of the Division of Nuclear Power. In the preparation of this report, valuable contributions to, and/or reviews and comments on, the various drafts were made by some members of the Advisory Group meetings on contracts and the financing of nuclear power projects in developing countries, by S.G. Xu (Guandong Nuclear Power Joint Venture Corporation Limited, China), J.-P. Lee (Korea Electric Power Corporation, Republic of Korea), M. Kanzaki (Japan Electric Power Information Center, Japan), J.A. Marques de Souza (NUCLEN, Brazil), H. Mitsuishi (Japan

Atomic Industrial Forum, Japan), H. Tsuchida (Electric Power Development Corporation, Japan) and, in particular, by A.F. El-Saiedi (Nuclear Power Plants Authority, Egypt), H. Herold (Kreditanstalt für Wiederaufbau, Germany) and K. Shimazaki (The World Bank). G. Woite and C.W. Hu, of the IAEA Division of Nuclear Power, prepared sections 3.2–3.6 in Chapter 3.

The IAEA expresses its appreciation to all those who participated in the preparation of this reference book and also to the Member States that made available experts to assist in this work.

EDITORIAL NOTE

CONTENTS

Chapter 1

INTRODUCTION

The use of electricity increased rapidly at a world average of 3.9% per annum during the period 1974–1991, while during the same period total energy use grew rather slowly at an average growth rate of 2.2% per annum. It seems very likely that the future availability and use of electricity will be determining factors in both economic development and energy policies. Facing strong demand for electricity and assuming that electricity will increase productivity, enhance economic growth and improve living standards, developing countries had no hesitation in allocating financial and technical resources to promote power development. Unfortunately, most of these countries are now facing serious financial problems associated with such capital intensive power projects.

In spite of the demonstrated overall economic competitiveness and technological feasibility of nuclear power, the high capital requirements for nuclear power plants pose difficult financing problems, and financing remains one of the major constraints on nuclear power programmes in most developing countries. The IAEA topical seminar on Financing of Nuclear Power Projects in Developing Countries [1] reaffirmed that 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 needed on reasonable terms. Furthermore, the financing of such 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 perceived by various lending organizations. 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 are reluctant to lend these countries additional funds, especially to build costly nuclear power plants.

The situation regarding the national debt of different countries, though improving, remains serious. While some countries have rescheduled their debts and are paying the interest on a step-by-step basis, the net export of goods is often still too low to supply sufficient foreign exchange for debt repayment. The situation is, of course, different from country to country and project to project. However, in general, unless the debt service capability of a developing country is judged to be satisfactory, lenders, exporters and the governments of industrialized countries will remain hesitant to finance a nuclear power project in that country. The major problem is thus more a question of the general economic condition of a country than of obtaining financing for a nuclear power project. In addition to the debt servicing problem, recent international efforts to regulate the risk exposure of financial institutions are resulting in a dwindling of financial flows to developing countries.

Other findings of the IAEA Seminar [1] were as follows:

— The magnitude of financing requirements means that no one source can assume the risk alone. Risk sharing is now the accepted mechanism.
— Domestic financing to the maximum extent possible through conventional mechanisms is highly recommended.
— The commitment of local authorities to guarantee funds for the local portion of the project and ensuring the continuity and availability of funds in a timely manner are important for successful project realization and for meeting budget constraints. Examples of countries that did not do so, and experienced very high cost overruns, are Argentina, Brazil and Mexico.
— It is recommended that funds be allocated or sources of financing be secured to cover cost overruns, when needed. However, it is better to structure the contracts and interrelationships between the entities involved in such a way as to avoid such a situation. One proven method of minimizing cost overruns is the turnkey, or single responsibility, approach.
— The build–operate–transfer (BOT) model, although applicable to conventional power plants or major energy projects, is difficult to apply to nuclear power projects because of the non-conventional risks involved which the supplier or builder cannot take and which cannot be financed on the basis of non-recourse financing. A similar model, build–own–lease (BOL), is under consideration, e.g. in Indonesia; however, the financing aspects are more or less the same as for the BOT model.
— The Organisation for Economic Co-operation and Development (OECD) Consensus (the OECD's 'Arrangement on Guidelines for Officially Supported Export Credits') has the general advantage of avoiding potentially ruinous competition over concessional forms of credit. However, it does not provide for favourable conditions for the borrowers as regards nuclear power projects. There is a need to review the Consensus with a view to making it more responsive to the particular requirements of developing countries for nuclear power as a viable source of electrical energy.

The financing of nuclear power projects in developing countries involves complex issues that need to be fully understood and dealt with by all the parties involved. Consideration should be given to the principal characteristics specific to nuclear power projects, as well as to the overall complexities of such projects and how these complexities affect their financing. It is essential that every effort be made by all parties involved in the development of a nuclear power project to reduce the uncertainties linked to such large investments and long project times, in order to improve the overall climate for the financing of these projects in developing countries.

This report begins by identifying the special circumstances for financing nuclear power projects in developing countries. They are: long construction times, large capital requirements on terms which are extraordinary in comparison with other projects, and the likelihood of cost overruns. In addition to these considerations, public acceptance of nuclear power has also become an important concern, particularly because of safety, waste disposal and non-proliferation issues. The report introduces the specific issues affecting the financing of nuclear power projects and the actions that each party involved in the financing can take to make such projects more predictable.

The expected costs for nuclear power investment and electricity generation are important elements in evaluating the feasibility of the project and for power sector expansion planning. This book presents the cost elements and the economic feasibility of nuclear power plants in comparison with conventional power generation systems, based on recent studies.

Conventional options for financing power generation projects in developing countries have included financing through a utility's own resources, national budgets, local commercial banks and foreign multilateral and bilateral sources, usually to cover foreign exchange costs. Most developing countries often lack foreign exchange and the ability to mobilize resources in their domestic capital markets. Industrialized countries able and willing to export components and services for power generation systems have made a number of arrangements to assist developing countries in financing their projects. This book discusses the various conventional approaches and sources for financing power generation projects in these countries.

To supplement national financing schemes, multilateral financing institutions were created after World War II to assist developing countries in mobilizing financial resources for economic development. The World Bank Group is one such institution. The efforts of the World Bank have been supported by the establishment of regional development banks in Africa, Asia, Europe, Latin America and, most recently, of the European Bank for Reconstruction and Development. While multilateral sources have made a major contribution to financing development — about one fourth of officially supported financing originates from multilateral institutions — they have not yet participated in the funding of nuclear power projects.

Successful financing arrangements depend on the thorough use of a full range of expertise and on learning from experience. If the national budget or a sponsor's equity and cash flow can accommodate the implementation of a project, there will be no problem in financing the project. If a country launching a nuclear power project, or expanding it, is creditworthy, it can be helped through the granting of export credits and can procure funds by international borrowing. If the capital market is relatively developed in the host country, local financing may be easier. The reality, however, has proved to be different. This book presents some cases, as well as key issues and lessons learned in financing power projects in developing countries.

In general, as long as the debt servicing by a given developing country is a cause for concern, lenders, exporters and the governments of developed countries will remain hesitant to finance nuclear power projects, owing to their high degree of uncertainty with respect to costs and schedules. In view of the need for more foreign exchange in most developing countries and the difficult situation existing currently in the international financing environment for lending to a developing country for a nuclear power project, additional approaches and complementary mechanisms must be explored. Developing countries are turning increasingly to more innovative financing options. This book presents some of the approaches in power sector planning and ideas for further consideration. 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 long process of negotiating innovative financing approaches for their power sector development. The results of these negotiations could, but may not necessarily, give an indication of the potential for these models to be applied to nuclear power projects.

Chapter 2

THE STATUS OF NUCLEAR POWER AND SPECIAL CIRCUMSTANCES RELATED TO THE FINANCING OF NUCLEAR POWER PROJECTS

The feasibility and success of nuclear power projects and programmes in developing countries depend, to a large extent, on the following:

— Grid size and stability.
— Availability of qualified manpower at all levels: management, operations, construction and maintenance.
— Organizational structures to plan, take and implement decisions, execute and operate the project and regulate its safety.
— Industrial support, not only for construction but also for operations, maintenance and repair.
— Research, development and demonstration, not only on the nuclear side but also in general industrial research of fundamental importance.
— Adequate and sound financing for the project.

So far, nuclear power has been introduced only to a limited extent in a few developing countries.

It has become apparent that a major requirement for, 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. The discussion here will consider the role of nuclear power in developing countries and the factors which make nuclear power projects more difficult to finance than conventional power projects.

2.1. STATUS OF NUCLEAR POWER AND ITS ROLE IN DEVELOPING COUNTRIES

2.1.1. Current status [2, 3]

According to data in the IAEA's Power Reactor Information System (PRIS), at the end of 1991 there were 420 nuclear power reactors connected to electricity supply grids in 26 countries, with a total of 326 611 MW(e) of installed nuclear power generating capacity (Table I, Ref. [2]). There were also 76 power reactors under construction in 16 countries, with a total generating capacity of 62 044 MW(e). The accumulated operating experience amounted to more than 6000 reactor-years.

TABLE I. NUCLEAR POWER REACTORS IN OPERATION AND UNDER CONSTRUCTION [2]
(as of December 1991)

Country	In operation				Under construction			
	Number of units	Net capacity (MW(e))	Cumulative experience		Number of units	Net capacity (MW(e))	Nuclear electricity (TW·h)	Nuclear share (%)
			Years	Months				
Argentina	2	935	26	7	1	692	7.2	19.1
Belgium	7	5 484	107	7	0	0	40.4	59.3
Brazil	1	626	9	9	1	1 245	1.3	0.6
Bulgaria	6	3 538	59	6	0	0	13.2	34.0
Canada	20	13 993	263	1	2	1 762	80.1	16.4
China	1	288	0	1	2	1 812		0
Cuba	0	0	0	0	2	816		0
Czechoslovakia	8	3 264	68	1	6	3 336	22.2	28.6
Finland	4	2 310	51	4	0	0	18.4	33.3
Former USSR	45	34 673	559	3	25	21 255	212.1	12.6
France	56	56 873	655	3	5	7 005	314.9	72.7
Germany	21	22 390	425	8	0	0	140.0	27.6
Hungary	4	1 645	26	2	0	0	12.9	48.4
India	7	1 374	93	1	7	1 540	4.7	1.8
Iran, Islam. Rep. of	0	0	0	0	2	2 392		0
Italy	0	0	81	0	0	0		0
Japan	42	32 044	514	3	10	9 192	209.5	23.8
Korea, Rep. of	9	7 220	63	1	3	2 550	53.5	47.5
Mexico	1	654	2	9	1	654	4.1	3.6

Netherlands	2	508	41	9	0	0	3.5	4.9
Pakistan	1	125	20	3	0	0	0.4	0.8*
Romania	0	0	0	0	5	3 125		0
South Africa	2	1 842	14	3	0	0	9.1	5.9
Spain	9	7 067	110	7	0	0	53.2	35.9
Sweden	12	9 817	171	2	0	0	73.5	51.6
Switzerland	5	2 952	83	10	0	0	21.7	40.0
UK	37	11 710	925	10	1	1 188	62.0	20.6
USA	111	99 757	1592	3	3	3 480	612.6	21.7
Yugoslavia	1	632	10	3	0	0	4.7	6.3
Total	420	326 611	6038	9	76	62 044	2009.1	17.0

Note: The total includes the following data in Taiwan, China: 6 units, 4890 MW(e) in operation; 33.9 TW·h of nuclear electricity generation, representing 37.8% of the total electricity generated there; 62 years and 1 month of total operating experience.

Germany reported five reactors (Greifswald units 1 to 5) as being shut down in 1990.

The USA reported one reactor (Rancho Seco) as being shut down in 1990. Construction of two reactors (Comanche Peak and Watts Bar-1), suspended in 1988, was restarted.

Values with an asterisk are IAEA estimates.

Construction of four reactors was cancelled during 1991.

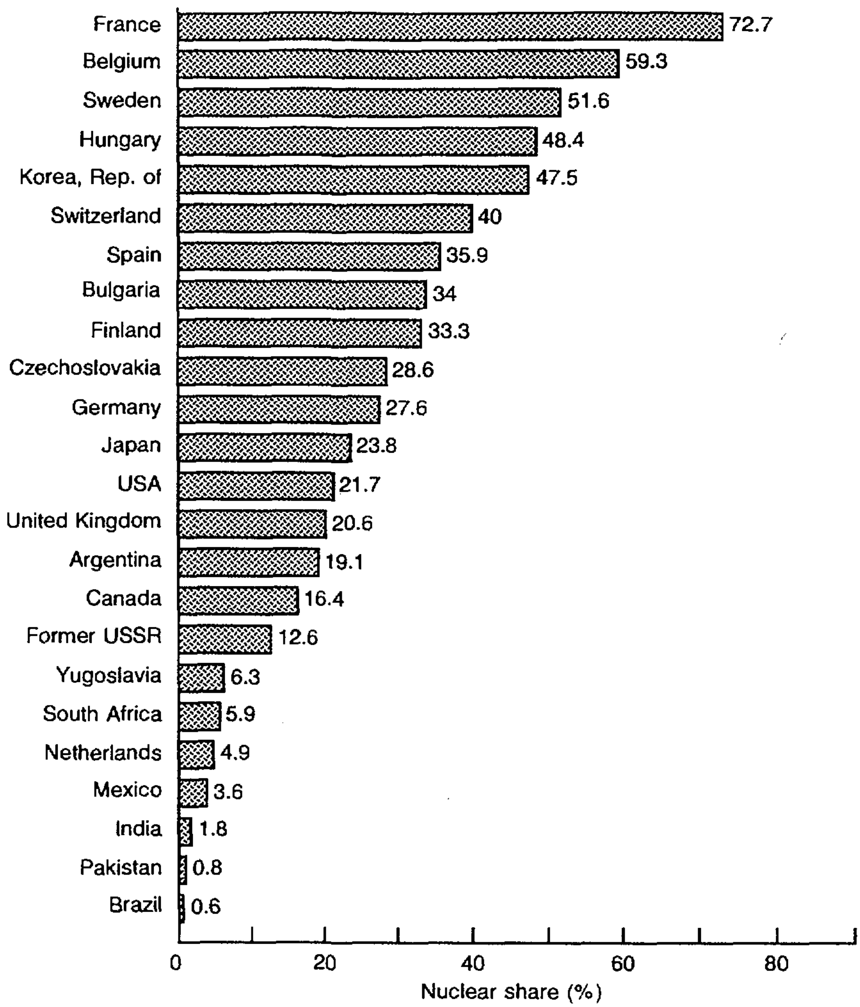

FIG. 1. Nuclear share of total electricity generation during 1991 (source: IAEA PRIS).

The geographical distribution of nuclear power plants, either operating or under construction, indicates that the development of nuclear power has occurred mainly in the industrialized part of the world. Nearly 95% of the installed nuclear power capacity and 85% of the nuclear power capacity under construction are located in countries belonging to the OECD and the former Council for Mutual Economic Assistance (CMEA). When the 76 nuclear power plants currently under construction worldwide are brought into commercial operation in the late 1990s,

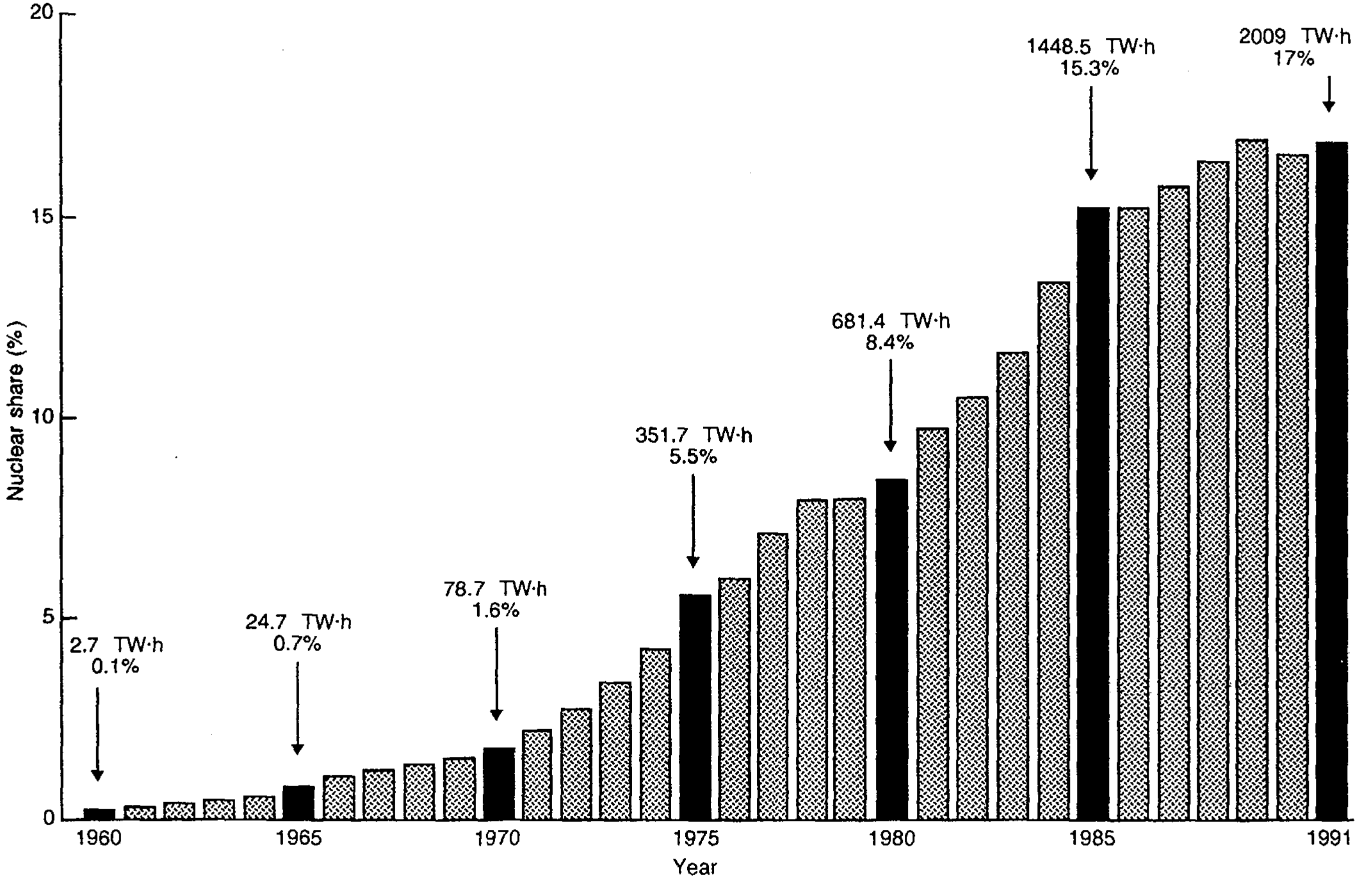

FIG. 2. Nuclear electricity generation and share of total electrical energy from 1960 to 1991 (source: IAEA PRIS).

there will be 29 countries with operating nuclear power plants. The three additional countries are Cuba, the Islamic Republic of Iran and Romania. In the years to follow, the share of worldwide electricity demand met by nuclear generation is expected to gradually decrease even though the amount of electricity generated by nuclear power will gradually increase. Although the Chernobyl accident has drastically influenced nuclear power development and plans in a number of countries, particularly in the former Union of Soviet Socialist Republics, in the period since the accident more than 100 GW(e) have been added, while power plants representing about 27 GW(e) have been shut down or cancelled.

Table I also shows nuclear electricity generation during 1991 in each country. Figure 1 shows the nuclear share of electricity generation by country. Currently, there are nine countries with 30% or more of their electricity generated by nuclear power plants. France has the largest share of electricity generated by nuclear power, with 72.7% of total production, followed by Belgium with 59.3%, Sweden with 51.6%, Hungary with 48.4%, the Republic of Korea with 47.5% and Switzerland with 40.0%.

Figure 2 shows the development of nuclear electricity generation for the period 1960–1991. Generation expanded rapidly in the 1970s and by 1980 its contribution was 8.4% of the total electricity produced, representing an average annual growth rate of 24% in the decade 1970–1980. During 1980–1991, it increased from 680 TW·h to more than 2000 TW·h, which corresponds to an average annual growth rate of 11%, reflecting a decrease in the number of new construction starts in the late 1970s and 1980s. This is a trend which is continuing. Currently, nuclear electricity generation accounts for 17% of the total electricity produced in the world.

2.1.2. Future outlook for nuclear power [3, 4]

During the next ten years, the growth pattern for nuclear power will be unlike that in the past. Not only have the growth rates for electricity consumption in industrialized countries declined over the past decade, but public concerns regarding nuclear power have heightened. Thus, actual growth has consistently been lower than forecast. Owing to the long period of time needed for implementation, additions to nuclear generating capacity in the short term (up to about the turn of the century) will largely be determined by past decisions, although construction, licensing delays, or policy changes could still have an effect. The situation after the year 2000 is less predictable, but perhaps less gloomy.

According to the IAEA's recent estimates (1992), the total projected increase in nuclear generating capacity, in the low scenario, is from 327 GW(e) in 1991 to about 412 GW(e) in 2010. This corresponds to an average annual growth rate of 1.2% and a total increase of about 85 GW(e) during this period (see Table II, Ref. [4]).

TABLE II. FUTURE OUTLOOK FOR NUCLEAR POWER (IN GW(e)) [4]

	1991		2010 (low and high growth scenarios)			
	Nuclear capacity	Share of total electrical capacity (%)	Projected nuclear capacity		Share of total electricity capacity (%)	Average annual rate of addition (%)
			Additions	Total		
World total	327	11.4	85	412	9.0	1.2
			176	503	9.1	2.3
Developing countries	18	2.8	27	45	3.2	5.0
			47	65	3.3	7.1

During the same period, nuclear generating capacity in developing countries (for statistical purposes, those states that are neither part of the OECD nor the former USSR and eastern European countries) is expected to reach 45 GW(e) by the year 2010. This corresponds to an addition to nuclear capacity of 27 GW(e) and an average annual growth rate of 5.0%. Nuclear power in developing countries is expected to continue to gain an increasing share of electricity generation, from a 4.3% share in 1991 to 4.9% by 2010. In capacity terms, 32% of all new nuclear generating capacity to be placed in commercial operation in the world by 2010 is expected to be from developing countries.

2.1.3. The role of nuclear power in developing countries

To ensure the required level of economic growth in developing countries, electricity consumption in these countries must grow at rates above those of their economic growth and total energy consumption, probably even at rates higher than those experienced in industrialized countries at similar stages of development (Table III, Ref. [4]).

On the basis of the above considerations, the total electricity generation of all developing countries is projected to increase from the present level of around 2700 TW·h to around 6400 TW·h by the year 2010. This projected electricity generation corresponds to an increase in the average per capita electricity consumption from the present 720 kW·h to around 1200 kW·h, compared with a present average of 6700 kW·h in industrialized countries.

TABLE III. ESTIMATES OF AVERAGE ANNUAL GROWTH RATES (IN PER CENT) DURING THE PERIOD 1991–2010

Country groups	Population	Total energy consumption	Total electricity consumption	Nuclear energy production	Nuclear capacity
OECD	0.5	0.6–1.1	2.0–2.5	0.8–1.5	0.7–1.4
Former USSR and EE[a]	0.6	1.1–1.5	2.4–3.3	2.7–4.7	2.2–4.2
Others	1.8	2.3–2.9	4.4–6.3	5.5–7.4	5.0–7.0
World average	1.5	1.3–1.8	2.7–3.8	1.5–2.5	1.2–2.3

[a] EE: eastern European countries.

TABLE IV. ELECTRICITY SUPPLY CAPACITY AND PRODUCTION IN DEVELOPING COUNTRIES (1989 AND 1999) [5]

Type	1989				1999			
	GW	(%)	TW·h	(%)	GW	(%)	TW·h	(%)
Hydro	185	(39.3)	674	(33.2)	322	(37.7)	1207	(31.5)
Geothermal	2	(0.4)	11	(0.6)	5	(0.6)	29	(0.8)
Nuclear	14	(3.0)	80	(3.9)	38	(4.4)	212	(5.5)
Oil, thermal	70	(14.8)	224	(11.0)	84	(9.7)	255	(6.6)
Gas, thermal	31	(6.7)	120	(5.9)	65	(7.8)	332	(8.6)
Coal, thermal	169	(35.8)	907	(44.7)	341	(39.8)	1793	(46.6)
Net imports	—		14	(0.7)	—		16	(0.4)
Total	471	(100)	2030	(100)	855	(100)	3844	(100)

TABLE V. POWER CAPITAL EXPENDITURES IN DEVELOPING COUNTRIES IN THE 1990s [5]

	Thousand million 1989 US dollars	Per cent
Generation	448	60.0
Transmission	81	10.9
Distribution	152	20.5
General	64	8.6
Total	745	100.0

According to the World Bank, electricity use is expected to increase at an average annual rate of 6.6% in the developing countries during the 1990s, and the installed generating capacity is expected to increase from 471 GW(e) at the end of 1989 to 855 GW(e) at the end of 1999, an increase of 81.5%, requiring capital expenditures of the order of US $745 000 million in 1989 terms [5]. The breakdown of capacity and electricity production by source of power generating capacity is given in Table IV [5]. The capital expenditures necessary for power generation expansion in developing countries are given in Table V [5].

The electricity requirements of developing countries can only be met through the more extensive use of conventional thermal and hydropower sources, together with an increased use of nuclear power in those countries which have nuclear power programmes, and the introduction of such programmes in other developing countries. In this context, it is significant that developing countries with nuclear power programmes already under way now generate more than half of the total electricity production in all such countries. However, nuclear power in these countries today makes up only about 4.3% of their total electricity production, compared with about 21% for industrialized countries.

The expanded use of nuclear power in industrialized countries could also ease the energy problem in developing countries by reducing world demand for fossil fuel supplies; it also helps to alleviate global environmental problems [6]. During 1991, nuclear power plants produced more than 2000 TW·h of electricity worldwide. To generate this amount of electricity by other means would require substantial resources — for example, more than 490 million tonnes of oil equivalent, which is more than half of the annual oil production capacity of all the Middle East countries (843 million tonnes in 1990). It is clear that if these additional quantities of fossil fuels were required for electricity generation, the upward pressures on coal and oil prices would have a significant impact, particularly on developing countries.

In contrast to the proven capabilities of nuclear power generation, the present technical and economic uncertainties surrounding solar power, wind power, biomass, etc., do not permit dependence on them for large scale electricity generation in the foreseeable future, although they could play a role in supplying electricity in villages and remote areas not connected to a centralized grid. Experience has shown that nuclear power generation is, in many situations, economically competitive with other sources of energy and that nuclear power can be safely controlled and managed and can meet growing global environmental concerns.

2.2. PRIMARY CHARACTERISTICS OF NUCLEAR POWER PROJECTS

There are four primary characteristics specific to nuclear power projects, which make the arranging of adequate financing even more difficult. They are: high investment costs, generally long construction times, a high degree of uncertainty with regard to costs and schedules and the issue of public acceptance.

2.2.1. Capital intensity [7]

The primary difficulty in financing a nuclear power project is its high capital 'intensity'. Depending on the plant size, construction time, financing terms, interest rates and other factors, costs have ranged from US $1000–$3300 per kW(e). This means that the initial investment cost of a 1000 MW(e) nuclear power plant would range from US $1000–3000 million or even higher for projects that have encountered long delays during construction (see Chapter 3). 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.

2.2.2. Long construction times [7]

Construction periods for nuclear power plants in various countries have ranged from 4 to 15 years (Table VI, Ref. [2]). Generally, the longer construction times have resulted from a variety of non-technical problems. A good average projection of the construction time for a nuclear power plant would be of the order of eight years. This estimate may vary depending on the developing country in question, since there may be differing infrastructure development requirements (the construction of roads or harbours for the transport of heavy equipment, housing for workers, etc.).

During this long construction period, and because of it, the owner is confronted with interrelated problems which are more severe for nuclear power projects than for other kinds of projects. These are:

(a) Lack of revenue from the project, as the plant under construction is not yet producing electricity;
(b) The financial requirement to pay interest during construction.

Clearly, any delay in bringing the project on-line will have major implications for its economic feasibility. Firstly, because of the long gestation period, interest payments during construction (IDC) must themselves be financed. For example, for an eight year construction period, interest costs add about 30–45% or more to the project cost at an interest rate of 7–10% per year. Secondly, further delays would add more than 10% per year to the project costs. It is therefore clear that every effort must be made in advance not to exceed the projected construction period.

2.2.3. Uncertainty regarding costs and schedules of a nuclear power project [7]

Owing to the large amount of money invested and the long construction period, as well as the uncertainties regarding the eventual outcome with respect to both of these factors, lenders generally consider that financing nuclear power projects is a highly complex and risky undertaking. Experience in various countries has shown that construction of such a plant can be faced by many uncertainties which could lead to longer than expected construction times and, as a consequence, to large cost overruns and thus higher, protracted, financing requirements, as well as large debt servicing payments. Delays arise for various reasons, for example, regulatory intervention, inadequate local financing and unexpected site conditions. Unpredictable additional costs due to escalation can also be a problem, in particular when supplies come from countries with high inflation rates, or if there is a substantial part of local supply or services in countries with high rates of inflation.

2.2.4. Public acceptance

In addition to the cost related considerations mentioned above, public acceptance of nuclear power has become an important issue for the general public, professionals and decision makers. Since the Chernobyl accident, in particular, heightened public concern over nuclear risks has had a direct and profound influence on nuclear projects worldwide. A new feature of the current decision making climate is the desire of the public to be directly involved in deciding the key directions of energy policy development. Energy decisions are no longer the sole domain of government and industry. The future development of nuclear energy will depend, to

TABLE VI. AVERAGE CONSTRUCTION TIME SPAN FOR NUCLEAR REACTORS [2]

Country	Operating and shut down reactors (year of grid connection)															
	1955–1960		1961–1966		1967–1972		1973–1978		1979–1984		1985–1989		1990		1991	
	No.	Months	No.	Months	No.	Months	No.	Months	No.	Months	No.	Months	No.	Months	No.	Months
Argentina							1	69	1	108						
Belgium			1	59			3	55	2	84	2	78				
Brazil									1	131						
Bulgaria							2	59	2	95	1	88			1	80
Canada			1	48	5	62	5	67	7	92	3	95	2	102		
China															1	81
Czechoslovakia					1	172	1	56	2	82	5	96				
Finland							2	62	2	77						
Former USSR			2	78	4	80	12	53	18	73	15	67	1	73		
France	2	39	3	65	5	66	5	64	29	65	16	82	3	93	1	92
Germany			4	53	6	53	11	61	8	95	7	104				
Hungary									2	111	2	89				
India					3	68			2	155	2	167				
Italy			3	48			1	95								

Japan			2	52	4	41	16	56	10	51	8	56	2	74	1	44
Korea, Republic of							1	67	2	69	6	73				
Mexico											1	150				
Netherlands					1	41	1	48								
Pakistan					1	62										
South Africa									1	93	1	108				
Spain					3	51			4	109	3	103				
Sweden			1	77	1	60	5	55	4	89	2	66				
Switzerland					3	48			2	93						
UK	8	42	16	69	5	75	5	105	5	179	5	126				
USA	2	42	8	60	22	52	44	78	19	126	27	145	2	176		
Yugoslavia									1	79						
Totals	12	42	41	63	64	59	117	68	127	89	107	101	10	106	4	74

Note: Construction time is measured from the first pouring of concrete to the connection of the unit to the grid.

The totals include the following data in Taiwan, China: 1973–1978: 2 units, 63 months; 1978–1984: 3 units, 70 months; 1985–1989: 1 unit, 72 months.

a considerable extent, on the nuclear community's efforts to deal with public concerns about safety and waste disposal through public awareness activities with the aim of restoring public confidence in nuclear energy. It has been recognized that a primary means of allaying public concerns is to provide full and timely information. A broad array of communication tools and a variety of individual experiences, detailing both the successes and failures of nuclear power projects in various conditions, are critical in establishing competent public information programmes in developing countries.

A Senior Expert Group reporting to the IAEA on the Promotion and Financing of Nuclear Power Programmes in Developing Countries recommended that: (a) short seminars be organized on the basic issues and general requirements of nuclear power programmes for policy makers at the political level, as well as other decision makers and experts who prepare the technical background on the basis of which decisions are made in developing countries, and (b) activities be increased to systematically develop and make available information on the questions most frequently raised in relation to public acceptance [7]. This information could be provided to the public and used as reference material in schools and also by industry and government professionals who have to deal with questions raised by the public. The IAEA has strengthened its activity in the area of public information through specialist meetings on the public awareness of nuclear power [8]. The actions proposed above should also be taken by each country and by industries in a developing country which has, or is planning, a nuclear power programme.

2.3. ISSUES AFFECTING THE FINANCING OF NUCLEAR POWER PROJECTS

It is essential that every effort be made by all parties involved in the development of nuclear power to reduce the uncertainties and risks associated with the specific characteristics of nuclear power projects. This is also necessary in order to improve the overall climate for financing such projects.

The Senior Expert Group mentioned in Section 2.2.4 [7] specifically identified the main issues affecting the financing of nuclear power projects and suggested actions that each party involved (lenders, export credit agencies, suppliers, investors, multilateral organizations and developing countries) could take to reduce the economic and financial risks and to make a nuclear power project more predictable. These issues are grouped into five major areas: programme and project related factors, the investment climate, financing plan, export credits and creditworthiness.

2.3.1. Programme and project related factors

Since it is essential to minimize uncertainties in the costs and schedules of nuclear power plant construction, the host government's commitment to the nuclear power programme is of paramount importance. The government should take early and firm action to put into place the legal and institutional arrangements required by the programme.

Strong government support of nuclear power should be consistently demonstrated by including nuclear power in the national energy and power sector plans and, if necessary, by appropriating the required funds and by approving guarantees and the borrowing of foreign exchange. The latter has become increasingly difficult for most developing countries in recent years.

The owner organization, together with other appropriate organizations in the host country, should carry out long term energy and power sector studies to determine the appropriate role nuclear power should play in the national energy plan. Feasibility studies for the nuclear power project should include an analysis of financing possibilities and the overall financial feasibility. Also, the owner organization should prepare long term plans for a power generation system which includes nuclear power.

Personnel development programmes should be established at an early stage in the preparations for project implementation and for power plant operations and maintenance. The exact personnel requirements will depend upon the contractual arrangements for the project and much can be gained by paying special attention to this aspect in the contracts with suppliers and with an experienced utility in the supplier country. It is possible to overcome local deficiencies to a great extent by using outside consultants and architect–engineering firms, and by using the services that can be offered by a turnkey contract. This is the customary form of the contract for the first plant in a country.

2.3.2. Investment climate

Given the complexities of financing a nuclear power project, it is of critical importance that, in addition to ensuring that all is done to maintain the schedule and keep within budget constraints, the climate surrounding such a project should be favourable. The investment climate can be enhanced if the government and the owner organization of the host country achieve good records of consistent and fair dealing with lenders and investors, and if they develop an electricity tariff structure adequate for the financial strength of the utility.

The World Bank has played a useful role in assisting owner organizations in determining tariff structures which would be adequate to meet the needs of investment programmes, i.e. on the basis of the long term marginal costs of generation. The IAEA's methodologies for the economic evaluation and optimization of an electricity generation system could be usefully applied, in co-operation with the World Bank.

2.3.3. Financing plan

The financing plan must be designed to meet the special needs of financing a nuclear power project, such as long construction times, large capital requirements on terms which are extraordinary in comparison with other projects and the likelihood of cost overruns.

All possible steps should be taken to alleviate the special needs of such a project, e.g. trying to shorten the project implementation period, reduce costs and minimize the likelihood of delays and cost overruns. The IAEA can help in carrying out financing analysis using methodology developed for that purpose (the FINPLAN method) [9].

2.3.4. Export credits

The present schemes of export credits and commercial financing do not adequately meet the needs of financing nuclear power projects in most developing countries in terms of the repayment periods or profiles, nor do they provide the flexibility necessary to deal with delays and cost overruns. In particular, the profile of the required repayment schedule (equal installments of principal plus interest payments) imposes a high annual capital charge requirement, especially during the first year after starting operation. Furthermore, some of the conditions attached to the interest rates and the exclusion of aid credits tend not to favour nuclear power projects in comparison with conventional projects.

Some specific steps could be taken to alleviate the problems of export credits. In particular, opportunities for multivendor projects should be investigated and, where appropriate, promoted as a means of overcoming limitations on export guarantees and in distributing the financial risk.

2.3.5. Creditworthiness

Doubts regarding the creditworthiness of the host country can preclude the financing of a nuclear power project. Only countries with acceptable credit ratings can 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 contribute to this end.

Annex I presents summaries of specific issues affecting the financing of nuclear power projects and actions proposed to reduce the uncertainties that are essential in improving the overall climate for the financing of such projects in developing countries.

Chapter 3

COSTS AND ECONOMIC FEASIBILITY OF NUCLEAR POWER PLANTS

The expected costs of nuclear and conventional power investments and electricity generation, and the comparison of these costs, are important in evaluating the feasibility of nuclear power projects and in expansion planning of electricity generation systems. This chapter discusses the cost elements and economic feasibility of a nuclear power plant based on the IAEA's study of nuclear and conventional baseload electricity generation cost experience, and the projected costs of nuclear and conventional baseload electricity generation in some IAEA Member States.

3.1. COMPONENTS OF NUCLEAR POWER GENERATION COSTS

The main components of nuclear power generation costs [10] are the following:

(a) *Basic elements*: Capital investment, nuclear fuel cycle costs and operation and maintenance (O&M) costs (decommissioning costs are included either in capital investment costs or in O&M costs).

(b) *Additional elements:* Infrastructure development costs such as for R&D and technology transfer and domestic industrial and personnel development associated with a nuclear power programme.

(c) *Plant construction and performance:* Reflected in its construction time, load factor, net power rating and economic life.

(d) *Outside economic influences:* Interest and real escalation associated with plant construction, the fuel cycle and O&M costs during plant life as exogenous parameters.

3.1.1. Capital investment costs

The capital investment cost of a nuclear power plant is the sum of all expenditures incurred in the design, licensing, manufacture, construction and commissioning of the plant.

Several accounting systems are used to split the capital investment cost into its principal parts; the breakdown shown in Table VII is the one employed in the IAEA. It shows the cost structure and defines direct and indirect, base, fore and total capital investment costs. The fore cost, as defined here, does not include the effects of

TABLE VII. STRUCTURE OF THE POWER PLANT CAPITAL INVESTMENT COST

Direct costs

Structures and site facilities

Reactor/boiler equipment

Turbine plant equipment

Electric plant equipment

Miscellaneous plant equipment

Cooling system, etc.

Indirect costs

Construction management, equipment and services

Home office engineering and services

Field office engineering and services

Base cost = direct cost + indirect cost

+ Owner's costs

+ Spare parts

+ Contingency

= Fore cost

+ IDC

+ Escalation

+ Interest on escalation

= Total capital investment cost

(Items not considered above: Initial fuel loading; heavy water inventory; cost of land; taxes and fees; infrastructure development costs.)

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inflation (escalation) on prices to be paid for labour, equipment, material and services, nor does it include interest on capital borrowed during the construction period (IDC). All of these items are included in the defined total capital investment costs. Items such as taxes and fees have been excluded from the present definition of total capital investment costs. There are other accounting methods which include

TABLE VIII. STRUCTURE OF NUCLEAR FUEL CYCLE COSTS

Natural uranium reactor	Enriched uranium reactor
	Front end costs
Natural uranium	Natural uranium
—	Conversion to UF_6
—	Enrichment
Fuel fabrication	Fuel fabrication
Transportation	Transportation
	Back end costs
Storage and transportation of irradiated fuel	Storage and transportation of irradiated fuel
	Reprocessing
	Credit for plutonium
	Credit for uranium
Disposal of wastes	Disposal of wastes

Direct cost = front end costs + back end costs

Indirect cost = interest on direct costs

Total nuclear fuel cycle cost = direct costs + indirect costs

these items, along with others, or which include all or some of the infrastructure development costs. Items excluded in the IAEA accounting system from the total capital investment cost do, of course, contribute to the power generation cost.

3.1.2. Nuclear fuel cycle costs

Lower nuclear fuel cycle costs, as compared with fossil fuel costs, are the key factor in the competitive position of nuclear power plants. The complexity of nuclear fuel cycle economics stems from the fact that it involves numerous expenditures made at different points in time before the fuel is actually loaded into the reactor and electricity production begins (front end costs), as well as other disbursements made long after the spent fuel has been unloaded from the reactor for ultimate disposal, or for the reprocessing and disposal of radioactive wastes (back end costs).

The front end processes of the nuclear fuel cycle include the costs incurred in the exploration, mining and milling of uranium, conversion into UF_6 and enrichment in the ^{235}U isotope (for reactors fuelled with enriched uranium) and, finally, fabrication of fuel elements and the stocking of spare fuel in the plant. All costs for transportation between processes and dispatch to the reactor site are also included.

The back end processes of the nuclear fuel cycle include the expenditures incurred in the storage and transportation of irradiated fuel, reprocessing for the extraction of plutonium and uranium (closed fuel cycle) and the separation, concentration and final disposal of radioactive wastes. The economic effect of recycling the recovered plutonium and uranium (closed cycle) is to add a credit to the nuclear fuel cycle costs. Interest on expenditures incurred at the front end, as well as at the back end, of the fuel cycle constitutes the so called indirect cost of the nuclear fuel cycle. Direct plus indirect costs determine the total nuclear fuel cost component of the electricity produced by the fuel burnt in an enriched uranium reactor (Table VIII). In the case of a natural uranium fuelled reactor, the items from conversion to UF_6, enrichment and credit for the uranium are waived.

Since many fuel batches of different composition and different fuel burnup may be used during the life of the reactor, it is customary to calculate the levelized cost of the electricity produced by the nuclear plant throughout its expected lifetime (30 years).

TABLE IX. STRUCTURE OF POWER PLANT O&M COSTS

Cost category	Description
Wages and salaries	Power plant staff and administrative staff
Operation and maintenance materials and equipment, repair costs, etc.	Maintenance materials and equipment required to repair or replace plant equipment; repair costs, consumable materials and expenses, etc.
Insurance	Property and nuclear liability insurance fees
Inspection	Routine inspection fees
Purchased services	Maintenance service and repair performed by off-site staff
Backfitting allowance	(If not included in capital investment cost)
Decommissioning allowance	(If not included in capital investment cost)
Other costs	All other relevant O&M costs not included in the above categories

(Items not considered: National and local taxes and fees; cost of water.)

3.1.3. Operation and maintenance costs

Table IX lists the components of the O&M costs. Some of these costs are fixed costs (e.g. wages and salaries, insurance and other fees), while others have fixed and variable components. The variable costs depend on the number of operating hours (e.g. consumable and maintenance materials, repair costs and maintenance services performed by off-site plant staff).

3.1.4. Decommissioning costs [11]

Recent studies have shown that technical methods and equipment are currently available for the safe decommissioning of nuclear power plants, whatever their type or size. For nuclear plants in operation, decommissioning is affordable. Decommissioning has a very small impact on the electricity generation costs of a large nuclear power plant. In levelized power production costs, its share is a few per cent at most. The uncertainties involved in estimating the decommissioning costs, in the applicable discounting rates and in the facility operating lifetime, are large but still unlikely to affect this conclusion significantly.

Assessing costs for work activities, materials and services can be based on previous experience from similar projects or from other technical fields. In practice, decommissioning costs are classified into three categories: (a) activity dependent costs (to be calculated on the basis of activity lists, plant inventories and unit cost factors), (b) time dependent costs (on the basis of estimates, project schedules and staff requirements); and (c) collateral costs and special item costs (to be assessed separately for each item). Each separate cost item may include a contingency allowance.

Several factors may affect the decommissioning costs. They are:

— *Institutional framework:* Nuclear energy policy and legislation; the regulatory framework, including exemption levels and criteria for the final disposal of radiological wastes; and financial responsibility.
— *Infrastructure development:* Technology and availability of disposal facilities.
— *Decommissioning plans:* Scope of the estimates and decommissioning strategy.
— *Plant characteristics:* Reactor type, size and age.
— *Technical approach:* Extent of decontamination.
— *Economic factors:* Labour costs, and materials and equipment costs.
— *Contingencies:* Residual uncertainties and technical risks.

For financing future decommissioning work, some rules already exist. In some countries, a fund, whether set up within the utility company or which has been set aside by the authorities, has to be established to collect money from the operating revenues during the lifetime of the power plant; this fund is then placed under the control of the authorities. In other countries, both the responsibility for and the mode of financing are left to the plant owners.

3.1.5. Infrastructure development costs

There are many tasks and activities which involve certain expenses, and which are needed for the implementation of a nuclear power project and programme, but which are usually not included in the power generation costs. Such activities are: planning, studies, R&D in support of a nuclear power programme, personnel development programmes at all levels (except training of operations staff, which is included in the owner's cost), industrial surveys, development of national infrastructures (governmental, regulatory, industrial, transport and educational), promotion of national participation, technology transfer, regulatory and licensing costs.

These infrastructure development costs are difficult to express and evaluate; it is also questionable as to what extent they should be charged to a single nuclear power plant or to a long term nuclear power programme. It should also be taken into account that they can produce spin-off benefits by promoting the country's overall development. The usually accepted procedure is to assume that infrastructure development costs and benefits balance out appropriately and to exclude them from the calculation of electricity generation costs.

3.1.6. Other factors influencing electricity generation costs

In addition to the components of electricity generating costs mentioned above, the following factors can influence, to a greater or lesser degree, the total generating costs:

(a) Controlling the length of the construction period is important because of the interest and escalation costs accruing during this period and also to avoid additional costs as a result of having to provide replacement power. The shortfall in electricity production resulting from the difference between the scheduled and actual dates of commissioning has to be made up either by the purchase or production of electricity from other power plants at the utility's disposal, resulting in substantially higher costs. Moreover, the escalation of prices during construction will increase capital costs. Taken together, high interest and escalation rates combined with lengthy construction times will lead to substantial additions to the fore costs.

(b) The capacity factor, defined as the ratio between the actual quantity of energy produced and energy that the plant could have produced at its rated capacity under continuous operation during the given period, is also important in cost considerations. The projection of the plant capacity factor contains some uncertainty since, in addition to planned shutdown periods for scheduled refuelling and maintenance, forced outages will occur due to unexpected events.

(c) The plant net electric power rating similarly influences power and electricity production and is a yardstick for the efficiency of plant operations and management.

(d) The plant economic life plays a role in the determination of the annual fixed charges, due to the depreciation of and interest on the capital investment; the economic life and the discount rate will define the capital recovery factor to be used for calculating the annual fixed charges on capital investments.

(e) The interest rate on money borrowed to meet the cash flow requirements during the construction period has a great impact on the IDC of the plant.

(f) The discount rate, which is the opportunity cost of money in the country or region where the plant is built and operated, plays a highly important role in the economic analysis of power plants.

(g) It is usually assumed that inflation will affect power generation costs for all alternatives in the same way and, consequently, all cash flows can be expressed in constant value currency in an economic analysis. However, for financing purposes, assumptions regarding future inflation rates should be made in order to determine the expected flow of payments.

(h) Cost drift (real inflation) is a parameter which affects the fore costs of a nuclear power project and, through them, total generation costs. It is associated with price increases in constant money owing to the increased scope and content, and design changes due to regulatory requirements, etc.

TABLE X. NUCLEAR AND CONVENTIONAL POWER COST EXPERIENCE

		Nuclear	Coal
Construction cost	US $/kW(e)	900–2700	640–1800
Investment cost (with IDC)	US $/kW(e)	1000–3300	720–2000
	mills/kW(e)	17–40	5–20
O&M cost	mills/kW(e)	4–13	3–10
Fuel cost	mills/kW(e)	4–10	10–45
Electricity generation cost	mills/kW(e)	25–60	20–60

Note: Monetary values of different years.

Based on a survey of Canada (Ontario Hydro), Czechoslovakia, Hungary, India, the Republic of Korea and Spain, and on reference data from France and the USA.

3.2. NUCLEAR POWER COST EXPERIENCE [12]

Publicly available information on the investment and operating costs of nuclear and conventional power plants varies a great deal (Table X). A range of capital cost values can be observed at the country level, but this range is especially broad in worldwide comparisons. A general explanation for this variation in capital costs is difficult to find, which makes it difficult for decision makers and the public to understand what a reasonable cost range should be. This creates a factor of uncertainty which investors generally, and understandably, abhor.

The institutional, technical and economic reasons for this variation include differences between countries and projects with regard to:

— Social and political environment;
— Organizational framework;
— Contract approach;
— Financing approach;
— Regulatory approach;
— Project management;
— Site related factors (e.g. multi-unit siting, seismicity and infrastructure);
— Plant design (including the extent of standardization);
— Unit prices (e.g. of locally available materials and labour);
— Accounting system (e.g. inclusion or exclusion of IDC, inventories of fuel and heavy water, cost reference data and currency exchange rates).

Some of these factors can have a very substantial impact on investment costs. The factors most prominent in projects with high costs and extended construction schedules were difficulties with project management and regulatory procedures. Long construction times also led to a much higher IDC. The IDC alone amounted to over US $2000 per kW(e) for some plants which had construction times of up to fourteen years.

On the other hand, the important features of low cost projects with construction times of five to six years (for one unit) include:

— Efficient project management,
— Strong feedback of experience,
— Largely completed detailed design,
— Resolution of political and regulatory issues before the start of construction,
— Design standardization over several units.

Most existing nuclear power plants were constructed and have been operated in such a manner that they generate electricity at competitive costs. Without this achievement, nuclear power could never have penetrated the energy market to the extent that it actually has. Individual projects have failed to achieve competitiveness, but such exceptions are attributable to specific situations and/or unforeseen conditions. These specific situations and conditions are now well understood and the associated cost uncertainties must be satisfactorily reduced before initiating a nuclear power project.

3.3. PROJECTED NUCLEAR POWER COSTS IN COMPARISON WITH CONVENTIONAL POWER COSTS

Economic competition between available alternative energy sources is a powerful force which acts on each of these sources. Consequently, the cost trends of nuclear power cannot be considered in isolation. The future evolution of nuclear power costs may follow the overall pattern of evolution of the whole energy market, where each available alternative source tends to maintain or improve its competitive position.

Cost estimates for future plants can be obtained on the basis of plant engineering cost estimates, or by extrapolating these estimates. Cost extrapolations can be derived from cost experience with a plant of similar design built under similar conditions, if such exists, whereas cost estimates based on plant engineering imply estimation of the amounts of materials, equipment and labour required to build the plant and the relevant unit costs. Taken together, these permit an estimation of the total direct cost of the plant. This must be supplemented by estimates of indirect costs and of the construction schedule, based on a detailed construction plan. Such a cost estimate based on plant engineering will be required for taking a decision to build a nuclear power plant. It is useful to compare this estimate with the cost experience of plants with a similar design and built under similar conditions.

Cost estimates for future nuclear and conventional base load plants were surveyed by expert groups of the International Union of Producers and Distributors of Electrical Energy (UNIPEDE) [13], the OECD [14] and the IAEA [15]. The projected electricity production costs include all incremental charges to the utility specific to the plants under consideration and are given in constant value money. These include all capital costs (including real interest charges during construction), fuel, O&M costs, waste management costs, decommissioning costs and plant specific insurance costs. Taxes on income and profits and transmission costs are excluded. Also omitted are other costs common to the overall utility system, together with external costs such as environmental damage. It should be noted, however, that all generating plants and their fuel cycles are designed to be operated within the framework of current and planned national and international regulations and obligations concerning safety and environmental issues.

Specific efforts have been made to compare the costs of nuclear based and conventional coal based power generation for each country. The results of these calculations are expressed as '**average discounted costs**' or '**levelized generating costs**', i.e. the ratio of the total discounted costs to the total discounted electricity

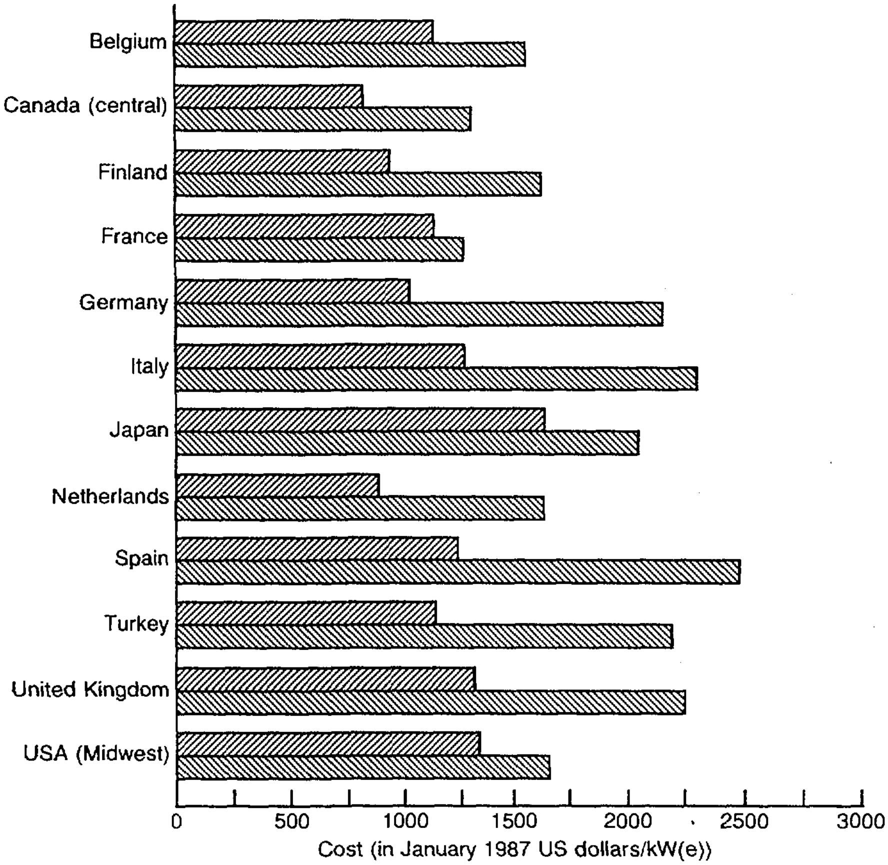


FIG. 3. Projected investment costs for coal fired and nuclear power plants in OECD countries [14]. (▨: coal fired; ▧: nuclear.) (Note: *investment costs include real interest during construction (5% annually).)*

generated over the same period using real discount rates. These levelized costs in constant money differ from cost appraisals made in current money on the basis of accounting rules and are not suitable as a reference for tariff and financing analysis. They are, however, quite appropriate for the economic comparison of plants performing similar functions, e.g. for base load electricity supply in a specific time-frame. It is always possible, however, to transform costs as expressed in current money to costs in constant money [16].

Absolute costs should not be compared between countries because of differences in social and economic systems, currencies, radioactive waste management procedures, plant decommissioning and environmental protection

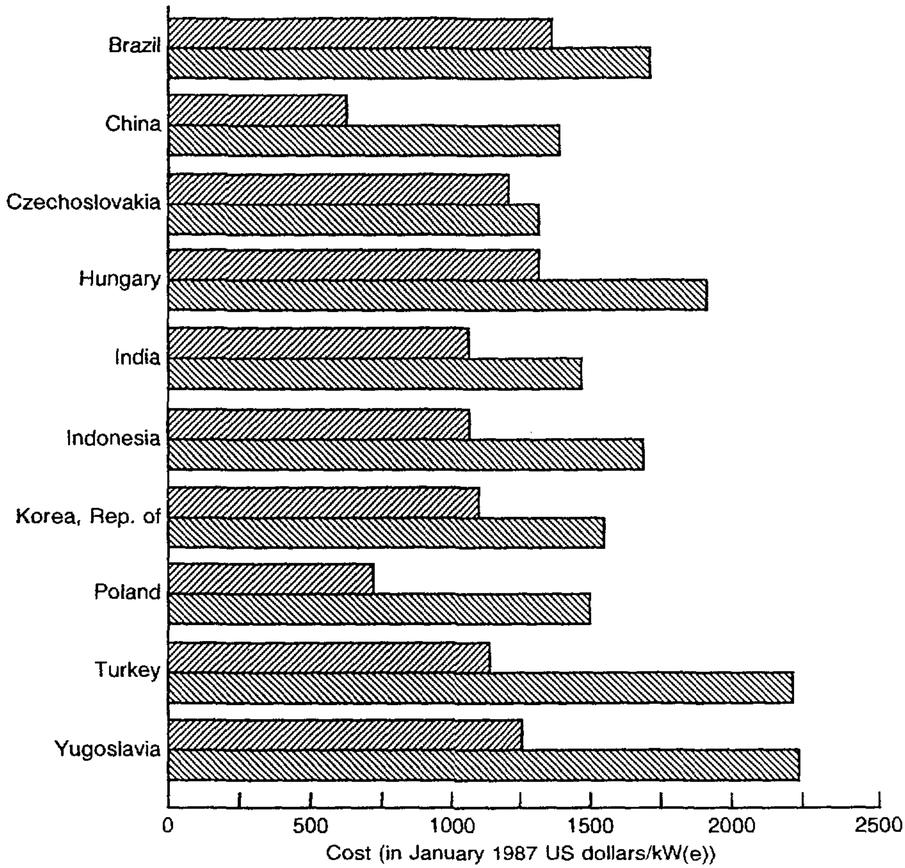


FIG. 4. Projected investment costs for coal fired and nuclear power plants in some IAEA Member States [15]. (▨: coal fired; ▧: nuclear.) (Note: *investment costs include real interest during construction (5% annually).)*

regulations. For example, environmental protection laws in most OECD countries require flue gas desulphurization (FGD) and some countries also require the abatement of nitrogen oxides at new coal fired plants. But most non-OECD countries do not even practice FGD yet. The electricity generation costs for coal fired plants with abatement for sulphur and nitrogen oxides are generally projected to be 15–20% higher than those for plants without this antipollution measure.

The projected investment costs of nuclear power plants scheduled for commissioning in the period 1995–2000 were found to range from about US $1300 to $2500 per kW(e) (Figs 3 and 4) and their levelized electricity generation costs were from 20 to 48 mills/kW·h (in January 1987 US dollars, with a 5% real discount

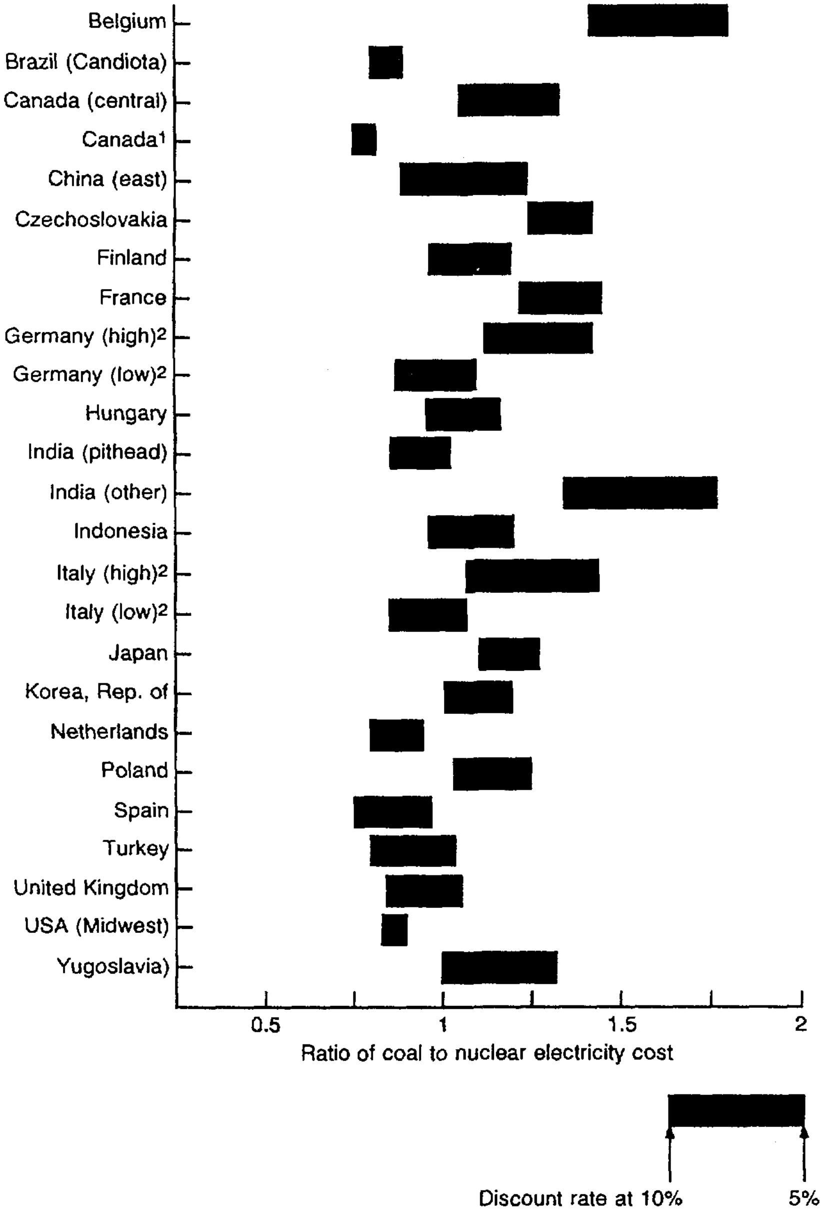


FIG. 5. Relative competitiveness of coal based and nuclear electricity using discount rates of 5 and 10% [14, 15]. (1: Western coal compared with eastern nuclear power; 2: high and low estimates of coal prices.)

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, were estimated to range from about 21 to over 60 mills/kW·h [13].

These ranges are rather wide and overlapping and therefore do not permit general conclusions to be reached on the economic feasibility of nuclear power plants. The reasons for the variation include differences between countries in the relevant institutional and economic environments, as discussed in Section 3.2. Cost comparisons across countries can therefore be misleading. They are only meaningful when the costs have been made consistent.

More useful for determining economic feasibility are comparisons of nuclear power and conventional electricity generation costs in the same country. Most countries which participated in the surveys expect nuclear power to have a lower levelized generating cost than coal fired power plants (Fig. 5). However, nuclear power plants are generally not economically feasible in areas with low cost coal or hydroelectricity, in countries with small electricity grids and in countries with a scarcity of investment capital (and, therefore, high interest/discount rates).

3.4. RISK OF CONSTRUCTION DELAYS

Evidence of economic risks is the fact that many nuclear power projects suffered long delays and, as a result, experienced very high investment costs. The reasons include:

— Regulatory intervention;
— Legal intervention;
— Inadequate financing (in particular, inadequate local financing);
— Poor management/organizational framework;
— Design changes during construction;
— Intervention of public opinion;
— Lack of political support.

The reasons for design changes during construction could include:

— Insufficient detailed design work before the start of construction;
— Unexpected site conditions (e.g. instability of underground formations and unexpected seismicity);
— Additional regulatory or utility requirements.

To minimize the risks of construction delays and cost increases, thorough site investigations, a favourable (or at least stable) project environment and efficient project management are of decisive importance. The site should be selected and licensed long in advance. The project environment includes mainly issues of an institutional nature, such as:

- The organizational framework;
- The regulatory requirements and procedures;
- Policy and political issues;
- National participation;
- Financing.

Nuclear power projects, like other capital intensive projects, e.g. hydroelectric power plants, are extremely difficult and costly to complete in an adverse project environment.

The most important factor leading to lower costs is a short construction period (optimally five to six years for one unit). Delays have significant impacts both on the direct cost and on time dependent costs (escalation and IDC). It is therefore extremely important to have efficient project management. The project management group must have full responsibility and authority and must continuously control the quality of work, as well as the costs and schedules in all relevant areas.

3.5. IMPORTANT ISSUES FOR DETERMINING THE ECONOMIC FEASIBILITY OF NUCLEAR POWER PROJECTS

Most important in assessing the feasibility of a nuclear power project is that its costs should be estimated with reasonable accuracy and reliability and it should be viewed as being part of a least cost electricity system expansion plan. Decision makers in the host country and in lending institutions must be able to trust the cost estimate, and the prospective owner must be judged as being creditworthy. As mentioned earlier it is very important to have a favourable project environment, including:

- Co-operation between the regulatory body, utility and suppliers, with strong feedback of experience;
- Avoidance of major changes in organization, project management and responsibilities during the implementation of the project;
- Stable political and regulatory environment;
- Resolution of regulatory issues before the start of construction;
- National participation according to the international competitiveness of the local industry;
- Adequate funding in all currencies involved.

Feedback of experience is achieved through co-operation between the utilities, manufacturers, regulatory body and through standardization and replication. Many lessons from construction and operating experience have been learned. For example, new or modified designs have been submitted in time for regulatory review, so that they can be reviewed and completed in detail before the start of construction. The IAEA is seeking to establish international agreements on design and safety principles for future plants and to assist in making regulatory procedures more predictable. These measures should assist others in achieving the benefits of the more successful regulatory practices and experience.

It is also very important before the start of construction that:

- Reliable cost experience for the plant design is available from operating plants and/or plants under construction;
- The detailed design of the plant is largely completed;
- The direct and indirect costs of plant construction, commissioning and operation are estimated by a competent reactor vendor and an experienced consultant and/or utility;
- An experienced and efficient project team, and efficient cost and schedule control, are assured;
- Safe operation of the plant, with the highest feasible levels of reliability and availability, can be assured.

The estimated costs must then be evaluated and compared with alternative projects, both at the plant level and at the level of the electricity grid.

The owner (utility) and the investor should be sufficiently assured that all relevant prerequisites for a sound nuclear power project have been met. Otherwise, the economic feasibility of the nuclear power project can be called into question and the project should not be initiated.

3.6. CASH FLOW ANALYSIS

Cash flow analyses show the annual and cumulative expenditures and revenues of a plant. They can be used to identify financing requirements and to investigate the financial feasibility of a project. The cash requirements of nuclear power and large hydropower projects will be higher than those of fossil fuel fired power plants prior to the start of operation, but will be lower after the repayment of credits.

Cash flow calculations are usually performed in nominal money, i.e. including the effects of inflation to show the actual cash requirements and revenues. They may also be made in constant money (i.e. in purchasing value of a reference date). Discounted cash flows are used for the economic comparison of alternative projects and for the calculation of levelized electricity generation costs.

Illustrative examples of the cash requirements for a 1200 MW(e) nuclear power plant and for twin unit (2 × 600 MW(e)) nuclear, coal and oil fired power plants are presented here. The cost information for the 600 MW(e) units and the assumptions for financing are based on a recent feasibility study of medium sized

TABLE XI. GENERAL ASSUMPTIONS FOR FINANCING A 1200 MW(e) NUCLEAR POWER PLANT AND TWIN UNIT (2 × 600 MW(e)) NUCLEAR, COAL AND OIL FIRED POWER PLANTS [17]

General inflation rate (%)	4
Escalation rate (except fuel) (% nominal)	6
Commitment fee (% per annum)	0.25
Management fee (%)	0.3
Cost reference data	January 1991
Start of operation (second unit)	January 2000
Operating regime (hours per annum)	6570
Economic plant life (years)	30
Financing conditions for the foreign portion (75%)	
Credit (%)	85
Cash (%)	15
Interest rate (% nominal)	10
Payback period (construction) (years)	15
Financing conditions for the domestic portion (25%)	
Credit (%)	80
Cash (%)	20
Interest rate (% nominal)	12
Payback period (construction) (years)	8

nuclear power plants [17]. The data and assumptions are summarized in Tables XI and XII. The assumptions for financing are given below.

(a) *Construction costs:* The annual payments during construction are: 75% through export credit financing (85% credit and 15% cash) with a 10% per annum interest rate and a repayment period of 15 years of operation; and 25% through local financing (80% credit and 20% cash) with a 12% per annum interest rate and a repayment period of 8 years of operation.

TABLE XII. PLANT SPECIFIC ASSUMPTIONS AND COST ESTIMATES FOR A 1200 MW(e) NUCLEAR POWER PLANT AND FOR TWIN UNIT (2 × 600 MW(e)) NUCLEAR, COAL AND OIL FIRED POWER PLANTS [17]

Plant type	PWR	MPR[a]	Coal	Oil
Number of units	1	2	2	2
Unit electricity capacity (MW(e) net)	1200	600	600	600
Plant electricity capacity (MW(e) net)	1200	1200	1200	1200
Base cost (million US $)	1570	1978	1475	744
Supplementary costs (million US $)	140	140	[b]	
Staff training, simulator (million US $)	80	80		
Owner's cost (million US $)	120	130	145	
Site specific cost (million US $)	250	252		
Subtotal construction cost (million US $)	2160	2580	1620	744
Subtotal construction cost (US $/kW(e))	1800	2150	1350	620
Plant construction period (years)	5.5	6.5	5.0	4.5
Initial fuel supply (million US $)	114	115	34	60
Fuel price (US $/tce)[c]			45	92
Annual fuel cost (million US $/a)	43	43	138	241
Nominal escalation rate of fuel (%)	4	4	5	6
Decommissioning charge (mills/kW·h)	1	1		
Annual O&M cost (million US $/a)	66	71	41	35
Levelized costs				
investment cost (US $/kW(e))	3512	4328	2559	1223
(mills/kW·h)	62.7	70.7	43.1	20.6
O&M cost (mills/kW·h)	24.5	25.4	14.7	12.4
fuel cost (mills/kW·h)	11.0	10.7	41.2	86.4
generation cost (mills/kW·h)	98	107	99	119

[a] MPR: medium sized power reactor.

[b] The supplementary costs for coal are included in the base cost figures.

[c] tce: tonnes of coal equivalent.

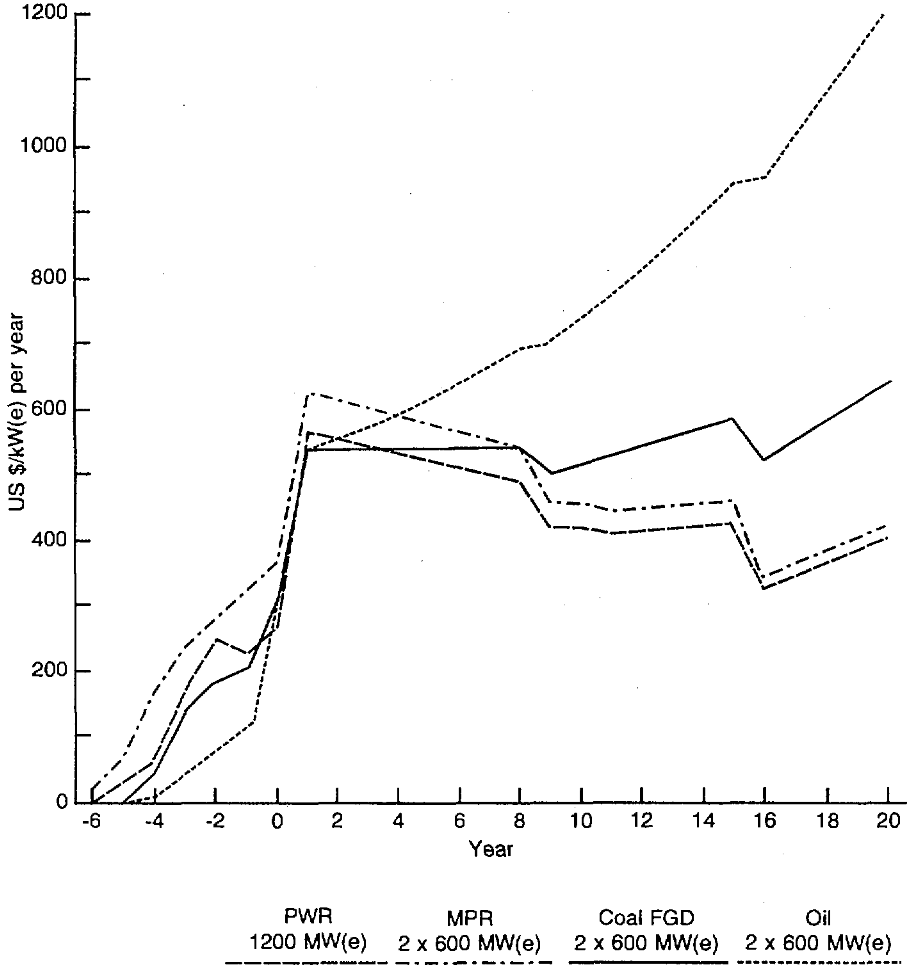


FIG. 6. Annual nominal cash requirements for nuclear and conventional power plants (inflation rate: 4%; real escalation for construction and O&M costs: 2%; real escalation for coal prices: 1%; real escalation for oil prices: 2%; MPR: medium sized power reactor; FGD: flue gas desulphurization).

(b) *Initial fuel supply cost for nuclear power plants:* Seventy-five per cent of the first fuel load cost of nuclear reactors is financed with a repayment period of ten years.

(c) *Fuel stock for coal and oil fired plants:* A three month fuel supply for the coal and oil fired plants is paid for in cash in the year preceding commercial operation.

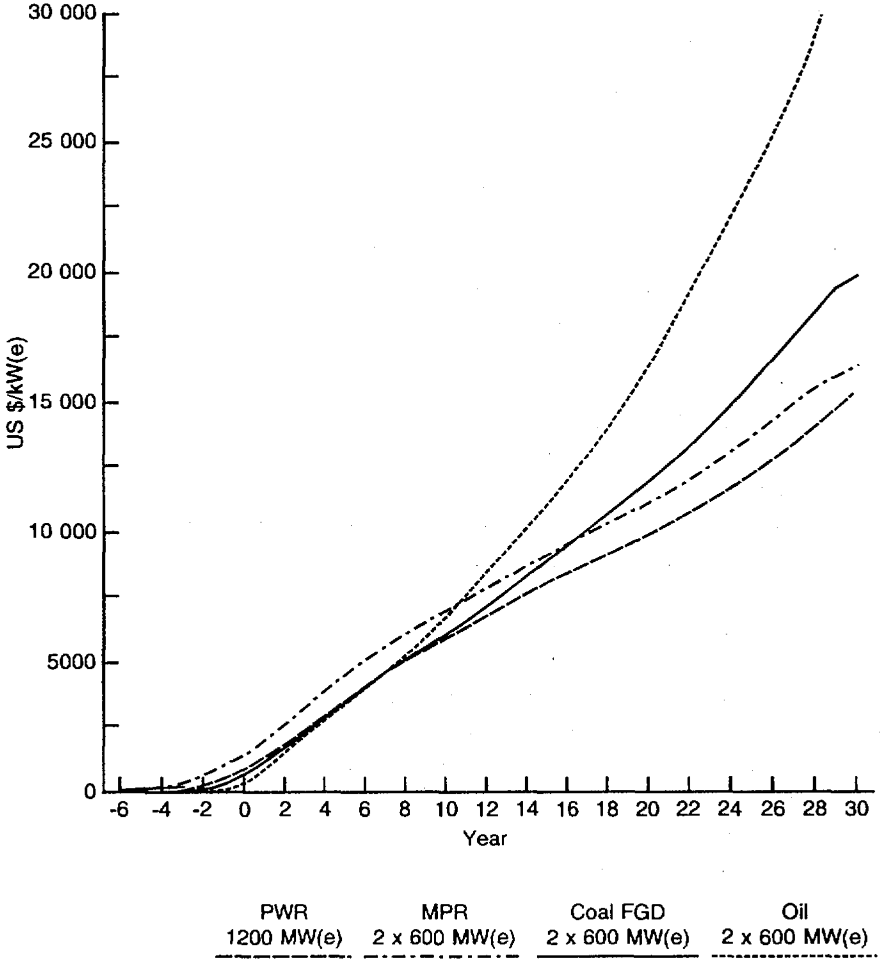


FIG. 7. Cumulative nominal cash requirements for nuclear and conventional power plants (inflation rate: 4%; real escalation for construction and O&M costs: 2%; real escalation for coal prices: 1%; real escalation for oil prices: 2%).

(d) *Financing fees:* The management fee is assumed to be 0.3% of the loan amount, and the commitment fee to be 0.25% per year.

The calculated cash requirements in current money as spent are presented in Figs 6 and 7. Since all plants have the same net electrical output, only the cash requirements are shown. The observations below refer mainly to plants with 600 MW(e) units, which may be adequate for the electricity grids of a number of developing countries. If a grid could also accept 1200 MW(e), the economics of the nuclear power plant would be improved.

3.6.1. Observations

The financing of expenditures during the construction of a nuclear power plant is an immense task. Depending on the size of the plant and the owner's internal financing capability, about US $1000–2000 million may have to be financed through the construction period and the first 15 operating years.

During the first years of construction, the financing requirements for a nuclear power plant are substantially higher than those for oil or coal fired plants.

In the year preceding commercial operation, the cash requirements for a nuclear power plant may approximately equal or be lower than those for oil or coal fired plants. One reason for this is that construction of the nuclear power plant must be completed at least six months before operation because of the extensive testing requirements and complex startup procedures. Fossil fuel fired plants do not require such extensive testing. Another reason could be that the necessary oil or coal fuel reserve is paid for in cash, whereas the initial nuclear fuel loading may be included in the financing package.

In the first operating year, the cash requirements for a medium sized nuclear power plant will be higher than those for oil or coal fired plants (about 16% higher in the example). Of the cash requirements during the first year of operation of a nuclear plant, over 60% is for debt service for the capital financing and only about 10% is for fuel costs. Conversely, about 20% of the cash requirements for an oil fired plant would be capital investment and about 70% would be for fuel costs. The remainder in both cases is for O&M costs.

After start of operation, the annual cash requirements for a nuclear power plant will usually fall because of the decreasing debt. The cash requirements for oil and coal fired plants will rise, since escalating fuel and O&M costs are usually greater than the benefit accruing as a result of decreasing debt.

After some years of operation, the annual cash requirements of a nuclear power plant will fall below those of an oil or coal fired plant (here, after four and eight years, respectively).

Up to completion of debt repayment (here, year 15), the cash requirements for this purpose will have decreased (to about 50% of the cash requirements for the nuclear power plant in the example). The cash requirements for O&M and fuel costs will have risen for all plant types because of escalation.

After debt repayment, the cash requirements for a nuclear power plant would typically consist of about 30–40% for fuel costs and 60–70% for O&M costs, and may be 40–70% lower than those for a conventional thermal power plant.

The cumulative discounted cash requirements of a nuclear power plant are higher than those for a coal or oil fired power plant during construction and in the initial years of operation. They will become lower than those for a fossil fuel fired plant after 10–17 years of operation (Fig. 7).

Summing up, the financing requirements of a nuclear power plant are a heavy burden during plant construction and the initial operating years. The essential factors for the economic success of a nuclear power project are:

— Efficient control of construction costs and schedules,
— Reasonable financing conditions,
— Reliable and safe plant operation.

Shortages of financing after starting the project often cause major delays and cost overruns, which can greatly jeopardize the economics of a nuclear power plant. Therefore, a complete and sound financing framework is a basic prerequisite for the start of the project.

3.7. SHORT TERM IMPLICATIONS OF CASH FLOW ANALYSIS AND THE COMPLEXITY OF FINANCIAL ANALYSIS [18]

A particular characteristic of nuclear power projects is that they require 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. As shown in Section 3.6, 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. If the lead time needed to build the power plant is taken into account, the utility could be faced with a period of 10–20 years during which it has to invest more in the nuclear alternative, although the long-term economics are usually favourable for the nuclear power option. This is clearly a problem in the short term because of the capital intensive nature of nuclear power and the longer implementation period required. In deciding whether or not to start a nuclear power programme, these factors will be very important for utilities in developing countries which are generally short of capital for investment purposes. In general, it is considered that such a programme should consist, at least in the long term, of more than one nuclear power plant/project.

For some components of the financing, repayment may even have to start during the construction period of six to ten (sometimes even more) years, with early expenditures in foreign currency (in contrast to hydropower projects, where expenditures for turbines and electrical equipment will occur towards the end of the project). The economic life of nuclear power plants is usually assumed to be more than 25 years. However, commercial banks will usually offer loans with repayment periods of up to 10 years only, and export credit agencies up to 15 years. This means that refinancing of part of the initial investment will be required after 10–15 years.

The financial analysis has to be carried out in current money terms because drawdowns and repayments are expressed in current money of the year in which they are made and the different fees are expressed as a fraction of the total amount in current money as spent. The financial analysis includes general factors, such as: the design and construction period, current and projected escalation rates, current and projected currency exchange rates and the discount rate; the loan specific factors are: the interest rate, fees (i.e. the management, commitment and guarantee fees), the frequency of interest payments, the grace period and the repayment period. A financial proposal usually includes various currencies and various fixed or floating interest rates.

The evaluation has to include projections of escalation rates, exchange rates and interest rates (if floating). Payment schedules must be evaluated, converted to a common currency and discounted to a reference date. The thorough evaluation of all the above parameters is essential, complex and demanding. Different projections of currency exchange rates may lead to variations in the final cost evaluation that are larger than the price differentials of the bids. The financial analysis can lead to quite different conclusions than those based solely on an economic analysis and it should be integrated into the economic comparison of the various bids to allow for normalized comparisons.

Chapter 4

CONVENTIONAL APPROACHES FOR FINANCING POWER GENERATION PROJECTS IN DEVELOPING COUNTRIES

Developing countries need to expand their power generation systems in order to permit and support economic and social growth. The magnitude of the required investment and the financing constraints underline the need for a greater effort to mobilize power sector financing from all possible sources.

The financing sources available for conventional power generation systems in developing countries have been utilized for:

(a) Covering domestic investment using the utilities' own resources and, to the extent that these are insufficient, the government's 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.

(b) Covering capital requirements for 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.

Power sector projects require for their realization both a financing component in national currency for the part of the investment activities to be paid for locally and a financing component in foreign currency for payments abroad for imported goods and services. On the basis of a World Bank review of its lending for electric power [19], the internally financed part of power sector projects in developing countries has worsened over time, starting at an average of 25% during 1966–1973, but falling to 17% during 1980–1985.

4.1. NATIONAL INVESTMENT FINANCING SOURCES

The sources of national or local financing [20] are:

(a) *Investor's own resources:*
- Equity capital (at least 15%, the more the better);
- Cash flow;

(b) *Debt capital:*
- Domestic bonds;
- Local bank credits;
- Donations and credits from public entities;

— Stand-by facilities for cost increases;
— Prepayments for future services of the project.

It is expected that the major difficulties which developing countries will encounter in financing power sector development will be related to the internal part of the investments. The funds in national currency can only be generated by increased national savings or by a reallocation of savings, while funds in foreign currency originate from the much larger reservoir of world savings.

Developing countries will therefore need to evolve and implement a policy for attracting the necessary private and public capital, as well as for improving the mobilization of domestic public resources, particularly by power sector companies.

The mobilization of domestic resources for power sector investment has been constrained by several factors, some specific to the power sector and others relating to the more general problem of the low domestic savings rates in developing countries. Clear limits on the ability of these countries to borrow from private and public sources and the important local cost element of total investments make domestic resource mobilization of critical importance. The capability of utilities in developing countries to finance large new investments, such as nuclear power projects, from their own resources is greatly limited owing to the limited capability of the utilities' internal cash flow generation. Utilities would have to attempt to fill the financing void with: (i) equity capital provided by the government for government owned utilities, or (ii) funds raised in the local capital markets by private utilities through the tapping of local sources of debt financing, such as domestic bond issues, local bank credits and credits from public entities.

The power sector in developing countries is dominated by public sector utilities and these public utilities operate in a highly regulated environment. During the early 1970s, most power utilities were able to generate a portion of the needed investment from internal resources. However, inadequate tariff increases, which have been widening the gap between electricity rate structures and real investment and operating costs, coupled with rising unit investment and fuel costs, have severely exhausted power sector finances. Financial performance has also been weakened by low capacity utilization and slow collection of bills. These elements limit the ability of the utility to control and plan for its financial operations.

An additional problem is the absence of domestic long term capital markets in developing countries. Because power utilities have not been able to finance the local cost component of investment programmes internally, they have been forced to borrow foreign exchange. If, however, the country is already indebted near or beyond the generally accepted limits, this solution may not be possible.

All of these factors have made it difficult for national power utilities to generate internal and external funds for investment programmes. In the World Bank's experience, most national power utilities in the developing countries have not been able to consistently meet self-financing ratios of 20–30% over time. Shortfalls in local cost financing have led some governments to create new sources of medium to long term local financing, as well as to increase contributions from the public budget for financing the project and to make direct equity injections to the national power utilities.

One relevant example is the Alternative Energy Fund of Egypt (see Annex II). The Egyptian Government decided to allocate a portion of its oil revenue surplus to cover part of the foreign component requirements of oil alternative energy projects. This oil revenue surplus is placed in a special fund that is not intended to cover the local currency content, but meant to cover, to the extent possible, the foreign currency requirements of oil alternative energy projects. At the time of creation of the Fund, Egypt intended to build eight nuclear power plants up to the year 2000. About US $1125 million is already available in this fund [21].

Investment financing requirements which cannot be met by domestic sources have to be drawn from international financing sources.

4.2. INTERNATIONAL INVESTMENT FINANCING SOURCES [20]

Examples of international financing sources and the relevant insurance agencies for power sector investment projects in developing countries are listed below.

4.2.1. Export credits

(a) *Export credit agencies*

- Canada: Export Development Corporation (EDC).
- France: Compagnie française d'assurance pour le commerce extérieur (COFACE), Banque française du commerce extérieur (BFCE).
- Germany: Hermes Kreditversicherungs AG, Ausfuhrkredit-Gesellschaft mbH (AKA), Kreditanstalt für Wiederaufbau (KfW).
- Japan: Export–Import Bank of Japan, Ministry of International Trade and Industry (MITI).
- Sweden: Exportkreditnamnden (EKN), AB Svenska Export Kredit (SEK).
- United Kingdom: Export Credits Guarantee Department (ECGD).
- United States of America: Export–Import Bank of the United States (EXIM), Private Export Funding Corporation (PEFCO), Overseas Private Investment Corporation (OPIC).

(b) *Equipment supplier's credit*

4.2.2. Multilateral development institutions

(a) *The World Bank Group*

— The IBRD,
— The International Development Association (IDA),
— The International Finance Corporation (IFC),
— The Multilateral Investment Guarantee Agency (MIGA).

(b) *Regional development banks and organizations*

— The African Development Bank/Fund (AFDB/AFDF),
— The Asian Development Bank (ADB),
— The Inter-American Development Bank (IDB),
— The European Investment Bank (EIB),
— The European Bank for Reconstruction and Development (EBRD).

(c) *Other institutions*

— The Islamic Development Bank (ISDB),
— The Arab Fund for Economic and Social Development,
— The Saudi Fund for Development,
— The Kuwaiti Fund for Development.

4.2.3. Bilateral financing sources

For example, member countries of the Development Assistance Committee (DAC) of the OECD (however, tied aid credits, associated financing, aid loans and grants are not permitted for nuclear power projects in developing countries).

4.2.4. International markets

— Commercial loans,
— International bonds (Eurobonds).

As can easily be recognized from this list, there are various possibilities for a developing country to secure the financing of its foreign currency needs, provided that the proposed project has a solid foundation and that the credit rating of the borrower and the given country is acceptable.

In the past, almost half of foreign capital flows originated from official multilateral and bilateral sources and half from private sources. Although an increase in the official flows 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 in foreign currency because the high technology plants must usually be imported. However, this project, which will generate a product, i.e. 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.

On the basis of these considerations, it would appear to be most advisable for developing countries to make every effort to become and remain reliable borrowers on the international capital markets, both by careful study of the lenders' loan conditions and by developing in their countries the managerial framework and expertise to put these loans to the best use and to service them punctually.

4.3. EXPORT CREDIT AGENCIES AND BILATERAL ARRANGEMENTS

4.3.1. General features [20]

Export finance through export credit agencies (ECAs) has been playing a significant and growing role in financing energy projects in developing countries. The main characteristics of export credits are:

(a) They generally involve a two tier system: specialized governmental entities which deliver the appropriate credit insurance or guarantees, and either official financial institutions or commercial banks which provide the funds jointly or in parallel.

(b) The currency in which they are transacted is generally the national currency of the exporting country. However, some countries are increasingly lending in Eurodollars by borrowing the required amounts on the international market and 'onlending' them to the borrower under the guarantee of their own export credit insurance agency.

(c) Ideally, financing would cover up to 85% of the cost of services and equipment from the exporting country (exclusive of IDC); in practice this is often less. The non-covered portion might be financed by commercial banks, or deliveries might be shifted to a third country to obtain additional credit insurance from that country.

(d) Maturities are generally longer than in the conventional financial markets. For nuclear power plants, export credit maturities are usually 12–15 years from the date of completion of the project, thus providing about twenty years of overall maturity; the period can be even longer in specific cases.

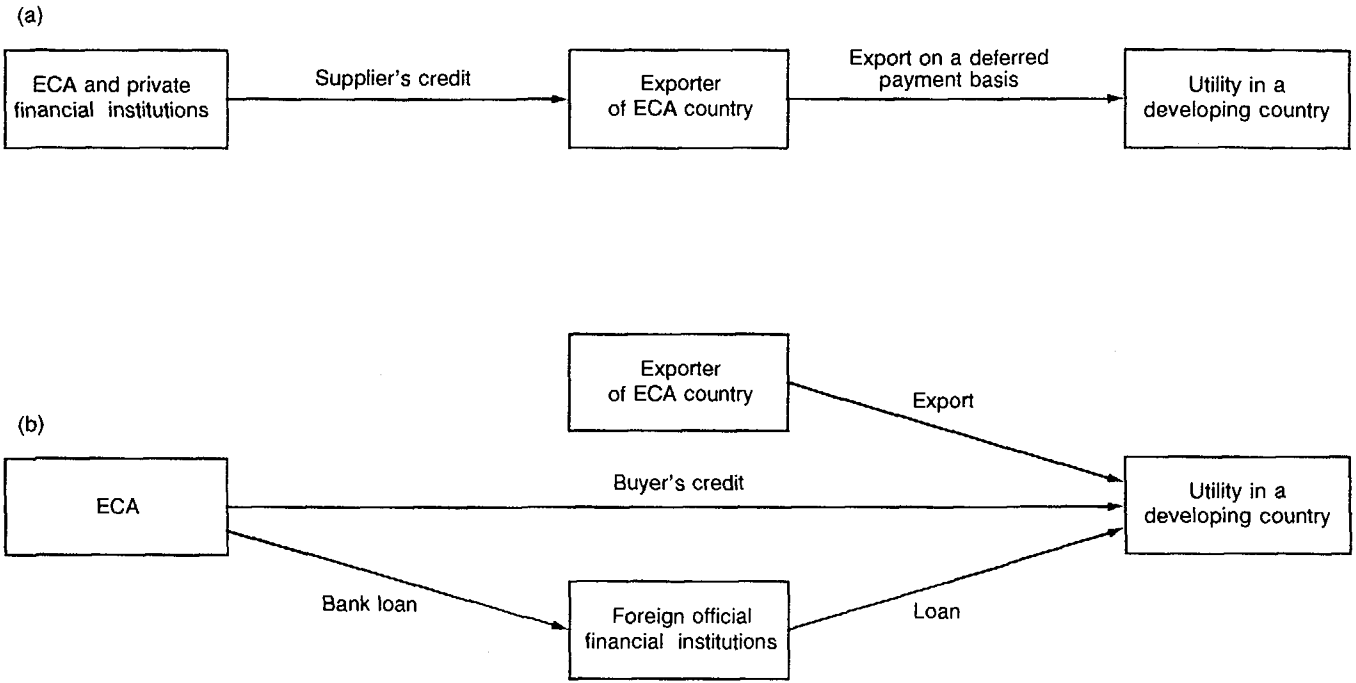


FIG. 8. Simplified schemes of export credit agencies (ECAs) lending to electric power development projects. (a) Supplier's credit; (b) buyer's credit.

(e) There is an extended grace period on repayments which usually covers the entire construction period, but with repayments in equal installments.

(f) Sometimes a subsidized interest rate is offered which is lower than commercial rates.

4.3.2. Export financing schemes

In general, two types of lending programmes are available from ECAs to finance electric power projects in developing countries. The first is a supplier's credit, which has been widely used to encourage exports of energy plants and other heavy machinery and equipment. This scheme is a form of indirect financing (Fig. 8(a)). In other words, instead of making direct provisions to overseas power utilities, ECAs extend credits to their countries' exporters. From the viewpoint of the ECA, the supplier's credit is a relatively easy method and covers a range of items, from turbines or insulators to a complete turnkey project, such as a thermal power plant.

The other scheme is a buyer's credit, in which an ECA directly funds overseas buyers or overseas financial institutions (Fig. 8(b)).

The terms and conditions of the above types of export financing are bound by the OECD Consensus on export credit [22]. For example, the maximum repayment period and the lowest interest rate are fixed by its rules. The OECD Consensus has to be strictly observed by ECAs.

Export loans can be supplemented by commercial loans for those parts not covered by credit insurance, e.g. 15% of down payments or local costs.

4.3.3. OECD Consensus

The OECD's Arrangement on Guidelines for Officially Supported Export Credits (the OECD Consensus) was agreed upon in 1976 to avoid excessive competition in the terms and conditions of export finance among OECD Member Countries and are revised from time to time [22, 23]. Under the Consensus arrangement, the use of tied aid credits, associated financing, aid loans and grants for the supply of nuclear power plants are in any case prohibited. It stipulates a number of guidelines to which participating countries pledge to adhere and they strictly observe these guidelines. The guidelines provide for matching the derogation of certain terms and conditions. The terms and conditions for officially supported export financing of nuclear power plants are subject to the Sector Understanding on Export Credits for Nuclear Power Plants (see Annex III), which is a part of the OECD Consensus. This understanding (agreed upon in 1984 and amended to include changes up to August 1991) is as follows [23, 24]:

(a) *Cash payment:* Borrowers (purchasers of exported goods and services) receiving officially supported export credits have to self-finance the cash payments at or before the starting point equal to a minimum 15% of the export contract value.
(b) *Local costs:* If any, restricted to the 15% cash payment.
(c) *Repayment:* Equal semi-annual installments.
(d) *Repayment term:* Maximum 15 years, beginning from the start of operation of the nuclear power plant.
(e) *Minimum interest rates* [25]:
  (i) Special commercial interest reference rate (SCIRR), which means the commercial interest reference rate, as defined by the OECD Consensus, plus 75 basis points; or
  (ii) Special Drawing Right (SDR), which means the weighted average interest rates of SDR currencies: SDR + 255 basis points (meaning one-hundredth of a per cent) for intermediate countries, or SDR + 120 basis points for relatively poor countries; or
  (iii) SDR + 230 basis points for intermediate countries, or SDR + 95 basis points for relatively poor countries.

The rates under item (ii) apply in cases where the financing begins from the delivery of equipment and services; the rates under item (iii) are for cases where the construction period is also financed. In both cases, the maximum repayment term applies. Options (ii) and (iii) are not available for relatively rich countries. As of August 1991, the weighted SDR rate used for determining matrix rates stood, in nominal terms, at 9% per annum.

4.3.4. Export insurance

To obtain official support for export credits, it is necessary both to have the approval of the exporting government (export license (EL)) and apply for export insurance. No exporter would be prepared to incur the expenses of making a tender for a project in a developing country unless its national export credit insurer has shown a preliminary willingness to support it [26]. As mentioned earlier, the government export insurance organizations are: the Export Development Corporation in Canada; the Compagnie française d'assurance pour le commerce extérieur in France; the HERMES Kreditversicherungs AG in Germany; the Ministry of International Trade and Industry in Japan; the Export Credits Guarantee Department in the United Kingdom; and the Export–Import Bank in the USA.

Export insurance covers those risks which prevent the exporter from exporting. Such risks fall mainly into two categories: **political risks**, such as the outbreak of war, or a prohibition on the remittance of foreign exchange; and **commercial risks,** such as the non-fulfillment of a contract by any other party, or insolvency.

Credit insurance premiums charged by various official credit insurers and credit exposures for individual countries might be fixed depending on the credit rating of the countries concerned.

In general, a prerequisite for applying for export insurance is a payment guarantee by the host government or a first rate foreign bank. In many cases, the host government is reluctant to issue a payment guarantee for various political/ economic reasons, or to avoid any precedent with regard to the equal treatment of other lenders.

In conclusion, export finance may be hard to get if a payment guarantee cannot be obtained from a bank or government to cover the outstanding portion of the credit.

4.4. MULTILATERAL FINANCING

4.4.1. The World Bank and its responsibilities [27]

'The World Bank' usually includes the International Bank for Reconstruction and Development (IBRD) and its affiliate, the International Development Association (IDA). The IBRD has two other affiliates, the International Finance Corporation (IFC) and the Multilateral Investment Guarantee Agency (MIGA). The IDA, IFC and MIGA are sometimes referred to as the 'World Bank Group'. The common objective of these institutions is to help raise standards of living in developing countries by channelling financial resources from developed countries to the developing world [27].

Loans from the IBRD generally have a grace period of five years and are repayable over 15–20 years. They are directed towards developing countries which are at a more advanced stage of economic and social growth. The interest rate the IBRD charges on its loans is calculated in accordance with a guideline related to its own cost of borrowing.

The IBRD's charter spells out certain basic rules that govern its operations. It must lend only for purposes that contribute to social and economic development and must stimulate economic growth in the developing countries to which it lends. It must pay due regard to the prospects of repayment. Each loan is made to a government or must be guaranteed by the government concerned. The use of loans cannot be restricted to purchases in any particular member country. And the IBRD's decisions to lend must be based on economic considerations only.

The IDA, created in 1960, finances the same type of projects as the World Bank and makes selections using the same criteria, though with less stringent requirements for the foreign currency holdings of the borrowing country. Its intervention is limited to those developing countries with a per capita GNP of less than US $580 (in 1989 dollars) and which cannot obtain the foreign currency they need through conventional loans.

TABLE XIII. LENDING (IN MILLIONS OF US DOLLARS) TO BORROWERS IN THE POWER SECTOR BY REGION, FISCAL YEARS 1981–1990 [28]

Region	Annual average 1981–1985	1986	1987	1988	1989	1990
Africa	129.8	217.0	69.3	88.0	138.4	230.0
Asia	1055.2	1155.5	1926.8	1095.9	1993.5	1503.3
Europe, Middle East and North Africa	268.1	595.2	597.0	400.0	415.0	587.5
Latin America and the Caribbean	571.3	819.2	423.8	423.0	736.0	897.5
Power sector lending (% of total lending)	2024.4 (14.5)	2786.9 (17.1)	3016.9 (17.1)	2006.9 (10.4)	3282.9 (15.4)	3218.3 (15.5)
Total lending	13 938.2	16 318.7	17 674.0	19 220.7	21 366.8	20 701.7

The terms of IDA credits, which are made only to governments, are as follows: ten year grace periods, 35 or 40 year maturities, no interest and an administrative charge of 0.75%. The IDA has no personnel of its own; all staff members of the World Bank carry out the same functions at the IDA.

Lending by the IBRD and IDA to borrowers in the power sector during the 1980s is summarized in Table XIII [28]. Recently, these institutions provided the equivalent of more than US $3000 million for investment in the power sector in developing countries, representing over 15% of the World Bank's total commitments in the developing world.

The IFC, established in 1956, assists developing countries by promoting growth in the private sector of their economies and by helping to mobilize domestic and foreign capital for this purpose. The IFC is legally and financially a separate entity from the IBRD.

Established in 1988, MIGA has a specialized mandate: to encourage equity investment and other direct investment in developing countries through the mitigation of non-commercial investment barriers, such as expropriation and war. To this end, MIGA offers investors guarantees against non-commercial risks; advises developing member governments on the design and implementation of policies, programmes and procedures related to foreign investments; and sponsors a dialogue between the international business community and host governments on investment issues. Its guarantee against non-commercial risks will be discussed in Chapter 6.6.

4.4.2. World Bank co-financing with commercial banks [27, 29]

For those World Bank borrowers who can borrow on commercial terms, the most important sources of external financing are export credits and commercial banks. Under the traditional arrangement for co-financing with commercial banks, the World Bank and a commercial bank enter into separate loan agreements with the borrowing country (the 'A-Loan'). Loans from the commercial banks are at market rates and are negotiated directly by the banks with the borrower. These loans are linked to the World Bank loan through an optional cross-default clause, and a Memorandum of Agreement is signed by the World Bank with the agent for the commercial bank.

In an attempt to strengthen its role as a catalyst for more commercial investment, the World Bank in 1983 introduced the 'B-Loan' programme designed to increase the participation of commercial banks in World Bank assisted projects. It was intended to supplement the World Bank's traditional methods of co-financing with the private sector and provide a wider range of options for structuring co-financed operations.

Under the B-Loan scheme, three additional options become available that permit the World Bank to participate in financing from commercial sources, in addition to making a direct loan. The new options are:

— Direct financial participation by the World Bank in the later maturities of a commercial loan;
— Guarantees of the later maturities of a private loan by the World Bank without direct participation.
— Contingent participation by the World Bank in the later maturities of a commercial loan initially financed entirely by commercial banks.

TABLE XIV. WORLD BANK CO-FINANCING OPERATIONS (IN MILLIONS OF US DOLLARS) FOR FISCAL YEARS 1990 AND 1991 [27]

Year	Pojects co-financed		Source of co-financing						World Bank contribution		Total project costs
			Official		Export credit		Private				
	No.	Amount	No.	Amount	No.	Amount	No.	Amount	IBRD	IDA	
1990	128	13 480.0	124	9 307.1	13	3 518.5	6	654.5	8 321.6	3 333.0	49 057.1
1991	126	8 948.6	122	7 056.5	7	1 494.5	7	433.6	7 778.0	3 187.2	29 677.6

The volume of co-financing anticipated in support of World Bank assisted operations amounted to US $13 000 million in fiscal year 1991. The largest sources of co-financing continued to be official bilateral agencies and multilateral development institutions, which together accounted for $7000 million. The volume of anticipated export credits reached an estimated $1500 million. Commercial bank co-financing amounted to $434 million, reflecting the continued difficulty experienced by World Bank borrowers in attracting medium to long term financing from commercial sources (Table XIV) [27].

Since the establishment in 1983 of the B-Loan programme for co-financing with commercial banks, the patterns of the overall financial flows to developing countries have declined precipitously with the onset of the debt crisis in the early 1980s and the recent stringent capital and mandatory reserve requirements imposed by banking regulators. At the same time, however, innovations in capital markets have become widely accepted and have significantly broadened the range of instruments available for financing to borrowers who are creditworthy. The World Bank adapted its commercial co-financing programme to changes in the market. The establishment of an expanded co-financing operations (ECO) programme in July 1989 has enabled the World Bank to provide flexible support for financing transactions undertaken by eligible borrowers in a broad range of markets. The ECO programme is intended to support World Bank borrowers seeking to gain access to international capital markets, including private placements and public bond issues, as well as to improve borrowers' access to medium term credit facilities, syndicated and club loans and limited recourse project financing. This will be discussed in Chapters 6.4 and 6.5.

4.4.3. The World Bank and nuclear power

The World Bank has closely watched the development of nuclear power and, in 1974, reached the conclusion that, technically and economically, nuclear power projects could be dealt with using its normal procedures. The World Bank seems ready to consider limited participation in the financing of such projects in developing countries if the project represents the least cost alternative for supplying the growing demands for electric power and if such participation attracts other sources of finance [20].

Thus, while World Bank lending for a nuclear power project is feasible, no such funding has as yet taken place. The principal reason has been the availability to developing countries of bilateral financing on favourable terms from a number of industrialized countries. Another commercial reason is that in the relatively few larger developing countries where nuclear power is economic, there have been other energy projects for which the World Bank could contribute more 'non-financial assistance' per dollar loaned than for nuclear power [29]. An example is natural gas development, where the World Bank can help implement a strategy fostering the development and utilization of domestic gas so that imported fuels can be phased out. The World Bank seems to take the position that as a financier of last resort it is unnecessary for its funds to be allocated for nuclear power projects.

While nuclear power technology is proven and economically viable, there is a high degree of uncertainty regarding the costs and schedules, as well as the public acceptance issues associated with nuclear power projects. Also, production problems have resulted in output which is well below capacity. So far there has been little financing by multilateral financing agencies, mainly because developed countries have been willing to provide financing, in many cases under exceptionally generous terms and conditions, to assist their manufacturers in establishing a position in the nuclear power plant export market. In the initial phase of such a project, the World Bank, with its extensive project related experience, could assist developing countries — either directly or through the IAEA — in building up the institutional framework and technical expertise necessary for nuclear power. Later, for actual projects, in addition to participating to a limited extent in the financing which would mobilize other financing sources (official or private), the World Bank could assist by maintaining oversight on the quality and timing of the project [20]. In the light of growing worldwide concerns about the safety and costs of nuclear power generation, and especially the experience with nuclear power in the former USSR and in eastern Europe, the World Bank, while unwilling to support nuclear power in developing countries, is reviewing its policy concerning the safety and upgrading of existing nuclear power plants in the countries of central and eastern Europe.

4.4.4. Regional development banks and organizations

The regional development banks in Africa, Asia, Latin America and Europe are potential sources of financing. These banks have the advantages of proximity to and close knit relations with their member states and detailed knowledge of local conditions, resources, priorities and needs in the power sector. While maintaining close links with the World Bank and its technical expertise, they can potentially make available their own resources, as well as additional funds gathered in their member states. Regional development banks also act as lead agencies for co-financing operations [20].

4.5. LENDING PROCEDURES, CHECK POINTS OF FINANCIAL ANALYSIS [20] AND PROJECT RISKS

All lending organizations display extreme prudence in the selection of borrowers to ensure they will get their money back. In addition, official credit organizations which, according to their by-laws, have to serve specific purposes, must strictly follow these rules. 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.

Undoubtedly the most demanding in this respect is the World Bank. Since it is the major lending institution for developing countries, it is imperative that it be informed in advance of the requirements which the project and the borrower must fulfil in order to finance a loan. Although every lending organization has its own specific conditions, those of the World Bank can be seen as being representative of such institutions.

In the World Bank's first systematic statement on the project appraisal methods it uses, it listed six different aspects of a project to be investigated: (a) calculation of the economic rate of return for a project; (b) the technical nature of the project, i.e. cost estimates, the possible need for engineering consultants, etc.; (c) quality of management; (d) organizational aspects; (e) commercial aspects, i.e. proposed procurement procedures; and (f) financial matters, namely, whether the investment costs of the project are adequately covered and whether the proposed operation can be expected to generate sufficient funds to meet debt servicing obligations.

For lending to the electric power sector, the World Bank widens its appraisal to include a project's position in the overall energy sector investment programme. More recently, it has shown a preference for projects that are likely to improve economic growth and alleviate poverty. Also, economic principles are now applied to utility operations. Cost related or marginal cost based electricity pricing focuses not only on electric power tariffs, but also on their structure. Finally, environmental concerns have come to play an increasing part in the World Bank's appraisals.

A brief summary of the World Bank's lending conditions and control measures are presented in terms of the overall project timetable, i.e. from the first phase of project identification to the retrospective evaluation at the end:

(i) *Identification.* In this first phase, the lender and borrowers select projects capable of contributing to the development strategy and of complying with the implementation criteria of the lender. These projects are then included in the lender's potential lending programme for the given country.

(ii) *Preparation.* Once a project has been identified, project preparation follows, i.e. its benefits and costs are determined; comparisons are made between alternative projects; and organizational, institutional, technical and financial problems are analysed with a view to finding solutions. At the end of the preparation stage, the project is appraised.

(iii) *Appraisal.* In the course of the appraisal, a report is prepared which sets out the economic, financial, organizational, institutional and technical features of the project. The appraisal report provides the basis for negotiating the legal documents for the loan between the borrower and the lender. By the time of these negotiations it has nearly always been demonstrated that the project is worthwhile and acceptable for financing. In the case of power projects it is no longer a question of whether a project should be implemented, but rather whether the revenues of the utility are sufficient. This is often a major issue, as it determines the financial soundness of the utility and its ability to carry out the project and service the debt. Such an analysis is not confined to the financial aspects only, but extends also to the technical, economic, institutional, managerial and other significant aspects of the project. The World Bank checks that the project will have a positive impact on the national economy and for this reason it surveys the main factors of the economy, including, if relevant, shadow prices for this examination. In the case of an electricity generation investment, it not only checks the opportunity alternatives for the same amount of investment, but compares the costs to the national economy if the project is not carried out. However, such a comparison serves more to identify extreme economic limits than to question an investment which is required for technical and possibly political reasons, and which is also basically acceptable from the economic point of view.

(iv) *Negotiations.* In this phase, the lender, together with the borrowers, studies the measures to be taken for successful implementation of the project. The agreements arrived at will constitute an integral part of the loan documents. The project is then submitted for approval by the lender's administrators. The completed loan agreement and approval by the lender's Board of Directors provide the basis for declaring the loan effective and making available the funds for the project and for implementation. The loan agreement contains standard provisions for the loan, terms, interest rate, payment dates and disbursement procedures. These provisions also give the lender the right to information regarding the project and the right to the lender's staff to visit the project during negotiations for the loan. Secondly, there are covenants ensuring that the borrower maintains financial soundness. Thirdly, there are provisions concerning the execution of the project, such as the use of consultants, procurement procedures, training programmes, etc.

(v) *Implementation and supervision.* The borrower is responsible for the implementation of the project. The lender oversees the execution through the advance reports submitted by the borrower and by periodic visits in the field. Procurement of goods and services for the project must follow the lender's official procedures for achieving efficiency and economy. The main purpose of the staff visits is to help ensure that the project achieves its objectives and to work with the borrower to identify and deal with problems that arise during implementation. Supervision takes place primarily in connection with collective problem solving, and as such is one of the most effective ways in which the World Bank provides technical assistance to its members.

(vi) *Retrospective evaluation.* After the last payment on the loan, a separate, independent department of the World Bank prepares its own evaluation report, based in general on the documentation existing at its headquarters; field visits are included only if necessary. This retrospective evaluation offers a final balance of past experience and possible suggestions for improving future project cycle activities.

During the first phase of the project related procedures mentioned above, additional information is collected regarding the borrower's organization, for example, the status of the entity (autonomous or under strict governmental control), management (centralized or decentralized), accounting system and practices in force, corporate planning, budgeting and budget control, financial regulations, internal control and audit systems, data processing, competence and training of financial staff, etc. A special analysis is devoted to the accounting system, checking its capacity and competence in general and in relation to the project under consideration. As far as the financial analysis is concerned, the main issues and items checked are those enumerated in Table XV.

In general, during the course of a 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.

(a) *Credit risks.* Lenders will assess the creditworthiness, track record, prospects and management skills of the parties involved.

(b) *Construction and development risks.* The lenders' assessment of risks in this phase of the project will involve careful scrutiny, for example, of the risk of non-completion of construction, shortfalls in expected operational performance, cost overruns, delays in completion and the availability of fuel and a work force.

(c) *Operations and market risks.* These may be linked to technical problems such as inadequate design, poor engineering and insufficient personnel training, or to economic problems, such as a rise in operating costs, shortage of supplies, or an incorrect assessment of the market (size, accessibility, tariffs, etc.).

(d) *Financial risks.* These are linked to the potential impact on the project of financial developments outside the control of project sponsors, such as fluctuations in exchange rates and increases in interest rates, fuel prices and inflation.

(e) *Political risks.* In all cases, banks take a political risk in the sense that a collapse of the existing political order in the borrowers' country or the imposition of new taxes, exchange transfer restrictions, nationalization, or other country risks may jeopardize the prospects of repayment and recovery. Risks related to force majeure, such as civil or foreign wars, and acts of God are also included.

(f) *Legal risk.* Developing countries may have fundamentally different legal and economic systems, with the result that, for example, there may be inadequate dispute resolution capabilities, and different laws on security and on enforcing the rights of lenders.

TABLE XV. ESSENTIAL ELEMENTS OF FINANCIAL ANALYSIS IN WORLD BANK FINANCED PROJECTS

Accounting system
Accounting data
Past financial performance
Present financial position
Financing plan for the proposed projects
Financial projections based on financial objectives — income statement, cash flow, balance sheet, working capital, investment programme
Detailed assumptions used — The World Bank would suggest using assumptions to the extent possible, e.g. minimum financial objectives
Sensitivity analysis for key variables
Management/efficiency indicators:
Per cent of population served
Per head consumption
Per cent system loss
Days accounts receivable
Employees/1000 consumers
Per cent contribution of investment
Per cent rate of return
Per cent debt (debt and equity)
Real tariff increase
Salary/employee/month
Operating ratio
Operating expenses/unit sold

4.6. MAJOR FACTORS INFLUENCING THE FINANCIAL VIABILITY OF DEVELOPING COUNTRIES

Owing to its convenience, versatility, safety and cleanliness, electricity is often the most preferred among various energy resources.

However, in many cases, power utilities in developing countries are state controlled. Many such utilities do not generate enough revenue for their operating and capital expansion purposes. Owing to these financial difficulties, many utilities in developing countries 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 makes it very difficult to attract capital from private commercial investors [30].

The growing financial strains on power utilities mean that greater attention must be paid to the four key domestic factors influencing financial viability, as listed below.

(a) *Electricity pricing* [29, 31]. One of the major sources of financial difficulties for utilities is their uneconomic pricing of electricity. For many utilities, electricity tariffs do not even cover the operating and debt service costs, and in most countries tariffs are below the long run marginal cost of supply. In addition to its economic impact, the underpricing of electricity causes the wasteful usage of energy and critically impairs the operating revenues of utilities, forcing them to reduce inventories, forego essential maintenance, request government subsidies and undertake additional borrowing that imposes a heavy debt service burden in later years. Many national power utilities need to increase their tariffs significantly to regain their long term financial health and to reduce their borrowing requirements to more manageable levels. The unwillingness of governments to raise tariffs in line with costs stems both from the political unpopularity of these measures and the mistaken conviction that curbing utilities' tariffs helps control inflation. Recent tariff increases in most developing countries have been granted on a haphazard basis to overcome immediate difficulties, rather than to ensure long term financial viability of utilities.

(b) *Operational efficiency* [29]. Another obstacle to financial viability is inefficiency of operation. In many countries, the growth of revenues is held back by the lack of qualified O&M staff, lack of spare parts and by technical inefficiencies. Poor maintenance decreases plant availability and reliability and causes heavy losses in the transmission and distribution of electricity. In some cases, plants are in urgent need of overhauling/upgrading. Bad metering and poor collection of bills add to these problems — unpaid bills exceeding six months of revenues is common. Even when tariff levels are adequate, uncollected bills owed by governments and other state enterprises often are a serious problem, one that cannot be resolved without budgetary intervention, especially when the situation has been allowed to deteriorate for many years.

(c) *Environmental concerns.* More recently, environmental concerns have emerged as obstacles to the growth of the electric power industry in developing countries. Projections of conventional power supply expansion show enormous increases in hydropower and in fossil fuel fired facilities. Large scale hydropower plants often require the relocation of sizeable groups of people and cause the permanent alteration of river basin ecosystems. Fossil fuel power generation can result in both local pollution and cumulative global increases in carbon dioxide that may lead to irreversible climate change. These concerns are leading lending agencies to think twice about financing large scale electric power facilities in developing countries [30]. However, global environmental concerns work more in favour of nuclear power than they do for conventional power generation systems.

(d) *Financing capabilities* [29]. Shortfalls in local cost financing from internally generated funds have led some developing countries to attempt to create new sources of medium to long term local financing, or to increase government loans or equity injections from the public budget to the utilities. Capital contributions from the government are not always forthcoming when due and utilities therefore either have to rely to a greater extent on money borrowed at high rates of interest or cut back their programmes. Utility borrowing is also sometimes restrained by a country's need to limit new debt as a result of support agreements. Difficulties in generating cash, coupled with the inadequate domestic capital markets in developing countries have, in some cases, forced utilities to borrow foreign exchange to meet local costs. In view of the scarcity of external capital, it would clearly be inappropriate to borrow abroad for local costs without first having made intensive efforts to raise the resources domestically. Such efforts should include an appropriate tariff level and structure to provide a reasonable degree of self-financing within the sector.

Of these factors, financial capabilities and electricity tariffs are of special importance in arranging for and repaying loans for power projects. While social and political considerations must be taken into account in determining tariffs, it is crucial that electricity tariffs should reflect costs. Unless power utilities show good financial performance, it is unrealistic to expect strong support from financial institutions.

Chapter 5

EXPERIENCE GAINED AND LESSONS LEARNED

5.1. INTRODUCTION

If funding from the national budget or the owner's equity and cash flow were adequate, there would be no problem in implementing and financing a project. If a country launching or expanding a nuclear power programme is creditworthy, it can obtain export credits and can procure funds by international borrowings. If the capital market is relatively well developed in the host country, local financing may be easier, although it will still be a difficult task, owing to the large amount and long credit periods required.

This chapter discusses the experience gained and the lessons learned — as well as country cases — in financing nuclear power projects in developing countries. In general, the importance of local financing must be stressed. For example, India has been supporting its pressurized heavy water reactor (PHWR) programme from its national budget and from the cash flow of the operating organization. A new financing instrument introduced is a debenture issue for procuring funds from the country's capital market. This approach provides a typical example of domestic financing. If financing is unavailable within the country, export credit facilities can be mobilized. The Republic of Korea provides a typical example of financing through supplier's credits. China's Guangdong nuclear power project is another example of such an arrangement, though with additional features, namely, a joint venture approach and an arrangement for acquiring foreign currency. For export credit facilities, ECAs must be involved. However, they have been facing difficulties, mainly long delays in the completion of projects, with consequent cost overruns. The OECD Consensus limits financing sources.

The discussion above lists the key issues involved in financing nuclear power projects. The balance of the chapter gives examples of these issues. If the host country faces a creditworthiness problem, financing a nuclear power project is a very difficult, if not impossible, task. It is then necessary to consider additional innovative approaches beyond those which have already been used (see Chapter 6).

5.2. IMPORTANCE OF LOCAL FINANCING [32]

5.2.1. Local costs

While the financing of the foreign components of projects, once arranged in advance, has not proved to cause any really serious difficulties, except that project delays often required certain modifications of loan documents and sometimes higher loan amounts, the most serious problem has come from securing the necessary financing of local costs, a task whose complexity is often underestimated. Raising enough money for the financing of local costs 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 involved with the projects have been solved.

Experience to date indicates that often no solid provision is made for financing the local cost component of nuclear power projects. The difficulties involved in raising local finances are often vastly underestimated, in particular when such huge amounts are needed. Frequently, those concerned consider the promised access to the domestic capital market, or support from the government budget, as a type of guarantee that sufficient funds from those sources will be made available in due course. At the same time, however, they are not fully aware of the constraints on capital markets. It may come as a surprise that there are difficulties in raising local financing at the same time that the necessary foreign financing has been secured in a legally binding form.

Local cost financing may also be jeopardized by government budget cuts. Governments, for political reasons, tend to administer across the board cuts, which do not take into account the special circumstances of a nuclear power project under construction, instead of implementing selective reductions which take into account individual impacts and subsequent costs.

5.2.2. Importance of financing local costs locally

Covering the gap in financing local costs using foreign exchange funding from abroad can often prove to be a problematic solution. To avoid straining the foreign exchange balances of a country, with the negative impact this implies, local costs should in principle be financed in local currency from sources within the buyer country itself (either from the buyer's revenues from other projects, from the national budget, or from funds raised in the domestic capital market). This is particularly necessary as power plants are almost always operated for domestic use only, thus generating cash flow only in local currency.

Owing to the scarcity of domestic currency financing, a country and/or the local investor might be under further constraints which narrow the scope for financing. In this connection, three aspects should be considered.

5.2.2.1. Underutilization of local contractors

Generally, about 20–40% of the investment costs of a nuclear power project would normally accrue in local currency, depending on the experience and capabilities of local industry. In addition to infrastructure, the major components of local cost expenditures include the civil works for the project. Depending on the degree of local industry participation in the project, part of the more sophisticated mechanical equipment could also be manufactured locally — often in co-operation with or under the supervision of, the foreign suppliers — thus reducing the foreign financing requirements and at the same time generating jobs and promoting the transfer of know-how. Unfortunately, owing to the scarcity of local finance, the possibility of a larger contribution from local manufacturers might not be utilized, which means the loss of an important opportunity for national development and for gaining experience.

5.2.2.2. Currency exchange risks

In view of the basic fact that a power plant project normally does not directly produce foreign exchange earnings on a scale worth mentioning, external financing (i.e. foreign exchange financing) should not, wherever possible, be spent on local costs, but be reserved for foreign exchange costs, such as imports. The debt service performance for foreign liabilities depends on the availability of foreign exchange earned by the national economy with other projects. Moreover, this means a considerable risk to the borrower in that the exchange rate between the currency in which the loan agreement is denominated and the local currency will determine the amounts to be raised in local currency. The risks connected with an appreciation of the foreign currency in question or any inflationary tendency on the part of the local currency is borne by the borrower.

5.2.2.3. Limited risk coverage

Apart from general economic arguments against the financing of local cost components using foreign exchange, another rather important aspect should be considered. As the various official credit insurers are in general only prepared to include local costs to a rather limited extent in their credit risk coverage — which is also in line with the OECD Consensus — the non-covered credit risk has to be borne exclusively by the creditors, thus very much limiting their leeway regarding credit volume. This situation is exacerbated by the fact that in the case of developing countries such insurance coverage is available only for limited amounts, as they are considered to be higher credit risks. Thus, credit risk coverage does not cover the huge amounts normally required for the import of power plants; it is only a 'partial coverage', leaving part of the risks with the banks or the suppliers.

For this reason, sometimes even the larger parts of the project can be financed only if some of the risk is assumed by foreign banks, which sharply limits the scope for additional financing of local costs. In this context, one should always be aware that even when credit insurance is available, as a general rule part of the credit risk always remains with the creditors and/or exporters.

5.2.3. Sources of local currency funding

To raise adequate amounts of local currency under the many constraints that the economies of developing countries have to face is an enormous and sometimes even impossible task. The different ways in which this might be accomplished also depend on whether financing should be raised by the government, or with its assistance, or by a private sector entity. In most cases, the investor will be a public sector company which is largely dependent financially on the government budget.

Sound sources of local currency funding for investment in a public utility power project would be the government budget and funds from the project's operating organization/utility, either from equity or from accumulated earnings set aside especially for such a planned investment. This presumes that the government allows the setting of reasonable electricity tariffs. These sources could be supplemented by credits raised in the domestic capital market.

Some countries have created special funds to promote the development of their electricity sectors. These funds could be maintained through special taxes, such as an energy tax, supplementary taxes, or fees tied exclusively to that purpose. There could also be an increase in the electricity tariffs, or a rule that a certain portion of the profits or depreciation from existing power plants have to be channelled into this fund. Such a fund could be operated like a banking instrument. It could lend on a revolving basis, for example, and/or provide guarantees as security for loans to be raised in the national capital market for financing power projects.

These financial resources could be complemented, e.g. by local bank loans to be secured, if necessary, by guarantees from the government or perhaps the special funds mentioned above. Bonds could be issued in the local market, too. However, this presumes that the capital market is more developed, which might be unrealistic. Some of the typical constraints of the financial market might be:

— Limited capacity with regard to loan volume,
— Highly inflated interest rates,
— Non-availability of longer credit periods commensurate with the life of the project,
— Lack of financing instruments adequate to the needs of the project.

It would be very demanding, but worthwhile, to try to tap the sometimes large savings of people working abroad who often are reluctant to invest in their home country and look instead for better security and profits abroad. Tax benefits, sound interest rates and arrangements for ensuring the security of investments could help to attract such money. However, as this money in general is very 'shy', or there is reluctance to invest in such projects, perhaps more has to be done to attract possible investors.

To deal with all of these constraints on the local capital markets, offshore financial institutions, including the multinational agencies, could assist in resource mobilization by underwriting, guaranteeing, or even facilitating repayment in a convertible currency at any time, with the choice of option being left to the investors.

5.2.4. Implications for local financing

Difficulties in financing local costs arise from shortages of government funds and constraints on 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.

To a limited extent, debt instruments have recently been developed in several highly indebted countries to reduce their foreign indebtedness by converting foreign debts into local currency. This could also help to make local funds available for investment.

To foster a country's technical and economic development, it would be desirable for local financing to cover the largest possible amount of the local content of the project and, ideally, all of the local participation in the project.

All of this leads to the conclusion that as much as possible of the total project costs, but in any event the local portion of these costs, should be financed from 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 adequate funds similar to escrow accounts, 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 to be considered creditworthy by banks.

5.3. THE CASE OF INDIA [33]

5.3.1. The Indian nuclear power programme

India's is one of the earliest nuclear power development programmes. In 1956, the 1 MW(th) APSARA reactor started operation at the Bhabha Atomic Research Centre (BARC) (then the Bhabha Atomic Research Institute). It was a domestically developed research reactor and was the first nuclear reactor unit in Asia.

The primary purpose of the Indian nuclear power development programme is to secure an indigenous energy source. Its long term objective is to close the nuclear fuel cycle based on thorium resources, which are abundant in India. The long term strategy for this programme encompasses the following:

— *First stage.* It is proposed to attain a nuclear power capacity of 10 000 MW(e) by the year 2000, when the contribution of nuclear power to the total power capacity in India would reach around 10%. This programme envisages 11 more units of the proven 235 MW(e) PHWR and 12 units of the 500 MW(e) PHWR. The objective of the 10 000 MW(e) programme at this stage is to establish nuclear power as a technically feasible and economically viable source of energy to supplement the traditional thermal and hydropower sources.

— *Second stage.* The plutonium produced in the first stage PHWRs would be used as fuel in fast breeder reactors (FBR), which in turn will produce more plutonium, or ^{233}U, if thorium is used as a blanket material. A 40 MW(th) fast breeder test reactor has been set up at Kalpakkam, near Madras, and the design work on a prototype 500 MW(e) FBR is at an advanced stage. The FBR is expected to be commissioned by the end of this century. Fast reactors in significant numbers are expected to form part of the power generation network in the early part of the 21st century.

— *Third stage.* Nuclear power reactors are expected to use ^{233}U along with thorium for breeding, so that the vast reserves of thorium in India can be exploited.

In order to achieve these long term objectives, nuclear power development in India encompasses all necessary activities, such as heavy water production, reprocessing of spent fuels, refining of thorium ore and the development of a FBR. India is, as a matter of principle, developing the capacity for the indigenous design, manufacture, construction and operation of nuclear power reactors. However, it is also flexible in introducing available foreign technologies from industrialized countries.

In 1958, India decided to construct its first nuclear power plant, and in 1964 ordered the Tarapur Nos 1 and 2 reactors (each a 160 MW(e) BWR) from the General Electric Corporation in the USA. These plants were completed and ready to operate in October 1969.

As of September 1991, the operating units in India are, with the exception of Tarapur 1 and 2, all CANDU type PHWRs. These are Rajasthan 1 and 2, Madras 1 and 2 and Narora 1, with a total operating capacity of 1465 MW(e). The plants under construction are all domestically produced PHWRs. The seven units under construction represent a total capacity of 1645 MW(e). These units are: Narora 2, Kakrapar 1 and 2, Kaiga 1 and 2 and Rajasthan 3 and 4.

5.3.2. Financing organization for the PHWR programme

Usually, the risks and uncertainties associated with the development of nuclear power in developing countries with limited industrial infrastructures preclude the possibility of any agency other than national governments taking on the responsibility for funding and executing nuclear power projects in their initial stages. Thus, it was the Government of India and its Department of Atomic Energy (DAE) that initiated the first steps towards utilizing nuclear power for generating electricity on a commercial scale.

In the early stages of the programme, projects were taken up sequentially and the power generation capacity created between 1960 and 1984 amounted to only 1000 MW(e). The cumulative capital expenditure on these projects up to 1990 was Rs. 2026 crores (1 crore = 10 000 000). These expenditures were met entirely through budget grants voted by the Indian Parliament, since the DAE directly administered the projects as departmental undertakings. During this period, the budget allocations were seldom fully utilized and no constraints on funds were felt.

In 1984, the Government of India approved the Nuclear Power Profile — a comprehensive programme aimed at increasing the installed nuclear generating capacity to 10 000 MW(e) by the year 2000. This programme envisaged a capital outlay of about Rs. 8600 crores at 1983 prices. However, in 1984–1985, at the time of formulation of the Seventh Five Year Plan (1985–1986 to 1989–1990), it was realized that the resources required during the Plan period for implementing the programme would not be available, and while Rs. 2100 crores were required, only Rs. 1410 crores were provided. Facing this situation, and in order to meet the target of the nuclear power programme, funds would have to be raised from extrabudgetary sources to supplement budgetary assistance. Since government departments could not use the capital markets to raise extrabudgetary resources, a corporate entity had to be created for raising funds. In September 1987, the Nuclear Power Corporation of India Limited (NPC) came into existence.

To demonstrate that nuclear power generation was a commercially viable activity, the NPC was registered as a company under the Indian Companies Act so that it would be subject to the statutory and financial discipline by which all commercial undertakings are governed. While the Government has absolute control over the management of the corporation, the entire equity capital being subscribed by it, the corporation and its Board of Directors are vested with substantial autonomy and flexibility in daily operations.

With the incorporation of the NPC, all operating nuclear power stations and projects under construction were transferred from the Government to the corporation, half as equity and half as a loan in perpetuity. The Government also indicated that it would contribute 50% of the costs of construction of nuclear power projects, including IDC, as equity in the NPC and that equity funds would be made available to finance the first half of the capital expenditures on any project. The remaining

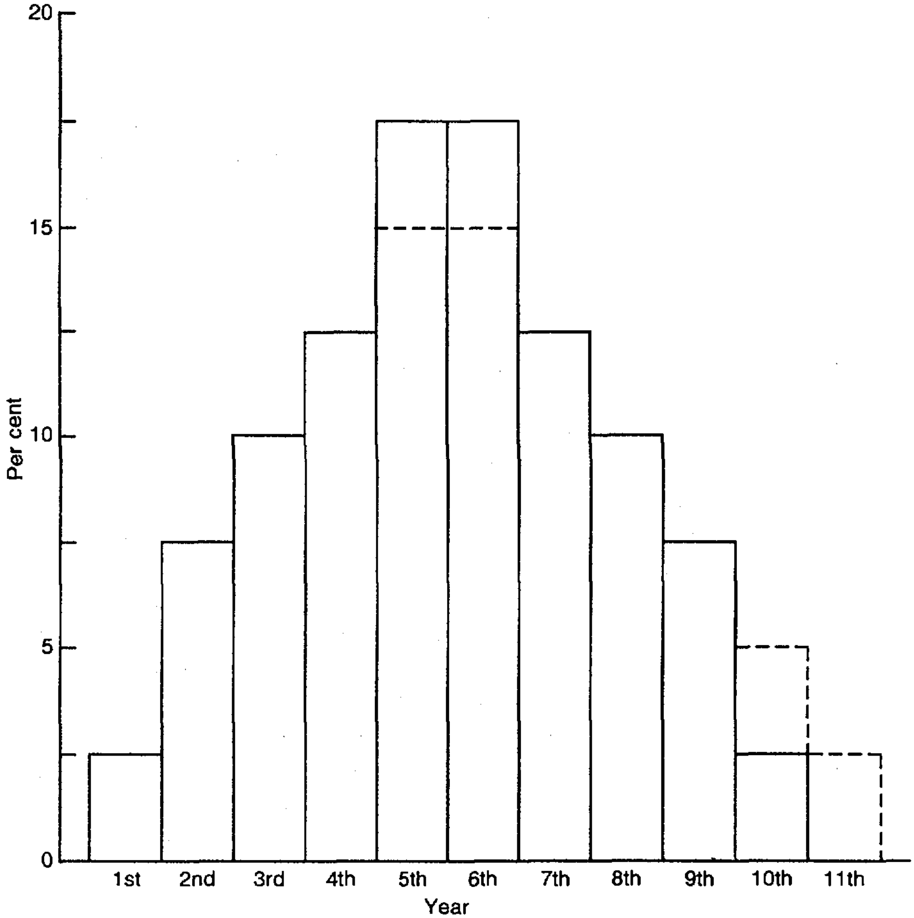


FIG. 9. Typical funds disbursement schedule, the case of India (———: 235 MW(e) units; - - - -: 500 MW(e) units) [33].

expenditures would have to be met by the NPC through its internal surpluses (return on capital employed, plus depreciation but less interest) and through market borrowings. The NPC would thus have an overall debt-equity ratio of around 1:1.

5.3.3. Capital requirements and financing plan for the PHWR programme

On the basis of the study of nuclear power plant construction costs in India over the past twenty years, typical costs of Rs. 19 000 per kW(e) installed for 235 MW(e)

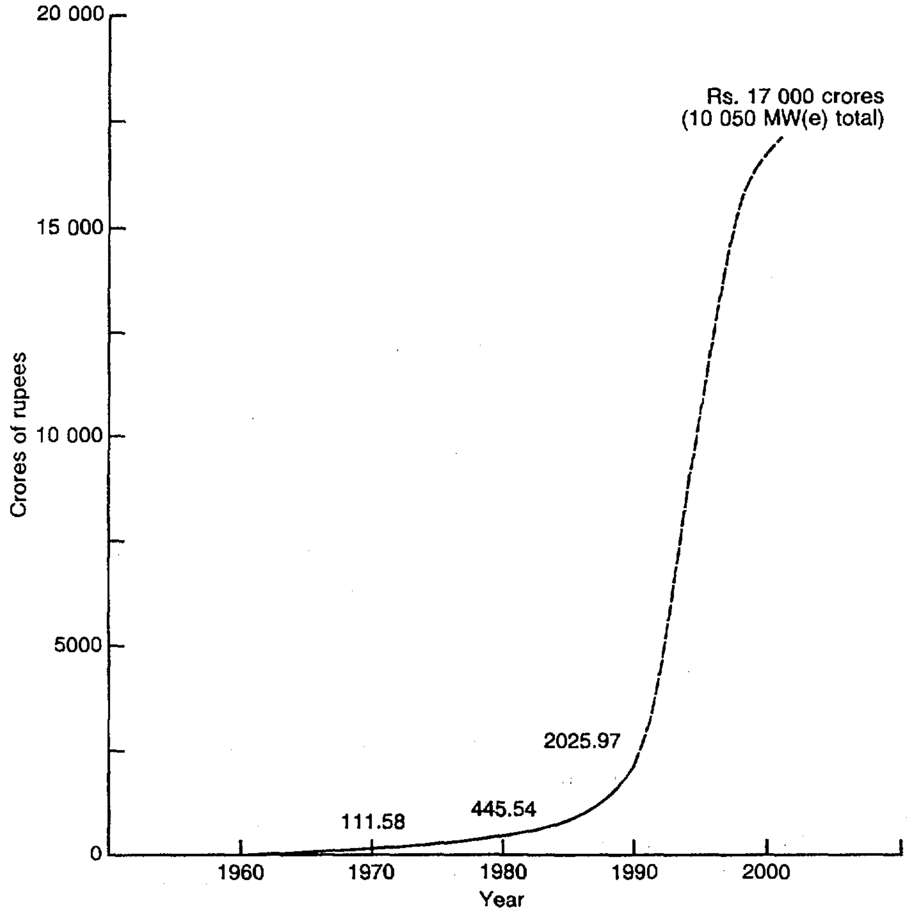


FIG. 10. Cumulative expenditures by India on the PHWR programme (——: actual; – – –: required; 1 crore = 10 000 000) [33].

reactor units and Rs. 20 000 per kW(e) installed for 500 MW(e) reactor units are used for projecting capital investment requirements. Figure 9 [33] shows a typical phasing of expenditures used for project schedules of eight years for 235 MW(e) units and nine years for 500 MW(e) units. Figure 10 [31] shows the projections of yearly capital investment requirements for the growth of installed capacity up to the year 2001, together with the anticipated buildup of nuclear power capacity. The total capital expenditure for the 1989-2001 programme at constant 1989 prices is estimated at Rs. 15 755 crores.

The three principal potential sources of funds in developing a financial plan for implementing the nuclear power programme are: the national budget, revenues of operating organizations and borrowings.

5.3.3.1. National budget allocations

The prospects for financing through equity depend entirely on the resources available to the Government and the allocation priorities of such resources. As previously mentioned, at the time of formulation of the Seventh Five Year Plan, the nuclear power programme was initially allocated Rs. 1410 crores against its requirement of Rs. 2100 crores. While the power sector has a high priority for the Government and the Planning Commission, there are competing demands for the limited resources available from other important areas, such as agriculture and rural development and even from within the power sector. In view of the urgent need to increase installed power capacity to ease power shortages in most parts of the country, gas and coal fired thermal power projects with lower capital costs and shorter gestation periods appear to be more attractive in the short term.

5.3.3.2. Revenues from operating plants

To assess the availability of funds from the internal operating surpluses of nuclear power plants, it is useful to examine nuclear power pricing in India. Nuclear power tariffs are determined and notified by the NPC after consulting with the Central Electricity Authority and the beneficiary State Electricity Boards, which buy power from the NPC and distribute it to the ultimate consumers. According to the present policy on tariff formulation, the tariff for each operating plant is determined separately, for three-year periods. Depreciation of capital assets excluding heavy water is computed by the straight line method for a 25 year plant lifetime, with a residual value of 10% of the original cost. This works out to a depreciation of 3.6% of the original capital cost, including the IDC per annum. The return on capital employed (net fixed assets plus working capital) is fixed by the Government and is currently 12%. Thus, operating surpluses consist of the return on capital employed plus depreciation less interest on borrowed capital. Since tariffs are based on a normative capacity utilization factor of 62.8%, or 5500 hours per year, the operating surpluses would be less if the actual capacity factors achieved at power plants are below the norm.

With a view to increasing the operating surpluses from nuclear power plants, a proposal is under consideration by the Government to revise the rate of return from 12 to 15% of capital employed, and also to introduce an additional element in the tariff of a levy for research and development. However, since the present operating base of seven units (with a total capacity of 1465 MW(e)) is small compared with the size of the programme up to the year 2000 (10 000 MW(e)), the impact of these measures will be marginal during the Eighth Five Year Plan period (1992–1997).

5.3.3.3. Borrowing — Debenture issues

Owing to the long construction time-span (i.e. an estimated eight to nine years for new projects being started), the Government of India introduced in 1987 a financial instrument especially suited to the needs of state owned public utilities in the power and communication sectors. This debenture, or bond, has two variants: one with an interest rate of 13% per annum payable semi-annually, subject to tax under the Income Tax Act and with a redemption period of seven years; the other with interest payable semi-annually at the rate of 9% per annum and free of income tax. This variant has a redemption period of ten years and thus is especially suited to long gestation projects. Table XVI [33] highlights the special features of these debentures.

TABLE XVI. SPECIFIC FEATURES OF BOND ISSUES (THE CASE OF INDIA) [33]

	9% per annum bonds	13% per annum bonds
Common features	— Choice of interest schemes — cumulative and non-cumulative — under each category — Half-yearly interest payments on non-cumulative bonds — Postdated interest warrant with non-cumulative bonds — Interest payable from date of realization of application money — No income tax reduction at source — Income tax benefits for charitable and religious trusts	
Indigenous features	— Interest totally exempt from income tax — Redeemable after ten years — Wealth tax exemption on entire investment — Easily transferable — by endorsement and delivery — Fully secured — Buyback facilities to limits — Bonds accepted by company as security in lieu of bid — Guarantee/earnest money/bank guarantee	— Income tax exemption under Section 80L — Redeemable after seven years

TABLE XVII. RESOURCE MOBILIZATION THROUGH CAPITAL MARKETS (THE CASE OF INDIA) [33]

Year	Public sector borrowings (in crores[a] of rupees)	NPC[b] bond issues (in crores[a] of rupees)	Front end costs (%)
1987–1988	2140	126	3.87
1988–1989	3139	200	0.75
1989–1990	3633	360	0.50
1990–1991	—	562	0.20

[a] 1 crore = 10 000 000.
[b] NPC: Nuclear Power Corporation.

So far, the NPC has been involved in four debenture issues. The first issue for Rs. 100 crores was successfully opened for public subscription in January 1988 after a short but intensive media campaign directed at projecting nuclear power as a safe, unlimited source of energy which was also commercially viable. Having established the Nuclear Power Bond as an attractive financial instrument in the capital market, the subsequent issues shown in Table XVII [33] were privately placed with financial institutions, with a small portion (20%) reserved for sale to the public. Since the front end expenses for a public issue are relatively high, around 3.8% for a Rs. 100 crore issue, the preferred practice now is for private placement with a very small front end fee, ranging from 0.2 to 0.5% of the amount raised.

On the assumption that the mix of public borrowings will consist of one-half tax free debentures at a rate of 9%, and one-half of the debentures at a rate of 13%, with some possible short term borrowings from the Government or banks at 15% per annum, and allowing for the issuing expenses, the weighted average cost of borrowings is about 11.5% per annum. This is the rate used for projections of borrowings during the programme period.

5.3.3.4. Financing plan

On the basis of the approved financing structure for projects to be executed by the NPC, and assuming that the Government would meet its commitments regarding contributions to equity, annual cash flows relating to government equity contributions and internal operating surpluses have been projected for the period up to the year 2001. In this scenario, to meet a net shortfall of only Rs. 6586 crores, total borrowings up to the year 2001 will have to be Rs. 8169 crores and the total funding requirements will be Rs. 26 656 crores. However, this scenario's equity subscription had to be suddenly increased in 1990–1991, but the Government was unable to accommodate large increases in its budget operations. Therefore, a more realistic approach was taken, namely that the current level of budgetary assistance from the Government would continue with an enhancement of 10% per annum to the year 2001, while the remaining requirements would have to be met from internal surpluses and increased borrowings (Table XVIII, Ref. [33]). It can be seen that to meet a net shortfall of Rs. 3305 crores, the borrowings have to be increased to Rs. 23 655 crores and the total funding requirement to Rs. 37 770 crores. Even at this level of borrowing, the overall debt–equity ratio for the NPC as a whole would only go up to about 3:1, while individual projects being commissioned in the mid-1990s would have debt–equity ratios of between 5:1 and 6:1.

Since rapidly growing power generating companies in India can avail of the benefit of depreciation allowances permissible under the Income Tax Act, they have to pay little or no tax. Thus, the benefit of high financial leverage that tax paying companies derive is not generally available to power generating companies. On the other hand, since interest on borrowings has to be paid out of the return on capital which is allowed in the power tariff based on normative capacity factors, a high debt–equity ratio could lead to heavy losses when the normative capacity factors are not achieved. Also, a high debt–equity ratio would imply a greater IDC and correspondingly higher unit energy costs, which may affect the competitiveness of nuclear power in the energy market.

5.3.4. Future implications for India

The financing of the nuclear power programme in India will have to depend largely on market borrowings in 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 Rs. 23 655 crores between 1988 and 2001, appear large, the Indian capital market, and especially the public sector bond segment of the market, has been growing rapidly.

While it may not be difficult to raise the sums indicated, the effect of large borrowings on power tariffs and on the profitability of nuclear power is bound to be severe. The solution appears to be equity capital obtained from outside the Government budget. Steps in this direction have been initiated and India is examining the possibility of joint ventures, including equity participation, with some leading manufacturers of nuclear and conventional power generation equipment both in the public and private sectors.

The scenario under consideration is said to be for a joint venture company to be set up by the NPC and two or possibly three other companies with 51% of equity subscribed by the NPC/Government and the balance by the joint venture partners.

TABLE XVIII. PROJECTION OF CASH FLOWS (IN CRORES[a] OF RUPEES) OF GOVERNMENT EQUITY CONTRIBUTIONS AND INTERNAL SURPLUSES UP TO THE YEAR 2001 FOR INDIA [33]

	Financial years														
Scenario	Up to 1988	1988–1989	1989–1990	1990–1991	1991–1992	1992–1993	1993–1994	1994–1995	1995–1996	1996–1997	1997–1998	1998–1999	1999–2000	2000–2001	Total estimated cost
A. Capital investments	1366	298	720	1069	1476	1732	2057	2191	2032	1613	1210	908	520	226	17 419
Interest payments		81	137	222	350	521	740	1015	1323	1631	1934	2230	2482	2673	15 320
Repayment								76	120	358	592	877	1236	1660	4 919
Total cash outflow	1366	359	857	1291	1826	2253	2797	3282	3475	3602	3736	4016	4239	4539	37 657
B. Equity contributions	971	211	240	264	290	319	351	387	425	468	514	566	622	685	6 314
Internal surplus		80	20	125	207	271	281	272	310	528	542	992	1706	2486	7 800
Total cash inflow	971	271	260	389	497	590	632	659	735	996	1056	1558	2328	3171	14 114
C. Borrowings to meet total cash outflow	395	200	597	902	1328	1662	2165	2623	2740	2606	2680	2458	1910	1389	23 655

Total fund requirement: Rs. 37 770 crores[a]

[a] 1 crore = 10 000 000.

This would ensure adequate Government control over the new company and would allow for lower debt–equity ratios. The obvious solution, if such joint ventures do not materialize, is to spread out the programme over a longer period, thus flattening the peak in the requirements for the funds. Whatever solution is finally adopted, it is clear that by the late 1990s, the internal surpluses generated would be expected to be large enough — Rs. 2000 crores per year — to provide adequate resources for the second and third stages of the three stage programme aimed at utilizing the abundant thorium reserves in the country to fuel the power requirements of future generations.

5.4. THE CASE OF THE REPUBLIC OF KOREA

5.4.1. Nuclear power development

The development of nuclear power in the Republic of Korea began in 1957 when it became a Member State of the IAEA. Since commercial operation of Kori Unit 1 began in 1978, nuclear power has made a significant contribution to this country's rapid industrialization and economic growth. The Korea Electric Power Corporation (KEPCO) is the only electric utility in the country and, as of the end of 1991, KEPCO's total nuclear power capacity was 7220 MW(e), with nine operating units generating 53.5 TW·h (47.5% of total electricity) during 1991. Nuclear power now accounts for almost half of the country's electricity production.

In the Republic of Korea, power generation development has been implemented along with the Five Year Plan of Social and Economic Development, in which nuclear power development has been prioritized because of insufficient domestic energy resources, in order to achieve diversification of power sources and to cope with the rapid growth of power demand and the instability of fossil fuel markets. The nation's nuclear power projects are summarized in Table XIX [34].

5.4.2. Kori nuclear power plants [34]

The Republic of Korea ordered its first nuclear power plant in 1969 from Westinghouse in the USA, a 587 MW(e) PWR that was commissioned in 1978 after seven years of construction. It is located in Ko-Ri Jang-An Eup, Yang San Gun, some 50 km northeast of Pusan. To finance this project, KEPCO considered the conventional approach of requiring potential suppliers to offer financing with their bids, e.g. export credits and commercial loans which would be provided by ECAs and commercial banks in the supplier's country.

The very first project, Kori No. 1, was based on a turnkey contract with Westinghouse. Over 50% of the total investment of US $299 million was from

TABLE XIX. DESCRIPTION OF NUCLEAR POWER PROJECTS IN THE REPUBLIC OF KOREA [34]

Nuclear power plants		Kori unit 1	Kori unit 2	Wolsong unit 1	Kori units 3 and 4	Yonggwang units 1 and 2	Uljin units 1 and 2	Yonggwang units 3 and 4
Capacity (MW)		587	650	678.7	950 × 2	950 × 2	950 × 2	950 × 2
Reactor type		PWR	PWR	PHWR	PWR	PWR	PWR	PWR
Construction period		1971/3–1978/4 (85 months)	1977/3–1983/7 (76 months)	1977/5–1983/4 (71 months)	Unit 3: 1979/4–1985/9 (77 months) Unit 4: 1979/4–1986/4 (84 months)	Unit 1: 1980/3–1986/8 (77 months) Unit 2: 1980/3–1987/6 (87 months)	Unit 1: 1981/1–1988/9 (92 months) Unit 2: 1981/1–1989/9 (104 months)	Unit 3: 1989/6–1995/3 (70 months) Unit 4: 1989/6–1996/3 (82 months)
SUPPLIERS	Reactor	Westinghouse (USA)	Westinghouse (USA)	AECL (Canada)	Westinghouse (USA)	Westinghouse (USA)	Framatome (France)	KHIC (Rep. of Korea) Combustion Engineering (USA)
	Turbine/ generator	GEC (UK)	GEC (UK)	Parsons (UK and Canada)	GEC (UK)	Westinghouse (USA)	Alsthom (France)	KHIC (Rep. of Korea) GE (USA)
	Architect-engineer	Westinghouse (USA)	Westinghouse / GEC	AECL	Bechtel (USA)	Bechtel (USA)	Framatome-Alsthom	KOPEC (Rep. of Korea) Sargent & Lundy (USA)
Project management method		Turnkey	Turnkey	Turnkey	Non-turnkey	Non-turnkey	Non-turnkey	Non-turnkey
Rate of localization		—	—	14%	33.2%	34.8%	40.15%	74%

Nuclear power plants	Kori unit 1	Kori unit 2	Wolsong unit 1	Kori units 3 and 4	Yonggwang units 1 and 2	Uljin units 1 and 2	Yonggwang units 3 and 4
Lenders of foreign Loans	Westinghouse (USA) EXIM (USA) Bank of America (USA) EEW (UK) Lazards (UK)	EXIM (USA) PEFCO (USA) Lazards (UK)	EDC (Canada) Hambros Bank (UK) Royal Bank (Canada) Lazards (UK)	EXIM (USA) Lazards (UK) CMAL (Hong Kong) Sanwa (Hong Kong)	EXIM (USA) PEFCO (USA) CMB (USA)	BFCE (France) Cogéma (France) Lloyds Bank (USA)	Banker's Trust (USA), etc.
Total investment[a] US $ (× million) % local portion	299 (41.9%)	988 (45.3%)	1094 (45.6%)	2458 (53.7%)	2598 (59.1%)	2582 (54.0%)	3100 (83.6%)

Note: Local participants — Hyundai Construction Co. Ltd, Dong-A Construction Co. Ltd, Youyang Nuclear Co. Ltd, Korea Inspection Development Co. Ltd., Korea Heavy Industries and Construction Co. Ltd, Korea Power Engineering Co. Ltd.

[a] Investment amounts are converted using an average exchange rate.

foreign sources: the US EXIM, Westinghouse, Bank of America, Lazards in the UK, and EEW, also in the UK. The actual terms and conditions of the loans are summarized below:

Lender	Loan amount (US $ × 1000)	Grace period (years)	Repayment period (years)	Interest rate (% per annum)
US EXIM (1970-6-24; 1970-12-14)	48 955	6–8	2–12	6
Westinghouse (1970-06-24)	16 244	5.5–8	0.5–12	6–8.5
Bank of America (1970-12-08)	1 326	4.5	2–7	Prime + 2.25
Lazards (1970-12-01)	60 686	5.5	4.5–11.5	5.5
EEW (1970-06-24)	3 213	5	2 (one shot)	9
Lazards (No. 1: 1974-10-22)	21 200	2.5	3.5	LIBOR[a] + 1.75
Lazards (No. 2: 1976-11-09)	6 000	1.5	3.5	LIBOR[a] + 2
Total	157 624			

[a] LIBOR: London Interbank Offered Rate.

The commercial loan from the BOA had to be repaid in a shorter period and limited commercial financing was available for this nuclear power project.

In the Republic of Korea, two other nuclear power projects, Kori No. 2 (a 650 MW(e) PWR) and Wolsong No. 1 (a 679 MW(e) PHWR) were implemented on a turnkey basis, following the Kori No. 1 project. The Korea Electric Power Corporation sought to play a significant role in the project implementation of the Republic of Korea's fifth and sixth nuclear power units, i.e. Kori Nos 3 and 4 (2 × 950 MW(e) PWRs). This project was implemented on a non-turnkey basis, using a conventional financing approach.

At the project formulation stage, the foreign component of financing for the project was estimated at US $1322 million in principal, while the local component amounted to $811 million. The anticipated debt was:

Principal:	$1322 million
Interest:	$891 million
Total:	$2213 million

For this project, the Parliament of the Republic of Korea agreed to appropriate $2815 million, equivalent to the principal of $1373 million, plus interest of $1442 million (interest rate between 9% and LIBOR + 2% per annum).

The project construction periods foreseen at the project formulation stage were:

For Kori No. 3: January 1978 to September 1984
For Kori No. 4: January 1978 to September 1985.

In September 1977, the Economic Planning Board of the Republic of Korea decided that Kori Nos 3 and 4 were priority projects for seeking US EXIM export credits, and preliminary consultations for the export credit contract began between KEPCO and the US EXIM. In November 1977, the 98th Parliament of the Republic of Korea agreed to introduce a public loan for financing the project. Negotiations between KEPCO and the US EXIM by the end of January 1978 on the terms of this loan resulted in agreement for payments to be made in 30 semi-annual installments, at an interest rate of 8.375% per annum. The United States Congress approved the US EXIM's export credit to be offered to the Kori project in June 1978, immediately followed by final approval by the US EXIM of this export credit facility for the construction of the Republic of Korea's fifth and sixth nuclear power units. The contract was approved by the Government in November 1978 and the loan became effective in February 1979. Actual construction of Kori Nos 3 and 4 started in April 1979.

Contract negotiations between KEPCO and Lazards lasted for five months and the contract was approved by the Government in November 1978. The loan became effective in February 1979 at an interest rate of 7% per annum and included 30 semi-annual installments.

In December 1977, the Korea Exchange Bank (KEB) proposed seeking loans from foreign commercial banks because KEPCO had little experience in managing such matters. However, KEPCO decided to handle the commercial loan arrangements itself in May 1978 and initiated direct consultations for a commercial loan from the Hong Kong based bank Chase Manhattan Asia Limited (CMAL). This bank had worked as the agent of a syndicate since June 1978, and the Ministry of Finance of the Republic of Korea orally agreed with KEPCO on this approach. At the end of June 1978, KEPCO issued a mandate letter to CMAL to form a syndicate. Before August 1978, a syndicate for US $400 million was formed comprising 40 commercial banks.

The foreign components for the Kori Nos 3 and 4 project are summarized as follows:

Lender	Loan amount (US $ × 1000)	Grace period (years)	Repayment period (years)	Interest rate (% per annum)
US EXIM	829 685	7	15	8.375
Private Export Funding Corporation (PEFCO)				8.25
Lazards	92 059	7	15	7
CMAL	400 000	4	6	LIBOR + 1
Total	1 321 744			

The loan commenced in February 1979, upon approval by the Government in November 1978. Construction work began in April 1979 and was completed in September 1985 for Kori No. 3, and in April 1986 for Kori No. 4, almost within the planned periods.

From this discussion it can be seen that even in the Republic of Korea, one of the most vigorous developing countries in the world at that time, public financing arrangements were the main sources of funding for nuclear power projects, with commercial loans providing supplemental financing only. The creditworthiness of KEPCO, a single state owned utility at that time, facilitated these financing arrangements. However, in the case of developing countries with higher risk factors, there may be no other alternative but to apply for a sovereign borrowing arrangement.

5.4.3. **Present financing of a project under construction** [34]

The financing of an ongoing project, Yonggwang Nos 3 and 4, is proceeding in a quite different financing climate and has different aspects. This project involves the construction of two 950 MW(e) PWR units at Gyaema-Ri, on the southwestern coast of the Republic of Korea, and the units are scheduled to be completed in 1995 and 1996, respectively.

The Government has assumed control of the country's nuclear power programme, with foreign companies serving as subcontractors to local firms. Yonggwang Nos 3 and 4 is the first nuclear power project in the country to be implemented on a component basis by local prime contractors and KEPCO, responsible for procurement as the owner, has designated the Korea Heavy Industries and

Construction Company Ltd (KHIC) as the prime contractor for the supply of the nuclear steam supply system (NSSS) and turbine/generator (T/G), and the Korea Power Engineering Company Ltd (KOPEC) for engineering services, while the Korea Atomic Energy Research Institute (KAERI) will also work on the NSSS system design. The Korea Electric Power Corporation and local contractors solicited bids from selected firms for the supply of the above mentioned services. The successful bidders for each package are as follows:

NSSS: Combustion Engineering Corporation (CE), USA;
T/G: General Electric Corporation (GE), USA;
Architect-engineering (AE): Sargent & Lundy (S&L), USA.

Through this ambitious component approach, KEPCO is responsible for all aspects of project management, engineering and design of the plants, procurement of equipment and materials, construction management, installation, pre-operational testing, startup and quality assurance, with necessary assistance from S&L, KOPEC, GE, KAERI and KHIC. While this approach will reduce costs, local manufacturers will have to bear a very large responsibility.

Major equipment, such as the NSSS and T/G, has been purchased on a fixed price basis. Construction is being carried out on the basis of competitive bids, fixed prices and reimbursable subcontracts.

In the early stage of the project formulation in 1986, KEPCO considered a conventional financing approach, such as supplier's credits and commercial loans. However, as shown in Table XX [34], the financing conditions were not attractive to KEPCO in view of market conditions, which favoured borrowers at that time. On the basis of its own creditworthiness, KEPCO decided to take advantage of the availability and relatively low cost of dollar denominated borrowings to raise funds in other markets.

At the beginning of the project, KEPCO assumed that foreign BOP procurement would amount to approximately US $200 million equivalent, while the estimated project cost would be $3100 million in total, of which local financing would cover $2400 million equivalent, funded mainly by KEPCO's equity capital. Of the foreign cost portion, 85% (some $700 million) would be funded through commercial sources in accordance with the actual progress of plant construction. The Korea Electric Power Corporation assumed responsibility for fund raising for the foreign cost portion, amounting to $700 million from 1987 to 1996. However, KEPCO's capability for self-financing using its own equity capital has increased in recent years (1986–1990) because of its strong financial performance. During the period 1986–1990, fixed assets, constituting over 90% of KEPCO's total assets, did not increase significantly owing to the fact that during the latter half of the 1980s, KEPCO was criticized for its high capacity reserve ratios (about 70% in 1987) and thus decided to defer power plant construction in the following years.

TABLE XX. COMPARISON OF FINANCING TERMS OF VARIOUS SOURCES IN 1986 FOR THE REPUBLIC OF KOREA [34]

Conditions \ Sources	Export credit (US EXIM)	Commercial loan	Bond	International finance	PEFCO with guarantee
Interest rate (% p.a.)	Fixed: 9.75 Fixed (fuel): 9.25	Floating: LIBOR + 1/8 ~ 1/2 Fixed: 8–8.2	Floating: LIBOR + (3–5)/8 Fixed: 8–8.5	8–9 (floating)	Floating: TR[a] + 1 Fixed: 8.5–9
Grace period (years)	7–10	4–6	5–10	3–10	5–10
Repayment period (years)	Equipment and service: 15 Nuclear fuel: 4	4–6	—	10–15	Same as EXIM
Fees (%)	Application fee: 2 Commission fee: 1/2	Management fee: 1/2–1 Commission fee: 1/2 Agent fee: US $10 000/a	2	Commission fee: 1/2–3/4	Guarantee fee: 1/2 Commission fee: 1/2 + 1/8

[a] TR: Treasury bond rate.

In the meantime, continued low fuel costs translated into large cash flow generation for KEPCO, despite the fact that tariffs were continuously lowered during the period. This had two major consequences for the liabilities side of KEPCO's balance sheet: it was able to rapidly prepay a large portion of its long term debt (a decrease from Won 4 737 000 million in 1986 to Won 2 702 000 million in 1990). Its equity capital greatly increased from large retained earnings — which included unappropriated retained earnings, legal reserves and reserves for business expansion — increasing from Won 4 671 000 million in 1986 to Won 7 568 000 million in 1990.

Consequently, KEPCO's leverage and coverage ratios were strong during the period. The ratio of total liability to total equity was 169.1% in 1986 and decreased down to 82.9% in 1990.

Under these circumstances, KEPCO's cash flow was unexpectedly strong, and it decided to reduce the scheduled external funding programme to $100 million through a commercial syndicated loan by Banker's Trust Company. The terms and conditions of the loan for $100 million are as follows:

Interest rate: LIBOR − 1.25%,
Grace period: 5 years,
Repayment period: 5 years,
Lenders: Banker's Trust Company for $25 million and ten other banks,
Contract date: 10 June 1987.

5.4.4. Experience of the Republic of Korea — Implications

The Republic of Korea 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 nuclear power programme has been developed in the Five Year Plans that the Government updates each year.

The Government's strong commitment to the nuclear power programme resulted in favourable conditions for KEPCO to manage the programme and promote increasing levels of national participation in successive nuclear power projects. This has led to a steady increase in local financing of the local cost component of these projects.

The project financing approach was not considered from the beginning. The Korea Electric Power Corporation depended mainly on public sources for the financing. Private financing sources from commercial banks that could be arranged by KEPCO in the early stages of its nuclear power programme constituted only a small portion of the total, and involved shorter repayment periods with higher interest rates than financing from public sources.

The Republic of Korea was able to acquire a US $400 million loan from commercial banks, for the nation's fifth and sixth units (i.e. Kori Nos 3 and 4). The Korea Electric Power Corporation, which was partially privatized in 1989, was a sovereign borrower guaranteed by the Government, which made the earlier financing arrangements possible. For less creditworthy developing countries, these kinds of financing arrangements would have been very difficult to achieve.

After its recent privatization, KEPCO has been made responsible for managing all financing arrangements, based on its own creditworthiness. As an independent private sector corporation, KEPCO will have to incorporate into its management policy the maintenance of corporate financial strength and the improvement of its financial constitution.

5.5. GUANGDONG NUCLEAR POWER PROJECT [35–37]

5.5.1. Description of the project

5.5.1.1. Background and history

In 1978, China, after considering nuclear energy as a strategic choice, decided to import the necessary technology and equipment for nuclear power plants. The former Ministry of Water Resources and Electric Power negotiated with Framatome over the construction of a 2 × 900 MW PWR nuclear power plant in Sunan. Although an agreement was nearly reached, the project was cancelled in 1979 because of financing difficulties. After this, the Ministry discussed with Guangdong Province the possibility of building a 2 × 900 MW PWR power plant jointly with Hong Kong (United Kingdom). In 1979, an agreement was reached to prepare a feasibility study to build a nuclear power plant in Guangdong Province. This province, and more particularly the site of Daya Bay, was chosen because of its spectacular industrial growth and its proximity to the Shenzhen Special Economic Zone and to Hong Kong.

In 1978, Banque Nationale de Paris was appointed as lead manager by China for the financing of the French contract(s) of the project, which was defined as the construction of a 2 × 900 MW(e) nuclear power station [38].

The Chinese National Planning Committee reviewed the feasibility study of the Guangdong nuclear power project in 1981 jointly with ten other relevant ministries and committees and, after careful consideration, the Government of China approved this feasibility study report in December 1982. In the same year, the former Ministry of Water Resources and Electric Power made contact with Framatome for the nuclear part and with the General Electric Company (GEC) (UK) and Alsthom (France) for the conventional part (turbines) of the nuclear power plant.

The Hong Kong Government assigned an independent consulting firm to review this feasibility study and, based on the results of the review, announced in January 1985 that it would not be opposed to the possible participation of Hong Kong investors in the Guangdong nuclear power project. During the course of these developments in 1983, a co-operation agreement on nuclear power was signed between the Chinese and French Governments.

On 18 January 1985, the Guangdong Nuclear Power Joint Venture Company (GNPJVC) was established to carry out the project. It was set up as a joint venture between the Guangdong Nuclear Investment Company Ltd (GNIC) for Guangdong Province and the Hong Kong Nuclear Investment Company Ltd (HKNIC), which is a 100% subsidiary of China Light and Power Company, a major public utility in Hong Kong. The nuclear power development plan in China is summarized in Table XXI.

TABLE XXI. NUCLEAR POWER DEVELOPMENT PLAN IN CHINA (AS OF MAY 1992)

Plant name	Reactor type	Current status	Financing
Qinshan-1	300 MW PWR	Planned operation in 1992, domestically developed	Total cost financed by Government
Qinshan-2	2 × 300 MW PWRs	Under preparation for construction Planned operation before 2000	Government planned project
Daya Bay 1 Daya Bay 2	900 MW PWR 900 MW PWR	Planned operation in 1993 (made by Framatome (partially GEC)) Planned operation in 1994	Total investment cost of US $3.48 billion (75% by China and 25% by Hong Kong)
Guangdong-II	2 × 1000 MW PWRs	Project is officially planned to be established in 1992 or 1993.	To be totally financed by Guangdong Province
Qinshan, 2nd programme	2 × 600 MW PWRs	State, Zhejiang Province and Shanghai Municipality will share required investment	
Dalian Point in Liaoning Province	2 × 1000 MW PWRs	Plan to import from former USSR has been suspended due to change in political status in that country	

5.5.1.2. The joint venture company

The GNPJVC is managed by a board of directors, which consists of 12 members appointed by GNIC and five other members appointed by HKNIC.

The equity of GNPJVC is owned 75% by GNIC and 25% by HKNIC. Total construction costs were estimated at US $4000 million, of which the sum of US $400 million was self-financed by the cash flow of GNPJVC, with the rest to be loaned by the Bank of China.

Implementation of the joint venture began on the day permission to operate was given to the GNPJVC and will expire after 20 years of operation of the second reactor at the Guangdong nuclear power station. The specific site selected for the Guangdong power plant was Dakeng Village, by Daya Bay in Guangdong Province. This

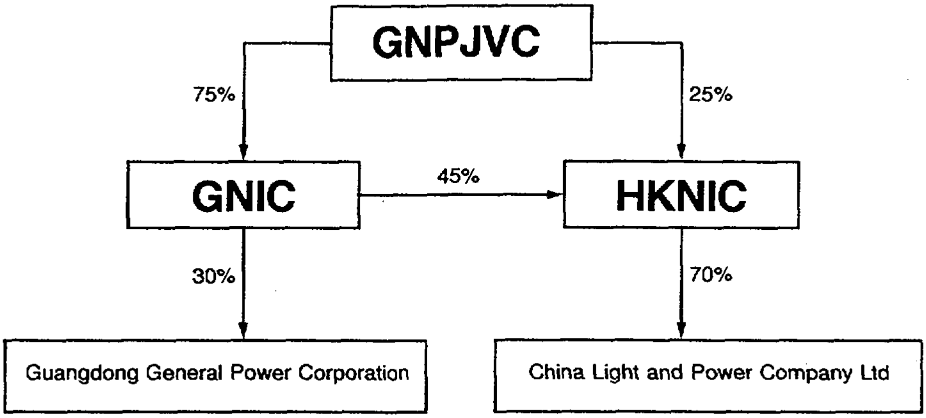


FIG. 11. Share of electricity generated at the Guangdong nuclear power station [37].

village is located about 50 km from Hong Kong and 45 km from Shenzhen City. The first plant is planned to start operation in the latter half of 1993 and the second plant is planned to commence operation in 1994.

Electricity generated at the Guangdong nuclear power station will be sold to GNIC and HKNIC in proportion to their equities, i.e. 75% of the total electricity produced is to be sold to GNIC and 25% to HKNIC. The GNIC will sell part (equivalent to 45% of total electricity produced) of its share of the generated electricity to HKNIC. Consequently some 70% of the total power production at the Guangdong nuclear power station will be exported to Hong Kong through China Light and Power, thus providing for the repayment of the foreign loans (Fig. 11, Ref. [37]).

5.5.1.3. Main contractors

China utilized PWR technology and imported reactors from the French firm Framatome for this project. The conventional part of the project, such as turbine generators, was supplied by GEC (UK). Eléctricité de France (EdF) was given the responsibility for all technical matters, including the basic plant design, construction and commissioning. Framatome supplied the 2 × 900 MW(e) nuclear islands, the initial fuel loads for the two reactors and the first reload for the first reactor.

The main contracts as well as the financing agreement were signed between the joint venture and the foreign suppliers on 23 September 1986. The main guidelines of the French financing were set forth in December 1986 in two 'Memoranda of Understanding' between the French and Chinese Governments. The Bank of China was officially appointed as borrower with the function of passing on the costs and credit conditions to the GNPJVC [38].

5.5.2. Financing for the Guangdong project

Since it was expected at an early stage of project development that China would import plant and equipment from France and the United Kingdom, the main points of negotiation among the parties were prices and the terms and conditions for foreign loans. Originally, there had been plans for another project, the Sunan project to be sited in Huadong region, south of Jiangsu Province, for which nuclear power plants would be imported. However, owing to the deterioration in China's foreign exchange reserves, it was decided that the Guangdong nuclear power project would be the first and last such project based on imported plants. It took a very long time for the parties involved to negotiate the prices and terms of the loans for the Guangdong project, one of the causes for the ensuing delays.

After almost seven years of negotiations between China, France and the United Kingdom, an agreement was reached on 23 September 1986 for the financing of US $4000 million for the project. As mentioned earlier, the GNIC holds 75% of the equity in the project and HKNIC holds 25%. The budget for the project was $4000 million, of which $400 million was in equity; the balance would be financed by export credits and commercial loans through the Bank of China.

For the export of turbine generators from GEC, the UK ECGD provided an export credit. Midland Bank, which was appointed as covenanter, was the agent for this project's financing. For the exports of reactors from Framatome, export credit was facilitated by BFCE, with export insurance provided by COFACE.

Two syndicates were finally agreed upon. The lead banks in the UK and French consortiums were Midland Bank and Banque Nationale de Paris, respectively. Interest rates for these syndicates were both 7.40% per annum with the following conditions:

(a) *Repayment period:* Ten and 15 years after commercial operation (for capitalized interest and principal, respectively);
(b) *Availability period:* Seven years.

In the UK, ten banks participated in the consortium for a total of UK £420 million guaranteed by the UK ECGD:

— *Managing banks*: Midland Bank, Barclays Bank, Lloyds Merchant Bank, National Westminster Bank, J. Henry Schroder Wagg, Morgen Grenfell.
— *Participating banks:* Bank of Scotland, Kleinwort Benson, Standard Chartered Merchant Bank, Royal Bank of Scotland.

In France, seven banks syndicated a loan totalling F.Fr. 13 000 million (or some US $2000 million at that time) backed by BFCE, as follows: Banque Nationale de Paris (BNP), Credit Lyonnais, Societe Generale, Banque Paribas, Banque de l'Union Europeenne, BFCE, Banque Indosuez.

Specifically, a French export credit line of F.Fr. 13 145 million (or US $2000 million at that time) was set up for the financing of [38]:

— Eighty five per cent of the French part of the two main contracts (EdF and Framatome),
— Eighty five per cent of the various orders in these contracts,
— Eighty five per cent of the contracts for the BOP,
— Eighty five per cent of the local part up to a maximum amount of 15% of the main contracts,
— One hundred per cent of the interest of the financing described here during the construction period (84 months).

Moreover, according to the OECD Consensus, this credit line is reimbursable in 30 semi-annual installments for the principal and in 20 semi-annual installments for the interest capitalized during the construction period. The OECD Consensus rate at that time was 7.4% per annum. The United Kingdom provided the same conditions for the financing of the conventional part of the project [38].

5.5.3. Additional contracts and their financing [38]

Following the conclusion of the main supply contracts with Framatome and GEC–Alsthom and the project services contract with EdF, contracts for civil works and for the erection of nuclear equipment, the conventional part and the BOP were placed as described below.

(a) *Civil works contract.* In June 1987, the civil works contract was signed with HCCM, a consortium of companies from China and other countries comprising:

— The French company Campenon Bernard (40%);
— Two Chinese companies, Hua Xing and Second Bureau of China's Construction Corporation (33%);
— A Japanese company, Maeda (27%)

Since one of the rules of the French buyer's credit is to pay the French supplier directly through such a credit, and since Campenon Bernard's share in the contract was higher than its share in the joint venture, France was obliged to find a legal solution acceptable to COFACE, the French export credit insurer.

(b) *Erection contract for the nuclear island.* This contract was signed in January 1988 with the French consortium Framatome Spie Batignolles.

The financing of the French part of these two contracts was made through a conventional buyer's credit, without any reference to the OECD Consensus. The conditions were:

— *Reimbursement*: Twenty equal installments of principal;
— *Rate*: OECD consensus rate;
— *Capitalization of interest*: No.

According to BNP, the French Government, which refused to include the favourable conditions of the OECD Consensus on export credits in these two contracts, would certainly have provided such conditions if they had been agreed upon at the time the main contracts were signed.

(c) *Erection contract for the conventional turbine generator equipment.* Under intense competition from foreign bidders, the Shandong Electric Power Corporation (SEPC) of China was awarded the conventional island erection contract. This company engaged GEC–Alsthom as technical advisor and subcontractor, which is supported by the financing arrangement for the local costs of this project by British Nuclear Credit.

(d) *Erection contract for BOP.* This contract was offered to the North-East Electric Power Corporation (NEPC) of China, which engaged the Bechtel Corporation of the USA as technical advisor on quality assurance and other technical aspects. The contract is paid for by GNPJVC from its working capital.

5.5.4. Features of Chinese nuclear power development

While China has put a priority on hydro and coal fired power plants for developing electricity power sources, it has also placed importance on developing nuclear power in response to the growth in electricity demand because of the:

— Existence of relatively rich uranium resources in the country,
— Possession of a fairly advanced nuclear engineering capability and relevant technologies through nuclear weapons development,
— Necessity for nuclear power to play a complementary role in the rapidly developing and energy hungry coastal areas, where constraints on long distance coal transportation and electricity transmission exist.

In China, two nuclear power projects are currently under way: the construction of the Qinshan nuclear power plant (300 MW(e) PWR, near Shanghai, full power operation in 1992) and the Guangdong Daya Bay nuclear power station (2 × 900 MW(e) PWRs, planned for start of operation in 1993–1994). These projects provide a contrast in the sense that the Qinshan nuclear power project is an R&D achievement in line with a 'self-reliance' policy, whereas the Guangdong project started as a measure to supply electricity as well as to facilitate technology transfer to China in the form of co-operation with Hong Kong, which has a substantial scope for growth in electricity consumption.

In January 1986, Chinese nuclear development activities were unified under the management of the Ministry of Nuclear Industry. Previously, there was independent dual promotion of nuclear power development by the Ministry of Nuclear Industry and the Ministry of Water Resources and Electric Power. China has promoted the active development of nuclear power so that the importance of the Guangdong nuclear power project within the nuclear power programme continues to be emphasized, since the project would provide it with experience and expertise in advanced technologies from industrialized countries.

The main features of the Guangdong project are:

— The project is based on a policy of importing from foreign suppliers.
— Seventy per cent of the net electricity generated is to be sold to Hong Kong 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 with 17 foreign banks (seven French and ten British). It was a difficult task to resolve the important problems of the security arrangements and loan guarantees; this is reflected by the seven years needed to negotiate the contract and the placing of an order with a supplier which up to then had no experience in manufacturing a full speed 900 MW turbine.

In the contracts with Framatome, EdF and GEC-Alsthom, one of the main features is arrangements for technology transfer to China. In the course of various phases of the Guangdong project, such as design, manufacturing, site works, including civil and building works and equipment installation works, testing and inspections and safety analysis, Chinese engineers are to participate in certain activities, for example design and safety analysis in France, and they will be trained in O&M tasks, as well as in equipment manufacturing. The French partners have responded favourably to requests from China, agreeing on the following allocation of responsibilities: EdF for project management, engineering and safety analysis and Framatome for nuclear island matters. This method of achieving fundamental technology transfer will be important in future nuclear and other projects.

5.6. FINANCING THE ANGRA NUCLEAR POWER PLANT IN BRAZIL

Although 98% of total electricity in Brazil is generated by hydropower, the costs of this power source have been increasing, while the sites are becoming more and more distant from electricity consuming centres. Environmental protection concerns have become another important issue in power planning and development. In addition, Brazil has a policy aimed at diversifying its electric power sources, away from a heavy dependency on hydropower. As a result of this policy and these power development circumstances, Brazil began construction of its first nuclear power plant in 1972.

This first power plant was constructed by Furnas Centrais Eletricas SA, which is a subsidiary company of the Government owned ELETROBRAS (the Brazilian public electric sector holding company), specializing in bulk electricity generation. Furnas is also responsible for the construction of the Angra units 2 and 3. Engineering, co-ordination of local participation and construction management is carried out by NUCLEN, a subsidiary company of ELETROBRAS.

5.6.1. The Angra 1 nuclear power plant [39]

Furnas ordered the first, second and third nuclear power plants because the planned site for these reactors was within its area of responsibility, and also because nuclear power plant construction was to be pursued by a Government owned firm with financing from the national budget and foreign loans guaranteed by the Government.

Construction of the Angra 1 nuclear power project (a 657 MW(e) PWR) started in 1972 and commercial operation began in 1984. The loans amounted to US $1117 million, of which $371 million were supplied from foreign sources and $746 million provided domestically (Table XXII) [39]. Locally financed funds were used for construction work, while the internationally financed portion was used to cover foreign equipment and engineering costs. Comparing various nuclear power plant construction activities in the 1970s, the construction period was exceptionally long and the magnitude of the investment for Angra 1 was exceptionally large.

TABLE XXII. LOANS FOR THE CONSTRUCTION OF ANGRA UNIT 1 [39]
(amounts in millions of US dollars; amounts in square brackets are in millions of South African rand)

Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1989	1980	Total
Local	1.75	2.8	112.7	8.1	8.1	98.9		86.2	192.4	234.9		745.85
Foreign loans			138.0	[2.4]			34.6 [2.0]		49.0		149.7	371.3
Total	1.75	2.8	250.7	8.1 [2.4]	8.1	98.9	34.6 [2.0]	86.2	241.4	234.9	149.7	1117.15 [4.4]

Note: South African currency was used to finance the acquisition of uranium concentrate (U_3O_8), which was purchased from South Africa for the first fuel load.

In addition to the financing for plant construction, Furnas received a loan from the uranium supplier, South Africa, of Rand 4.4 million (then about $3.74 million) for purchasing the first fuel load.

5.6.1.1. International financing for Angra 1

International financing continued from 1972 to 1980. The US EXIM provided four financing arrangements for Angra 1 during these nine years.

In 1972, US $138 million were loaned by EXIM — $128 million were spent on construction and $10 million on fuel fabrication. The loan maturity was set at 15 years, starting on 1 February 1978, with an interest rate of 7.5% per annum (7% plus a fee of 0.5%). This was the largest loan which Furnas received at that time.

In 1973, Rand 2.4 million (approximately $2 million) were loaned by the Industrial Development Corporation of South Africa Ltd. The terms of repayment were 2.5 years starting from 1978, with an interest rate of 6.25% per annum.

In 1976, the South African Industrial Development Corporation's loan was increased to Rand 4.4 million and the difference from the previous loan of Rand 2 million was lent by this corporation. Furnas used this to purchase UF_6 from NUFCOR of South Africa. Enrichment services were contracted from what was then the United States Atomic Energy Commission. Also in 1976, additional loans were obtained from a consortium, constituting the US EXIM, PEFCO and Morgan Guaranty Trust Company (N.Y.), amounting to $34.6 million. Of this loan, 50% came from the EXIM and the rest equally from the other two members of the consortium. The repayment term was 15 years, from 1978 to 1993. The interest rate was to be settled between 7.5% per annum, and a rate which is 1.75% higher than a minimum commercial lending rate (MCLR).

In 1978, $49 million were loaned by a consortium consisting of the US EXIM and Morgan Guaranty Trust Company, and also independently by Morgan Guaranty Trust. The conditions were as follows:

	Consortium	Morgan Guaranty Trust Co.
Loan (US dollars)	33.15 million	15.85 million
Maturity	1979–1993	1979–1988
Interest rate	5.5–8.985% per annum	(i) MCLR plus 1.0% per annum (ii) Credit supplier's prime rate plus 1.75% per annum

In 1980, $149.7 million were loaned by an EXIM led consortium. This amount was then on-lent to Furnas by ELETROBRAS, a parent company of Furnas. The sum of $51 million came from a consortium in which the EXIM share was $24 million, PEFCO $12 million and Bankers Trust Co. $15 million. The rest of the 1980 loan, $98.7 million, came from a part of the loan acquired from abroad by ELETROBRAS. The EXIM's conditions are repayment from 1981 to 1993 at an interest rate of 6.0–9.5% per annum.

In 1985, a further contract with EXIM was signed for $59.3 million for improvements to the plant. For repairing the electrical generator of Angra 1 and related services carried out by Siemens/Kraftwerk Union (KWU), financing contracts were signed in 1988 with Ausfuhrkredit Gesellschaft mbH (AKA) in the amount of DM 4.25 million and with the Kreditanstalt für Wiederaufbau (KfW) for DM 4.25 million.

5.6.1.2. Local financing for Angra 1

Local financing continued from 1970 to 1979. During these years, national loans were provided mainly by ELETROBRAS and the Brazilian National Treasury.

In 1970, ELETROBRAS loaned $1.75 million for Angra 1. The site for the plant was selected in 1970, so that Furnas spent this loan for basic construction work, such as site preparation, improvement and widening of roads, building an airport for small aircraft, construction of substations, geological and land surveys and workhouse construction.

In 1971, $2.6 million, or 4.8% of the 1971 borrowing from ELETROBRAS, were used for continuing basic construction work. The rest went for the construction of hydro and thermal power plants. Furnas spent $0.2 million of its own money in addition to $2.6 million for basic construction work for Angra 1. In the same year, selection was made of a 657 MW(e) PWR from Westinghouse. Negotiations for acquiring funds from the EXIM were successfully concluded.

In 1972, $112.7 million, or 66% of the sum lent by ELETROBRAS, were applied to the construction of Angra 1. In 1973, ELETROBRAS lent $8.1 million to Furnas. In 1974, the Comissão Nacional de Energia Nuclear, the Brazilian Nuclear Energy Commission, donated $8.1 million. In 1975, $90 million were borrowed from ELETROBRAS and $8.9 million from FINAME, Brazil's lending organization for purchasing machinery. In 1977, $86.2 million were lent, of which $76.3 million came from ELETROBRAS and $9.9 million from FINAME. In 1978, $185.9 million were loaned by ELETROBRAS and $6.5 million were appropriated by the Brazilian National Treasury. In 1979, ELETROBRAS provided $231.1 million and the Brazilian National Treasury appropriated $3.8 million.

5.6.1.3. Current situation of Angra 1

Angra 1 is currently operating, and Angra units 2 and 3 are under construction. Construction of Angra 1 started in 1972 under a turnkey contract with Westinghouse, and achieved first criticality in 1982. However, it encountered many technical problems that delayed commercial operation until January 1985. Even after achieving full power operation, it encountered difficulties, including a lawsuit on its emergency preparedness, financial problems, extensive repairs to the electric generator and modifications to the steam generators. These resulted in a 16 month shutdown, from June 1987 to April 1988. Furnas has sued Westinghouse, claiming tens of millions of dollars in damages for poor workmanship; the case remains unsettled [40].

In 1989, during a refuelling outage, and on a petition from local Green Party politicians, a lower court judge barred the restarting of the plant on the grounds that its emergency preparedness was inadequate. However, three months later, a higher court ruled that Angra 1 could be restarted.

With such a problem filled history, the cumulative capacity factor of Angra 1 remained at a low 20.1%. Operational Safety Review Teams from the IAEA have been invited twice and the plant received a favourable report. After the repair of the electric generator, the availability factor increased to 40.6% during 1990.

5.6.2. Angra units 2 and 3

In 1974, Brazil decided not to sign a turnkey contract for the construction of more nuclear power plants. In 1975, it signed a nuclear co-operation agreement with the then Federal Republic of Germany, which not only included eight nuclear power units, but also technology transfer for fuel cycle activities, such as enrichment and reprocessing.

Brazil currently has under construction two nuclear power units (Angra units 2 and 3; 2 × 1325 MW(e) PWRs) totalling 2.5 GW(e) under construction. For these units, KfW has provided half of the Hermes credit insured financing; the other half is from a syndicate of German commercial banks. In 1976, DM 4270 million were lent from three financial institutions:

(1)	Kreditanstalt für Wiederaufbau (KfW):	DM 1850 million
(2)	A German syndicate led by Dresdner Bank AG:	DM 1850 million
(3)	Compagnie Luxembourgeoise de Banque AA:	DM 570 million
	Total	DM 4270 million

Loans 1 and 2 stipulated 14 years for repayment, from 1984 to 1997. Loan 3 had a six year repayment period, from 1979 to 1984. Internal financing was obtained through onlending by ELETROBRAS to the Angra units 2 and 3 project, FINAME loans, FINEP loans, Caixa Economica Federal (Federal Savings Bank) loans and Brazilian National Treasury appropriations up to 1980, for a total of some US $1000 million [39].

However, because of financial difficulties, the construction work is currently behind schedule. By December 1991, about 90% of the erection of the buildings in unit 2 was completed. Just 2% of civil engineering works in unit 3 was completed. The 1325 MW(e) Angra 2, which was originally planned to start operation by 1993, is now expected to start operation in May 1998 because of construction delays. The foreign equipment and engineering services are supplied by Siemens/KWU. The Brazilian Congress authorized Furnas to invest $200 million in the Angra plants during 1990, and the 1990 budgeted funds are to be used for equipment installation. Hard currency financing for Angra 2 is assured by loans of the Dresdner Bank/KfW. However, they are insufficient for Angra 3 and an additional contract may have to be negotiated.

According to the Brazilian National Energy Expansion Plan (Plan 2010), there were to be seven nuclear power units in operation by the year 2010. However, because of financial difficulties, Brazil has had to constrain public investment substantially and the plan is now under review (Plan 2015).

5.6.3. Implication of the delays [32]

There are many reasons for the delays in the Brazilian nuclear power programme, in particular with respect to Angra units 2 and 3. The selection of the site initially caused problems and the construction permit procedure went on, for political reasons, for so long that there was an almost total suspension of construction work for three years. Apart from these reasons, there was a drastic change in the financial position of Brazil, which was severely handicapped by the debt crisis, such that after several years foreign currency loans to cover local costs could no longer be raised. Furthermore, 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 of time.

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, the delays in project execution normally resulted in higher delivery prices because of price escalation clauses, the fixed price part of contracts, fixed site and infrastructure costs, 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 would soar; on the other hand, there have been no increases in the delivery prices apart from extra costs for the storage and preservation of components.

The export financing community has responded to all of these problems in a very flexible manner. The KfW and German commercial banks have extended supplemental loans and have repeatedly postponed the deadlines for the start of amortization payments. These steps were taken with the approval of, and in co-operation with, the official German credit insurer, Hermes.

In the case of Angra units 2 and 3, KfW has concluded more than ten amendments to the various loan agreements. This was necessary not only because of the delays, but also because of several institutional changes made by the borrower which occurred during this very extended implementation period. As a result, amendments were also needed for the payment guarantees and the disbursement arrangements. New legal opinions were also required. All of these involved much extra and costly work.

In general, delays in the execution of a project lead to an increase in investment costs, in particular because of additional interest payments during construction. From the financing aspect, the situation has been considerably aggravated by opposition to nuclear power in general, and also by adverse public opinion in some countries which are planning or implementing nuclear power programmes. This has also contributed to the reluctance of the governments concerned to make scarce budget funds available, causing further delays in decisions on and implementation of these programmes, with concomitant cost increases.

5.7. EXPORT FINANCING FOR NUCLEAR POWER PROJECTS [41]

Present financing for nuclear power projects in developing countries is limited primarily to export credits, commercial bank loans and supplier credits. One of the annexes of the OECD Consensus, entitled 'Sector Understanding on Export Credits for Nuclear Power Plants', spells out the guidelines, terms and conditions for such financing. As discussed in Sections 4.3.2 and 4.3.3, under this arrangement, Western creditors (i.e. Canada, Japan, the USA and the western European countries) have agreed *not* to provide tied aid credits, aid loans, grants, or any other type 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, on the basis of the position discussed in Section 4.4.3, 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 such projects in developing countries.

Specifically, the present terms of the OECD Consensus rule out the use of bilateral soft loans, such as aid funds for equipment and services pertaining to that part of the project 'inside the security fence'. This ban on mixed credits penalizes nuclear power projects, whereas fossil fuel plants are not affected by this ban. Although it is recognized that, compared with investments in other industrial projects, the financing of nuclear power projects represents risks for lenders of a different degree, the OECD Consensus provides for terms that, in the case of

Category II (intermediate) and Category III (relatively poor) countries (developing countries), are at the current consensus matrix plus 100 basis points for a period of up to 15 years following the completion of plant construction and startup. The cost of money for such plants is high and runs between 10 and 12%, depending on the country category. In addition, an exposure fee can add an additional 1% to the financing costs. Terms in excess of 15 years will be at a slightly higher interest rate. The IDC represents a substantial foreign exchange requirement on the part of the owner and normally has to be met from commercial lending sources. There may be a reluctance by ECAs to finance IDC, thus placing an additional upfront borrowing burden.

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 the capitalization of interest may not exceed 15% of the export value, assuming the ECA is willing to finance such costs. In addition to direct credits, ECAs can also guarantee commercial bank loans.

The OECD Consensus came about to avoid the real risk of an officially supported export credit race among supplier countries through such means as lowering insurance premiums and rates of interest, lengthening repayment periods, relaxing other credit conditions so that they do not correspond to prevailing market conditions and mixing export credits with aid funds. The participants in the OECD Consensus comply with this institutional brake on potentially disruptive competition. Thus, given the OECD Consensus, it is clear that if funding is available for financing nuclear power projects in developing countries, it will likely be on a limited basis and the cost of money is unlikely to be much lower than commercial terms.

Chapter 6

ALTERNATIVE APPROACHES FOR MOBILIZING FINANCIAL RESOURCES

6.1. NEED FOR NEW FINANCING INSTRUMENTS

Nuclear power development has, in general, many of the same characteristics as other capital intensive industries, that is:

— Requirement for a very large quantity of initial capital investment,
— Long construction times,
— An extended period for capital recovery,
— High degree of risk with respect to construction and operation.

As capital markets are not yet well developed in most developing countries, there exists a resource gap between their huge capital requirements and the limited availability of financial resources from domestic markets. Therefore, a stable, long term supply of capital should be mobilized through banking institutions in industrialized countries, as well as by international financial institutions. Together with this, other factors that hinder the financing of nuclear power development are the creditworthiness of developing countries, recent stringent regulations on capital and mandatory reserve requirements and the risks incurred during construction and operation, as perceived by various lending organizations.

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 the governments of developed countries will remain hesitant to finance nuclear power projects, given the high degree of uncertainty with regard to their costs and schedule. In view of the need for foreign exchange in most developing countries and the difficult situation at present in the international financial environment, additional approaches and complementary mechanisms are being sought.

Thus, developing countries are turning increasingly to more innovative financing options for energy projects, most of which have been used in the industrialized countries. Some of the financial instruments that are now being studied in developing countries include [42]:

— Non-recourse, or limited recourse, financing (or project financing);
— Leasing of individual pieces of equipment or whole plants by local or foreign investors;
— Private ownership or operation of generation and distribution facilities;
— Countertrade, involving the barter type exchange of specific export goods for energy imports;

— Developing financial instruments to finance local costs, often involving the creation of new financial intermediaries;
— Revenue bonds with yields tied to enterprise profitability;
— Tax exempt bonds;
— Sale of electricity futures that seek more stable, longer term electricity price contracts.

Of all these instruments, non-recourse, or limited recourse, financing technique or project finance, are actively being sought as a means of mobilizing additional external financial resources for power development. These techniques, which have so far been used in only a few instances in financing energy development in developing countries, allow commercial firms and lenders to finance attractive projects on the basis of the projects' own cash flow, rather than on the basis of an overall guarantee offered by the host government of the project owner. The required conditions for successful project financing of this nature include a reasonable perception of country and project risks, a strong and internationally recognized project sponsor, preferably an export orientation of the project and generally a long term purchase contract. Other features of project financing will be discussed in Section 6.2.

The Multilateral Investment Guarantee Agency, created in 1988 as a member of the World Bank Group, can also play a role. It seeks to promote the flow of foreign investment to developing countries by providing guarantees (on a fee basis) against the following non-commercial forms of risk [42]:

— *Transfer risk.* This arises from host government restrictions on convertibility and transfer of foreign exchange;
— *Expropriation risk.* A result of legislative or administrative action (or omission) by the host government that leads to loss of ownership, control, or benefits;
— *Contract repudiation risk.* When the outside investor has no recourse to an adequate forum, faces undue delays, or is unable to enforce a favourable judgement;
— *War and civil disturbance risk.*

6.2. PROJECT FINANCING

If a project can be implemented in a traditional manner, i.e. with a turnkey construction contract financed by sovereign borrowings, the selection of this method may be warranted because of the high degree of certainty that the project will proceed. However, if a country cannot, or for budgetary or policy reasons prefers not to, finance all of its needed power projects on the basis of budgetary resources or sovereign borrowings, another approach must be sought. Under the present debt restructuring situation and international risk exposure regulations, it has become more and more difficult for commercial lenders to increase their level of activity with developing countries. These are some of the reasons why project financing has been increasingly recognized as an attractive financing technique for capital intensive projects.

6.2.1. Project financing described [43]

Project financing, or limited recourse financing, can be defined as the financing of a viable, independent economic unit which is expected to generate sufficient revenues to cover operating costs and debt servicing, while providing an adequate return on investment. Financing is granted, therefore, on the strength of the project's cash flow and not on the basis of a guarantee of the sponsors, nor on having full recourse against the income and assets of the borrower and/or the guarantor. It is, in a strict sense, a type of financing where there is reliance exclusively on the cash flow of the undertaking to ensure the repayment of the loan and the payment of interest and where the only security is the project's assets. It is non-recourse financing, i.e. without recourse to the sponsors of the project. However, in reality, financing with limited recourse to the sponsor of the project is more frequent because lenders rarely assume all the risks which may affect cash flow, whether of a technical, economic, or political nature. Lenders accept certain risks associated with the project, but are covered by various commitments with regard to other risks. The general rule is that lenders assume only those risks which can be clearly defined [44].

A successful project financing structure will entail a satisfactory and economic allocation of project risk among the various interested parties. In addition to the project sponsors and the senior lenders, risk may be accepted to a greater or lesser extent by equipment suppliers, contractors, operators, raw material suppliers, product purchasers, or end users, insurers and government agencies (including ECAs). The extent of the willingness of any party to shoulder project risk will vary with the return it anticipates it will receive. As an extension of this, the price required by different parties for taking a specific risk may vary significantly. In addition, some risks may be unacceptable to some parties regardless of the fees or margins that might be on offer.

In the case of commercial banks, it is certainly true that they will rarely enter into project finance without some form of commitment on the part of the project sponsors. In some cases, this might simply take the form of an equity investment in the project company; in others, it might involve arrangements that represent tangible credit support for, but are not dependent on, the performance of the project itself.

6.2.2. Areas of application and advantages of project finance [43]

The techniques of project finance are applied to a wide range of ventures, from the exploration and development of oil and gas fields and other natural resources to the construction and operation of luxury hotels and even large scale agricultural developments.

Large scale infrastructure projects — power generating stations, roads, railways and airports — account for much of today's project finance activity, particularly in the newly industrialized countries of Southeast Asia. In these projects, the build–operate–transfer (BOT) structure is often used and an assessment of the political as well as purely economic risk over the long term is particularly important.

The advantages are considered to be as follows:

- *Risk sharing.* Where the debt is wholly or partially of non-recourse to the borrower and sponsors, all or some of the risks will be borne by the commercial lenders if the project fails to produce sufficient cash flow. This is an important factor when the borrower is small in relation to the size of the project. If the project fails as a result of risks assumed by the commercial lenders, the project company or the project sponsors will not be responsible for the failure.
- *Accounting treatment.* More conventional forms of borrowing may have a greater adverse effect on the project sponsor's balance sheet than the techniques used in project financing. This is particularly true where the financing is of non-recourse type. The commitments of sponsors under take-or-pay, tolling or put-through clauses, or other arrangements, even where they correspond in commercial terms to guarantees, do not always appear as such on the balance sheet or the notes to the accounts.
- *Political risks.* A sponsor investing large sums overseas may wish to ensure that certain political risks — such as debt rescheduling, foreign exchange/transfer, expropriation or nationalization — are borne by the banks with respect to the bank debt. Banks may seek to protect themselves against such risks by asking for assurances from the host government and by taking out political risk insurance where this is available.
- *Restriction on borrowing.* Where a sponsor has borrowing restrictions in its articles of association or existing credit facility documentation, it will often be necessary or desirable to arrange the financing in such a way that the restrictions are not breached. For example, restrictions which affect conventional borrowing may not apply to project financing that is structured as a forward purchase agreement, trustee borrowing, or production payments arrangement.
- *Tax benefits.* The existence of tax allowances for capital expenditure and tax holidays for new enterprises may encourage sponsors to seek a project finance structure. To take advantage of the tax holiday, it may be necessary to set up a project company in the relevant jurisdiction. This company will be the borrower and all the project assets will be isolated within this borrowing vehicle.

In other cases, the structure of the financing may be driven by tax considerations for the production payment techniques, as in the USA.

The advantages listed above to the sponsors must, of course, be substantial to compensate for the additional costs, such as the long time period needed for project evaluation, contract negotiation, the very complex documentation, the increased insurance coverage and other charges made by the parties involved.

6.2.3. Structure of project finance [43]

While every project finance scheme has its own special features, the basic structure is often either:

— A limited or non-recourse loan, repayable out of project cash flows; or
— Purchase of an interest in the project output (translated into sales proceeds) in consideration for the payment up front of a capital sum either as a 'forward purchase' or a 'production payment'.

In each case, strong commitments on the part of suppliers, purchasers or users connected with the project may operate effectively to 'guarantee' the receipt of resale proceeds equivalent to the payment of the principal plus a commercial rate of interest. Alternatively, lenders may be prepared to take a market risk.

In appropriate cases, the basic structures of project finance may be adapted to accommodate a number of other financing techniques, including:

— *Lease financing.* In some circumstances, leasing can be an attractive method of financing a part, or even the entire project cost, particularly in those jurisdictions where leasing permits the benefit of tax allowances for capital expenditure on the project to be front end. However, because of the increased political risk exposure, leasing is a technique which is not commonly found in financing projects in developing countries.
— *Export credits.* Where export credits are available, the basic financing structure can be adapted to accommodate the requirements of the relevant ECAs.
— *Issuance of securities.* In some cases, it may be possible to provide lower total financing costs by issuing securities (such as commercial paper), backed by a commercial bank or other guarantees.

6.2.3.1. Loans

The basic structure of a limited, or non-recourse, project loan is conventional. If the borrowing entity is a limited liability 'vehicle' established by the project sponsors, the documentation may not provide for any overt restriction on recourse, the lenders accepting that the repayment obligation is that of the vehicle, not of the shareholders. If the borrower is not a vehicle, then the limitation on recourse to the borrower and/or its assets will need to be dealt with in very clear terms.

6.2.3.2. Production payments

Production payment has been mostly utilized by the oil industry in the United States of America. A production payment itself means the right to purchase a part or all of future oil production out of a specific petroleum mining area. There are basically two methods of realizing production payments:

- *ABC production payment* [45]: Suppose Company A sells a concession to Company B for $1 million. Company B buys 20% of it and pays $200 000 to Company A in cash. The remaining 80%, or $800 000, is sold to Company C, which is a special purpose company, as production payment. Company C raises purchase funds by offering this production payment as security to the bank. In this way, Company A obtains 100% of the selling price in cash. Since Company B receives only 20% of the income of the purchased concession, the income usually balances out the production cost and the company does not need to pay tax. Company C can depreciate its assets and gain a tax advantage as a company specializing in, say, oil, whose only source of income is the production payments, which are tax free (under the tax system at that time). The effect is tax reduction. From the point of view of the banks, debtor C is nothing but a special purpose company and has no other assets, depending only on the right to obtain oil from this purchased concession (production payments) which was offered as a mortgage.
- *Carve-out production payment* [45]: The owner of a concession 'carves out' a part of the concession and sells it as a production payment. The buyer offers the purchased production payment as security and borrows the purchase funds from a bank. This was regarded by the seller as an advance sale for tax reduction. In this case, the bank relied on oil production from the concession.

With the revision of the US tax system in 1969, use of these production payment finance methods immediately declined. However, the concept of financing with mineral resources to be produced from a specified project (concession) in the future as sole security was fixed as an important method of mineral resource development financing in the USA.

6.2.3.3. Forward purchase

More flexible than production payments, the forward purchase structure nevertheless shares many of its characteristics. Lenders may set up a special purpose vehicle to purchase agreed upon quantities of future production and/or the cash proceeds; the project company's obligation to deliver the product or proceeds will be formulated to match the agreed amortization profile and debt service.

The purchase contract will normally require the project company either to buy back the production or sell it to third parties as the agent for the lenders, either to the market or under sponsored take-or-pay or comparable arrangements. As in the case of production payments, the lenders will take out insurance coverage against risks attributable to their ownership — albeit momentary — of the product.

6.2.3.4. Build–operate–transfer

The build–operate–transfer (BOT) approach is being seen as a totally new concept, where the sponsors are given the right to develop and exploit a particular site or product for a defined time, after which the concession is handed back to the host government. However, it is only a form of limited recourse financing which has already been in use for many years in different guises; it can be understood as a method of turning over to the private sector for a limited period, the development and initial operation of what would otherwise be a public sector project. There are a variety of reasons for a government to adopt the BOT approach, but it will often be motivated by a desire to:

— Minimize the impact on its fiscal budget, thus permitting it to implement a project at a time when it could not itself provide the requisite funds, or, alternatively, leaving it free to use its resources for other purposes which may be of less interest to the private sector; and/or
— Introduce increased efficiency from the private sector; and/or
— Encourage foreign investment in developing countries, and the introduction of new technology.

This is discussed in more detail in Section 6.3.

One point to be stressed is that some aspects of financing for a power project are quite different from the financing of other projects. For example, in a mineral resource project, the 'goods' (i.e. the mineral resource) exist underground before the project starts and also before the financing begins. However, in a power project, what is completed at the stage when the project company is financed is a plant which is only a 'means' to generate a product. The plant itself does not have a value. The product generated, electricity, has a value for the first time when the plant is operated efficiently. The asset, or the plant, and the person or the sponsors who operate it are closely connected. It is an essential characteristic of power projects that a specific plant becomes useful for the first time when it is combined with the management system and technical capability of specific sponsors. When the sponsors change, project performance also changes. This is the aspect of power projects which differs most from other projects in utilizing project finance [45].

6.3. THE BOT APPROACH [46]

6.3.1. Background of the BOT model proposal

In most developing countries, public enterprises prevail. However, developing countries are now recognizing the role of the private sector as the engine for economic growth and, in particular, for reducing the financial burden on countries by attracting foreign capital.

The BOT concept was proposed by a developing country. The idea was driven by economic factors and sought to: improve the foreign exchange position, deregulate public sector enterprises, invigorate the private sector, deal with the shortage of funds due to financial stringency and increase efficiency as a result of foreign investment in the country. However, in addition to these economic factors, it must be noted that the proposal for the BOT approach was based on experience with conventional development strategies. Conventionally, foreign contractors install equipment, implement construction works and, after completion of the plant, deliver it to the host government. However, in using this approach, developing countries have seen that foreign contractors tend to maximize the return on their investment, sometimes at the expense of project quality.

Recognizing this, developing countries now request from foreign contractors:

- Cost minimization in the project investment,
- A project proposal in which the economic viability of the project can be achieved through marketing and the stable supply of the product can be assured by the investors/contractors.

In the BOT approach, the project would be transferred to the host government after the sponsors have demonstrated the viability of the project on their own responsibility. Unlike in the conventional approach, the sponsors have to fully commit themselves to the project. Therefore, cost consciousness would be built into the project.

6.3.2. The BOT model for a power project

The basic framework of project development through a BOT approach is developed as follows [47]. A number of foreign investors form a consortium, which establishes a joint venture company (JVC) with a local utility. This JVC sells the electricity generated to the utility. The foreign investors procure most of the funds for the project, which are used to:

- Build a power plant with foreign engineering expertise;

— Operate and manage the plant (by foreign investors/operators) for a certain period of time until all costs, debt service and equity are recovered by means of electricity tariffs; and then
— Transfer ownership of the plant to the country in which it is built.

Another variant of BOT is the build-own-operate (BOO) approach, which does not involve transferring the plant to the host country. The BOO plant can, in principle, continue to remain in private hands throughout the useful life of the project or up to some earlier date agreed upon by the host government and the private owners. In addition to these, a build-lease-transfer (BLT) approach has the same characteristics as BOT, except that the plant is leased to the host government utility for a rental fee — this approach is unlikely for a nuclear power plant [41].

6.3.2.1. Advantages of the BOT approach [47]

When a power plant project is implemented under a BOT scheme in developing countries, the following advantages may generally be expected.

(a) Foreign capital is attracted in the form of non-government debt for power plants.

The foreign consortium secures the necessary funds for constructing a power plant basically through recourse to the project cash flow derived from electricity tariff revenues, without any increase in the public debt of the country in which the power plant is being constructed. This means that as long as the host government promotes an open market economy and privatization of its economy, it can attract foreign capital in the form of non-public debt for construction of a power plant.

(b) Lower risk in construction and operation.

The consortium, which includes a foreign electricity utility with relevant expertise and experience, takes on the responsibility for the design, construction, operation and maintenance of the power plant. Its aim is to operate the plant safely and reliably and meet the demand for electricity in the country. After 10–15 years of operation (e.g. for a thermal power plant), ownership of the power plant is transferred to the host country at a price corresponding to its value. In the case of BOO, this final transfer is not implemented.

(c) Training and technology transfer.

In the course of the construction and operation of the power plant before final transfer, many engineers and personnel working on electricity power supply in the host country can gain valuable experience through on the job training, thereby providing the best and most practical opportunities of technology transfer.

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 from both the legal and financial points of view. The overall costs for a BOT project would be higher than for a project financed directly by sovereign borrowings [48]. The actual costs involved in this approach must await the implementation of a BOT project.

6.3.2.2. *Investments required and a JVC*

Build–operate–transfer projects in general would involve a combination of equity provided by the sponsors and debt provided by commercial banks, international financial institutions and bilateral government lenders. Some 15–30% of the total investment requirement may be provided as equity capital for the project. Foreign investors would organize a consortium to establish a JVC in the country where the power plant is to be built. The local sponsor, upon the request of the investors, would provide up to about 20–40% of a JVC's capital investment. For example, when capital is 20% of the total investment requirement, the host country could invest as equity capital up to 4–8% of the total investment.

6.3.2.3. *Investors' obligation*

The consortium is responsible for: (a) designing the plant; (b) constructing the plant; (c) financing the project; (d) controlling the project; (e) operating the plant for 10–20 years; (f) conducting the host country's manpower training; and (g) transferring the plant to the host country. For manpower training, the host country needs to learn operating know-how and other important aspects of running the power plant during the consortium's control of the project in preparation for the future transfer of ownership of the project to the host country.

The consortium will have to take responsibility for completing the project, except for force majeure events, e.g. earthquakes and war, and the host government's default. The consortium has to bear the burden of cost overruns and joint responsibility for not completing the project. The consortium carries an insurance policy to the extent agreed upon by the host government and consortium to cover the risks during the construction and operation of the project.

6.3.2.4. *Financing requirements* [47]

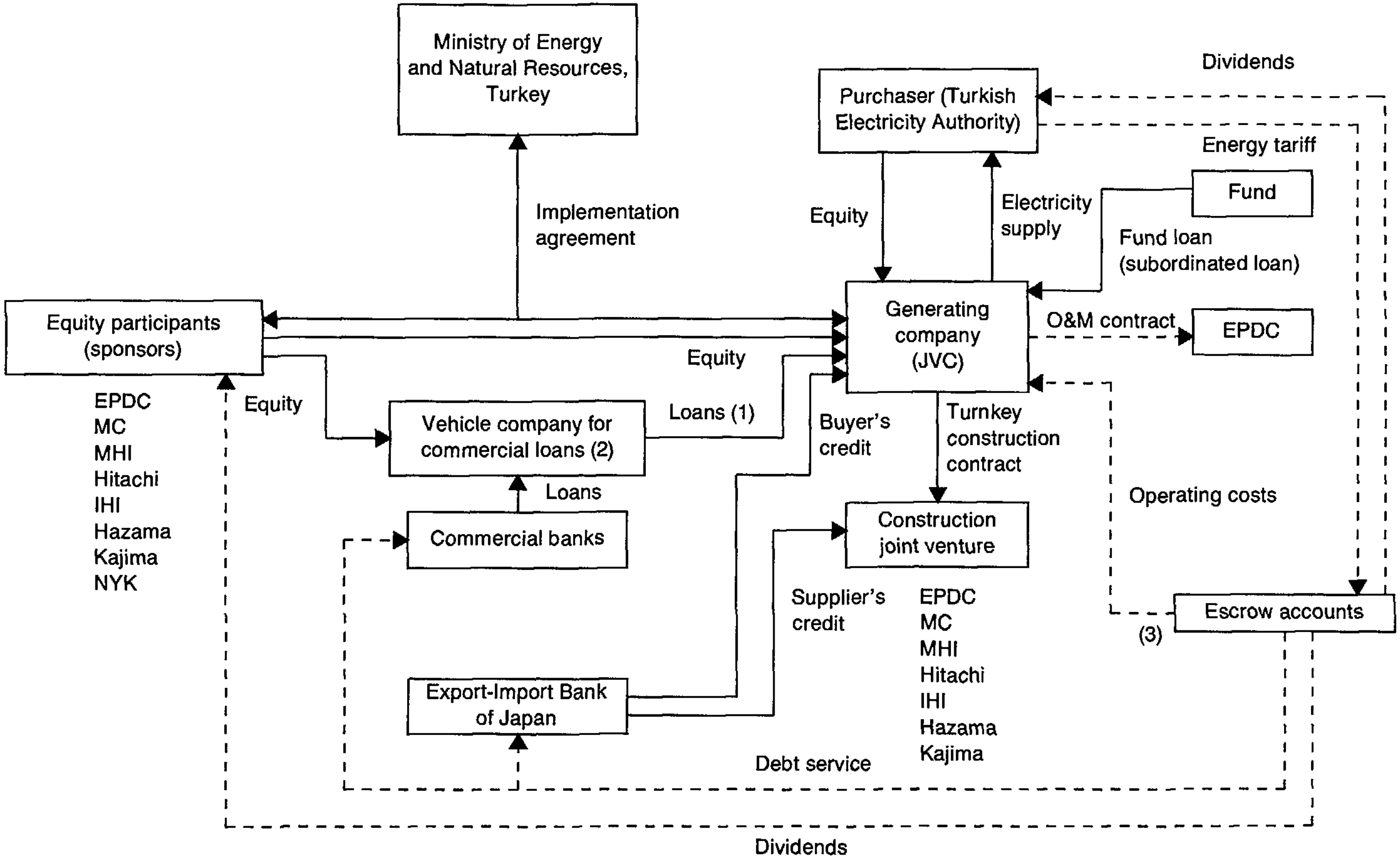
The most essential factor in implementing a BOT project is procuring the large amount of funds required for construction. Usually, most of these funds will be borrowed from 'prime rated' international financial institutions and such institutions almost always require some type of security arrangement by which debt service is substantially guaranteed. Specifically, since issuance of a payment guarantee by the host government is not required, a security package having a similar impact should be arranged.

An example of the elements of a security package is as follows:

- A completion guarantee is provided by the foreign consortium for possible endorsement by the relevant local authorities;
- Infrastructure (land, access roads, transmission lines, water supply, etc.) is assured in time to permit power plant construction without any delays;
- Fuel supply is assured;
- The operation licence is obtained by the foreign consortium, permitting gradual transfer to local personnel, including training on the job;
- Assurance is provided by the host government that debt servicing, payment of dividends, equity and profit repatriation and payment of other costs will be in convertible currency;
- Power purchase agreement (PPA), including a take-or-pay clause, is provided by the local electricity utility at the tariff rate of the cost plus fee. The tariff rate includes labour, fuel, financing costs and a fair return on equity;
- Funding shortages caused by political risks should be covered by the host government;
- If the two items above are not honoured by the host government, the consortium can hand over its debt to the host government, which should accept the transfer of this debt;
- In the case of the Turkish Aliaga BOT thermal power project (see Fig. 12 [46] and Annex IV), escrow accounts are to be established offshore as security for the debt service to 'senior' lenders and the energy tariff goes directly from the payer to the escrow accounts, from which the debt service portion goes to the senior lenders and the operation and fuel cost portions go to the generating company. The dividend portion is held in the escrow accounts as a security [49].

In such an arrangement, the host government is to provide additional funds for repayment of the principal and for payment of interest, if such repayment by the consortium becomes impossible during the period of construction and operation owing to force majeure and/or to actions of the host government. However, after the plant is commissioned and is in operation for some time, it may be expected that the consortium would raise additional funds for repayment of the principal and interest of its loan if the consortium is responsible for a shortfall.

If a shortfall occurs in the repayment of the principal and interest for reasons which are not the responsibility of the consortium, the host country is required to provide additional funding throughout the entire term of the project. Such cases can occur, for instance, under the conditions given below.


Ministry of Energy and Natural Resources, Turkey
Implementation agreement
Purchaser (Turkish Electricity Authority)
Dividends
Energy tariff
Equity
Electricity supply
Fund
Fund loan (subordinated loan)
Equity participants (sponsors)
EPDC
MC
MHI
Hitachi
IHI
Hazama
Kajima
NYK
Equity
Equity
Generating company (JVC)
O&M contract
EPDC
Vehicle company for commercial loans (2)
Loans (1)
Buyer's credit
Turnkey construction contract
Operating costs
Loans
Commercial banks
Construction joint venture
Supplier's credit
EPDC
MC
MHI
Hitachi
IHI
Hazama
Kajima
Escrow accounts
(3)
Export-Import Bank of Japan
Debt service
Dividends

(a) Responsibility of the host government

- Modifications of the legal requirements, which are made after the BOT implementation agreement is concluded and which affect the project, such as more stringent environmental regulations;
- Delays in providing agreed upon infrastructure, such as land, water supply and access roads.

(b) Force majeure events

- War, invasion, civil war and other activities similar to a war;
- Riots, uprisings and other political and social disorders;
- Seizure or appropriation of the project by the government or similar actions by governmental entities;
- Labour disputes, such as strikes and lockouts;
- Situations preventing implementation of the project, such as disabled port facilities or lack of transportation;
- Natural forces affecting the project, such as earthquakes, floods, typhoons, etc;
- Lack or deficiency of labour, materials and/or utilities for reasons beyond control.

6.3.2.5. Host government guarantee

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 output (generated electricity in case of a power project) from the project, as project financing in the BOT model involves a non-public debt transaction. However, financial institutions are hesitant to extend favourable loans on a non-recourse basis and this will often push up financing costs.

FIG. 12. Build-operate-transfer (BOT) project scheme for an imported coal fired thermal power plant in Turkey [46]. (1: loans consist of — project loan, escrow 1 loan and stand-by loan; 2: vehicle company is established by the sponsors; 3: dividends are kept in the escrow accounts; ——►: construction stage of power station; -----►: operation stage of power station; EPDC: Electric Power Development Corporation of Japan; IHI: Ishikawajima-Harima Heavy Industries; Hazama: Hazama Corporation; Kajima: Kajima Corporation; MC: Mitsubishi Corporation; MHI: Mitsubishi Heavy Industries; NYK: Nippon Yusen Kaisha.)

A PPA is concluded with the JVC by a competent organization in the host country, usually a public utility, which pays for an agreed upon quantity of electricity generated at an agreed upon price. The organization guarantees to purchase this quantity of electricity and pays for it even in the event of inability to purchase, under a so-called 'take-or-pay' clause.

Purchasing prices are calculated based on a method involving a basket of currencies, which means that the host government basically bears the foreign currency exchange risk. The host government ensures that debt servicing, payment of dividends, equity repatriation and other financial transactions are carried out in hard currency.

6.3.2.6. Responsibilities of the host government and favourable treatment for the project

The land necessary for the project is to be provided and approved by the host government, which will offer the most favoured treatment to the project, within legal limits. The host government can offer favourable treatment, e.g. with regard to income taxes and corporate taxes, which, in lieu of a government guarantee, are deemed necessary to enhance project credibility and reduce investment risks. Some examples are described below [47].

(1) Legal arrangements

A huge amount of funds is invested by overseas investors and this investment must be reasonably recovered over a long period of time. Therefore, appropriate legislative and administrative support must be provided to investors by modifying existing laws, or enacting new laws as necessary.

- Encouragement of foreign investment: laws encouraging foreign investment in the power sector; laws permitting remittance of profits in hard currencies and transfer of foreign currency overseas; no regulations preventing the convertibility of foreign exchange.
- Special taxation provisions: for purposes of providing an incentive, taxation laws should be modified to exempt from or lessen such taxes as customs duties and business and corporate taxes.
- Other exemptions from regulations: laws controlling the entrance and exit of foreign nationals in conjunction with the construction and operation of a power plant; employment regulations against foreign nationals, if any; laws controlling bidding (fair bid evaluation); laws controlling accounting (international financial practices). For example, a 'free trade zone' (FTZ) is *legally* defined in Turkey and incentives such as those mentioned above are given to an entity operating in the FTZ.

— Legal provisions: arrangements by which a JVC established in the host country can engage in the electricity utility business.

(2) Terms to be considered when constructing a power plant

As foreign investors from the private sector are making an investment to construct a power plant, the government of the host country should guarantee the following terms related to business operation.

- The consortium can select, in principle, foreign construction firms and key personnel for the construction/operation of a power plant who will be gradually replaced by locally trained personnel.
- The relevant authorities in the host country should secure the necessary land, construct roads, arrange electric power for construction and a water supply for power plant operation, etc., and offer these to the consortium on schedule, with or without compensation.
- Any disputes arising from the siting of the power plant, and compensation for a project site, should be resolved by the relevant authorities of the host country.
- As fuel is an essential element in power plant design and operation, the quality and price of fuel must be negotiated and, in principle, independently selected by the consortium on a competitive basis to ensure satisfactory plant operation. The import of fuel should be exempt from customs duties.

(3) Timing of the transfer

The project is to be transferred to the host country when the contract comes to an end, with both sides of the consortium and the host country having fulfilled their contractual obligations. The foreign consortium and the host government could renew the contract if both sides agree upon conditions at the time of conclusion of the contract. The host country may also negotiate with the foreign consortium to buy back the project before the end of the contract at a mutually agreed upon price.

The contractual operation period is determined on the basis of the conditions for repayment of the principal and interest, project operation and other factors through consultation between the consortium and the host country. Taking the BOO approach instead of BOT, it could be possible for the consortium to operate the project in the host country continuously.

6.3.3. Electricity tariff

There are different methods for setting electricity tariffs depending on the particular case. For example, a method using a full meter rate system, including fixed costs, needs to determine the standard amount of electricity generated in order to estimate the power generation cost per kW·h. For base load operation of a power plant, the warranted amount of electricity to be received by the host country is calculated based on the assumption of a certain plant availability factor, for example 75%.

6.3.3.1. Guaranteed annual net generation

The Turkish thermal power project carried out according to the BOT model (Annex IV) employs a concept of guaranteed annual net generation (GANG), which can be defined as the annual gross electricity generation corresponding to an agreed upon plant availability factor, minus power station auxiliary consumption and main transformer losses.

If the host country cannot accept the warranted amount of electricity owing to some fault on its part (including accidents in the transmission system), it will have to pay for this electricity anyway as if it had received it. This is the take-or-pay contract.

If the host country cannot accept this electricity owing to some fault of the project company, the host country does not have to pay for the difference between the warranted amount of electricity receivable and the actual amount of electricity received. The company then faces a situation where it cannot recover all of the fixed costs. This is a risk that must be borne by the company.

If the tariffs are more economical than those of other power sources, a situation might occur where the host country would demand electricity exceeding the GANG. The fixed costs of the project would have been recovered through the sale of the warranted amount of electricity, so that the incremental revenue from the sale of excess electricity would generate profits. This would be a premium for the JVC.

6.3.3.2. Annual base electricity tariff

The annual base tariff applicable to electricity generated up to the GANG is the sum of the component charges divided by the GANG. When setting the electricity tariff, it is desirable to keep capital charges constant over time; such charges include annual repayments of the principal and payments of interest on the loan, redemption of the principal of equity capital and dividends.

For loan capital, annual repayments of the principal and payments of interest are accounted for by pricing according to the repayment conditions of the loan.

For equity capital, after fully reimbursing the loan, tariffs are set taking into account the recovery of the principal. Dividends are to be accounted for by pricing from the beginning of plant operation; to keep capital charges constant, dividends have to be adjusted so that in later years they increase reciprocally as annual interest repayments decrease. The internal rate of return on equity capital is set at an agreed upon level, such as 15%, with an assumption that the electricity pricing is also set at a plausible level.

6.3.3.3. *Operational costs*

In the case of the Turkish thermal power project (a coal fired plant), electricity pricing is set in the same currency used to purchase the coal, e.g. US dollars, to minimize the effects of fluctuations in fuel market prices. For other operational costs, such as labour costs, repair costs and other O&M costs, electricity pricing is based on actual market prices, with escalation provisions according to the following concept: O&M costs are to be escalated in the same combination of currencies as the basket of currencies used for financing the project, according to fluctuations in the corresponding price indices. For example, the yen portion of the O&M costs will be escalated according to Japan's price index, those in German marks according to Germany's price index, and in US dollars according to the US price index.

6.3.3.4. *Taxes and other public charges*

As presented in Section 6.3.2.6, for companies in the FTZ, taxation and other public charges, such as corporate taxes, fixed property taxes, value added taxes and import duties, are exempted. The reason for this is that if taxes are levied, they will simply be reflected in the pricing and eventually the purchaser of the electricity generated or the host government will have to pay to defray these costs. It also is based on the idea of providing incentives, as well as seeking to simplify formalities through favoured treatment or tax exemption measures.

6.3.4. Issue of debt service guarantees

One of the main features of the BOT financing model is that the host government does not issue a conventional payment guarantee for loan repayment, but instead provides specific security arrangements, such as guaranteeing the purchase of an agreed upon amount of electricity at an agreed upon price to a private JVC to be established for the project. For the host government, the legal recipient of all loans necessary for the project is not the government but the JVC. Thus, the guarantee of loan repayment on top of the electricity purchase payment guarantee would constitute a double guarantee. The host government's intention is that its guarantee to purchase electricity would not be treated as a sovereign debt (i.e. it would be treated as a non-public debt) and thus the international debt carried by the host government would not be increased.

As regards the lenders, the concerns relate not only to securing payment of the electricity tariff, but also who guarantees debt servicing in case the JVC fails to earn revenues.

For lenders, the creditworthiness of a JVC established in a developing country is unsatisfactory, so they would naturally wish that the host government itself guarantee the repayment of the loan. In the Turkish BOT case, in spite of intensive negotiations between the lenders and the host government, the latter did not guarantee debt service under the BOT scheme. The possible contingencies are:

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

Returning to the Turkish BOT case, the host government did not require the JVC to repay the debt for the first two categories. However, the government believed that the JVC should repay the debt for a contingency which was the JVC's responsibility, as mentioned in the case of a JVC default. During the negotiations between the Turkish Government and the US EXIM, an idea emerged after mutual concessions, 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 loan has to be repaid by the project company from its future cash generation.

Also important for lenders is the extent to which the host government comes forward to bear the obligation to repay the debt. The lender's position presumably is 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 to the lenders and could be settled with conditions agreed upon earlier by them.

Depending on which of the above categories is applicable, if the debt servicing obligation is not honoured by the host government, the JVC has to ask the host 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 host government can act on the basis of two main BOT principles which, in the case of the Turkish project, are that: (1) the Turkish Government does not issue a conventional payment guarantee, and (2) the project company basically assumes the financial risks associated with its responsibilities/obligations.

6.3.5. Implications for nuclear power projects [41]

The BOT approach appears to provide some new ways 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.

For nuclear power plants, the larger the plant size, the more complicated is the BOT financial and commercial structure. The investors, host government and financial institutions may have competing interests regarding the protection of their investment and the structuring of an appropriate security arrangement.

Investors will be seeking a fair return on equity commensurate with risk and will wish to leverage their investment with a lower debt to equity ratio. The host government will be seeking financing which is free from sovereign risk guarantees and will wish to keep any debt assumed for a nuclear power plant 'off budget'.

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 a strong economic and credit structure 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 equity participation somewhat greater than 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 assures 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 dealt with when the BOT approach is applied to nuclear power projects are:

- *Nuclear third party liability* [50]: Such liability must be exclusively channelled 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.
- *Waste management and decommissioning* [50]: While the JVC should at least be able to store the fuel for a defined period, final spent fuel disposal, waste disposal, or other back end fuel cycle related activities have to be arranged for by the host government. Provisions for actual plant decommissioning could be made after the transfer of the plant to the host country's utility.
- *Assurance of fuel supply:* Nuclear materials, fabricated fuel and irradiated spent fuel are all sensitive items for the international community and international trade. The host country would be expected to accept the IAEA's full scope safeguards for inspection and monitoring. The political aspects of the management of nuclear materials supply are beyond the capabilities of investors and the project company alone. The host government would have to be involved as a core entity for assuring nuclear fuel supply.

In addition to these aspects, the BOT approach for nuclear power projects is likely to be a longer and more costly development process because the licensing, siting, environmental and financing considerations are more complicated than when using the BOT method for conventional power projects (see Annex V). Thus, investors/sponsors should be prepared to accept long lead times and large project development expenditures.

Since the application of the BOT approach for nuclear power projects in developing countries is more complex and risky than for conventional power projects, investors, host governments and financial institutions will look very closely at the experience amassed in developing and implementing the BOT approach for fossil power projects. This scrutiny will encompass a review of all phases of such projects, including the final settlement of financing arrangements and plant completion/operations before these parties will pursue a BOT scheme for a nuclear power plant. The outcome of the Turkish coal fired power project and the Hub Power Project in Pakistan (see Section 6.5) will no doubt influence investors' receptiveness to the BOT or BOO options for large size projects. The BOT approach for developing countries is by no means a panacea, but it remains a possible, though untested, alternative for revenue earning power projects, particularly for complex nuclear power projects.

6.4. THE WORLD BANK'S EXPANDED CO-FINANCING OPERATIONS

The World Bank, by its charter, is limited in its lending activities to making loans to sovereign governments or making loans that are covered by a sovereign guarantee. Thus, it has not been able to lend directly for project financing, which in a strict sense does not require a sovereign guarantee. However, the Bank has found indirect ways to assist its member states in executing project financing.

A private sector energy development fund in Pakistan, an energy sector loan from the World Bank to the Philippines and various sectoral studies are examples of this. In addition, the World Bank has currently instituted a new programme under the general heading of 'expanded co-financing operations' (ECOs) which might be used to facilitate BOT projects and others.

6.4.1. Expanded co-financing operations [51, 52]

A new programme of ECOs was authorized by the Executive Directors of the World Bank in July 1989, after they recognized the need for the World Bank to adapt its private co-financing programme to changes in the credit and capital markets. Since the establishment of the B-Loan programme, which was limited to commercial banks, the patterns of overall financial flows to developing countries have changed. As a result of the debt crisis in these countries and the more stringent bank capital requirements, commercial bank lending to them has declined. Meanwhile, innovations in capital markets have become widely accepted and have significantly broadened the range of instruments available for providing financing to creditworthy borrowers.

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 which are identified and appraised by the World Bank and which are normally accompanied by World Bank loans.

In general, borrowers implementing sound economic policies and who have reached, or are reaching, market creditworthiness for private borrowing are eligible for support under the private co-financing programme. Because this programme is intended to help countries that are close to voluntary private financing, developing countries that have restructured their external commercial debt within the previous five years are not normally eligible for such credit support. As of June 1991, ECO eligible countries specified by the World Bank were: Algeria, China, Colombia, Cyprus, Czechoslovakia, Fiji, Hungary, India, Indonesia, Malaysia, Pakistan, Papua New Guinea, Romania, Thailand, Tunisia, Turkey, Zimbabwe (list subject to change).

With this programme, the World Bank will be able to provide flexible support for financing transactions undertaken by World Bank borrowers in a broad range of markets. In addition to providing support for commercial bank lending, as previously authorized under the B-loan programme, ECOs can assist borrowers in gaining or broadening their access to international capital markets. While support is expected to be provided most frequently in the form of partial guarantees, other mechanisms, such as letters of credit, puts, stand-by lines, take-outs, or other contingent liabilities are also possible. Credit enhancement through ECOs could also be provided within the context of limited recourse project financing, including BOT arrangements, to support government undertakings with respect to the project.

The extent of credit support under ECOs could be easily adapted to meet borrower needs and market requirements. Such matters as the proportion of the financing covered and the coverage of guarantees will vary and can be negotiated with the borrower and lender on a case by case basis. In every instance, the World Bank expects to obtain substantial leverage of its contribution to the overall financing package. Possible structures for this private co-financing programme are as follows:

— *Guarantee of commercial loans.* The ECO can be structured to provide guarantees of commercial bank loans raised in the medium and long term credit markets in the context of financing for World Bank approved projects. Similar to the partial guarantee under the B-Loan programme, guarantees of commercial loans would be especially suitable for borrowers who do not yet have full access to commercial borrowing.

— *Guarantees of bond issues.* The ECO can be used to provide guarantees on medium and long term bond issues, either publicly issued or privately placed, with a smaller number of institutional investors.
— *Contingent obligations.* The ECO can be structured as a contingent obligation in a variety of ways. For example, a loan could be used with an option to 'put' it to the World Bank under predetermined circumstances. Such puts are similar to guarantees in terms of the credit support being provided, but they may be exercisable under differing circumstances.
— *Support for project finance.* It would be possible with the ECO to 'unbundle' risks by structuring the guarantee to cover only selected risks of a project in which the World Bank can provide support in the context of limited recourse project finance. In such ventures, project sponsors undertake investments in developing countries, but require certain undertakings from the government in support of the private financing that is provided to the project. Often, these undertakings take the form of financial commitments in the event that risks occur that are beyond the control of the sponsors. Through the new programme, support can be expected for specific undertakings of the government in these financing packages. It can be similar to partial insurance, rather than a comprehensive guarantee against all risks.

6.5. NEW PROGRAMME FOR PARTIAL GUARANTEE BY THE WORLD BANK [53, 54]

6.5.1. The Hub Power Project in Pakistan

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 first project under The World Bank's ECO approach is in Pakistan, the Hub Power Project, which is under negotiation. It is proposed to use a BOO approach here for a power plant with an installed capacity of 1292 MW(e), comprising four 323 MW(e) conventional oil fired power generating units and the associated facilities, to be sited near the mouth of the Hub River in Baluchistan Province, about 40 km from Karachi. This is the largest project now under way in Pakistan, with financing of US $1500 million. The new co-financing approach applied to the Hub Power Project has the following innovative features:

— The project should 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, would be 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, aid agencies and ECAs of industrialized countries would participate to structure an international project syndicate in major international financial markets.

The Hub Power Project has been proposed to cope with a chronic electricity shortage in Pakistan, and is being promoted by the Government of Pakistan, with support from the World Bank, as one of the main privatization projects in Pakistan's energy sector. The World Bank may have preferred this kind of approach because BOO projects support the development of local capital markets, rather than a BOT project under a quasi-turnkey contract. The project would be undertaken by the Hub Power Company (HUBCO), which would be established as a completely private company. Foreign investors would hold 69% of HUBCO's shares and local investors 31%. The foreign investors include Xenel Industries Ltd (Saudi Arabia), Mitsui and Company Ltd (Japan), Ishikawajima-Harima Heavy Industries Company Ltd (IHI) (Japan), Campenon Bernard (France), Ansaldo GIE SpA (Italy) and other members of an international consortium, which would undertake design, construction and operation of the project.

6.5.2. Financing scheme for the Hub Power Project

The total financing required for the project, including IDC, the reserve contingency fund and other finance related costs of US $498 million, would amount to $1560 million. Of the total financing required, about $320 million would be provided by equity and a $1240 million equivalent would be the debt portion. The latter would be financed on a limited recourse basis using the electricity sale revenues as debt servicing resources. For this project financing, an international syndicate of commercial banks ($360 million), ECAs from France, Italy and Japan ($300 million in total) and a Pakistani private financial institution ($150 million) would participate in the project as senior lenders. As a subordinate lender, the Private Sector Energy Development Fund (PSEDF) of Pakistan would participate in the project. Official aid agencies contribute to the Fund, as does the World Bank. The Pakistani National Development Finance Corporation (NDFC) would administer the Fund for the purpose of making a subloan of $410 million.

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, 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 under the Japanese yen portion of the syndicated loan to be extended by Japanese banks and foreign banks in Japan. The loan conditions would be:

— *Term:* 14 years,

— *Currencies:* US dollars and Japanese yen,

— *Interest rate:* LIBOR or long term prime lending rate, plus a certain margin.

The World Bank's guarantee is different from a conventional 100% financial guarantee, but is ingeniously devised, utilizing its ECO programme. It is not a guarantee of a redemption of principal at maturity. Rather, it is a newly developed approach to guarantee against debt service defaults arising from risks that are difficult for commercial banks to take in 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 a partial insurance covering political risks, rather than a comprehensive guarantee against all risks, in the sense that the ECO covers only selective risks of the project, leaving the remaining risks to the private sector.

In the Hub Power Project, fuel for the project is to be supplied to the project company, HUBCO, by the Pakistan State Oil Company (PSO), a public sector firm, and HUBCO would earn revenues from the sale of electricity generated by the project at a tariff predetermined by HUBCO and the Pakistan Water and Power Development Authority (WAPDA). The Authority would be obliged to take a fixed amount of electricity each year, and if HUBCO is able to supply the power and WAPDA fails to take it, the latter would be required to pay for the electricity as if the contracted power had been delivered (i.e. a take-or-pay contract). The Government of Pakistan would conclude a project implementation agreement which would guarantee the performance of certain critical public sector entities, such as the obligations of the PSO to supply fuel to HUBCO and of WAPDA to purchase and pay for the agreed upon amount of power generated from the project.

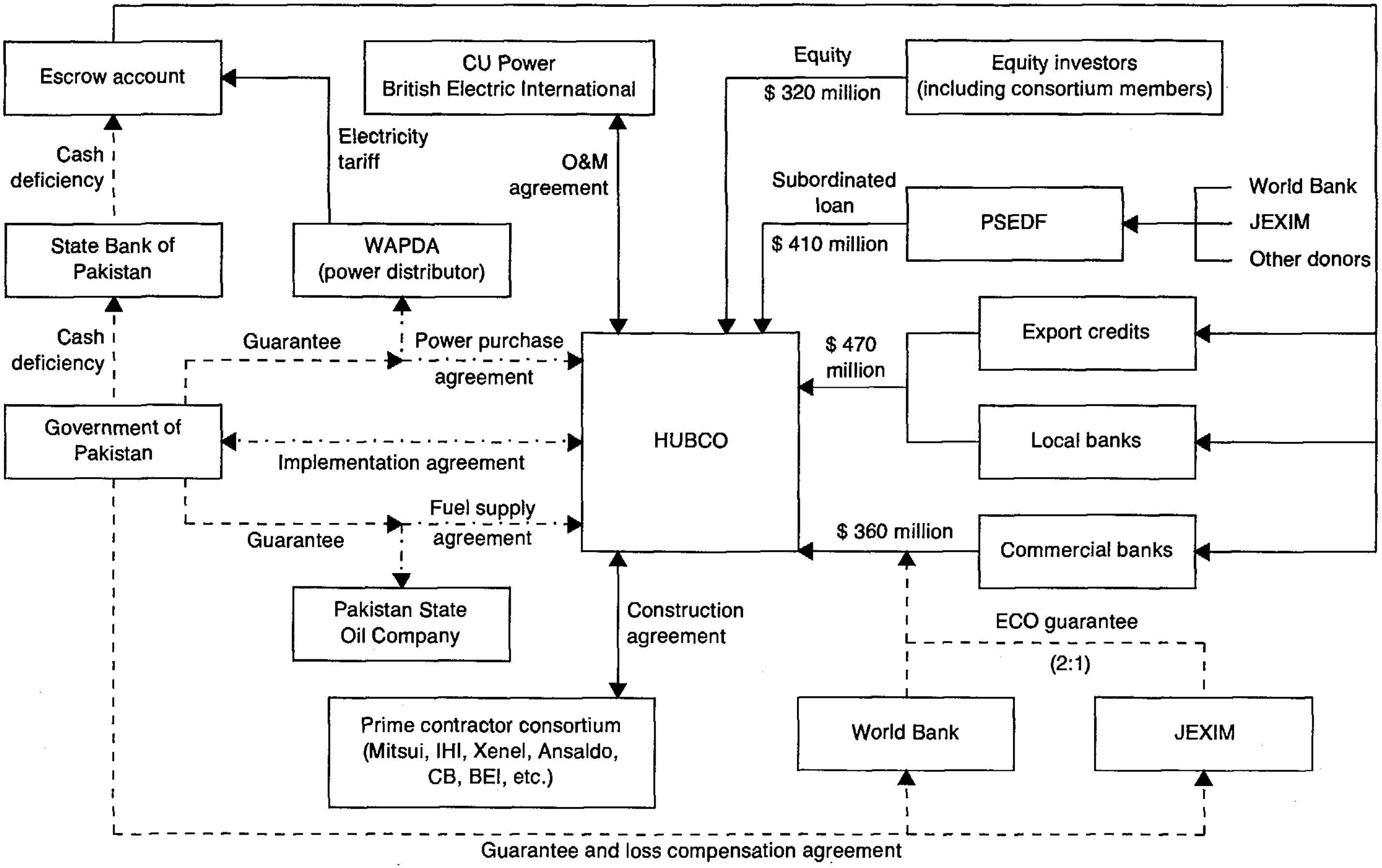
In addition, the agreement would provide for various support obligations by the government, such as a guarantee of foreign exchange convertibility to meet inter alia HUBCO's foreign currency debt service obligations to senior lenders, special temporary funding which would make funds available to HUBCO to meet shortfalls with respect to political force majeure situations in Pakistan and deficit funding of shortfalls in capacity/delivery of power to WAPDA. The World Bank's guarantee covering HUBCO's defaults on principal payments arising from the Government's failure to fulfill its obligations under the implementation agreement would extend to debt service 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. Since the Hub Power Project is a private sector undertaking, ECAs would not require the issuance of a letter of guarantee from the Government of Pakistan. Instead, a security package, which could provide on the whole the same level of credit enhancement as that of the payment guarantee, can be devised by expanding, through ECAs, the usual insurance coverage for extreme risks to include those risks covered by the World Bank's ECO guarantee.

Generally speaking, if the government does not provide any guarantees to cover lenders for project risks owing 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-financiers would be limited to minimum commercial risks related to the implementation of a turnkey project by a first rate international consortium. Within the debt, the loan of $410 million to be extended by the NDFC would be subordinated, so that the 'senior' debts of commercial lending institutions would be protected by the subordinated debt and equity ($730 million in total), covering 47% of the total project cost. This means that the security arrangement is structured very favourably for the senior lenders.

6.5.3. Mobilization of resources in development of the energy sector

In promoting the Hub Power Project, local financing has been a problem in Pakistan. Local banks were reluctant to extend loans to the BOO project and the local financial market is not well developed in Pakistan. The Government looked for methods for tapping locally available resources.

The PSEDF was established with the support of the World Bank, in co-operation with the Government of Pakistan, foreign aid agencies and ECAs. The Fund works as 'pump priming financing' in order to support privatization projects in the energy sector, obtain loans or support from JEXIM, the United States Agency for International Development (USAID), and the Governments of France, Germany, Italy and the United Kingdom, in addition to the World Bank. The World Bank and co-financiers have committed to the PSEDF a total of $459 million, of which $150 million were provided by the World Bank, $150 million by JEXIM in the form of untied funds and $46 million by USAID. All loans to PSEDF are guaranteed by the Government of Pakistan. The PSEDF provides initial debt financing of up to 30% of each power sector investment. Repayment terms of up to 23 years, including a grace period of up to 8 years, are designed to reflect the long gestation periods associated with energy sector projects. Loans made by the PSEDF to energy sector projects would be subordinated to loans provided by commercial banks and/or ECAs. The commercial lenders would be financing only about 45% of the total cost of the project and would be senior by right of payment to both the PSEDF, which



Escrow account
CU Power
British Electric International
Equity
$ 320 million
Equity investors
(including consortium members)
Cash
deficiency
Electricity
tariff
O&M
agreement
Subordinated
loan
$ 410 million
PSEDF
World Bank
JEXIM
Other donors
State Bank of
Pakistan
WAPDA
(power distributor)
Export credits
Cash
deficiency
Guarantee
Power purchase
agreement
$ 470
million
Local banks
Government of
Pakistan
HUBCO
Implementation agreement
Fuel supply
agreement
Guarantee
$ 360 million
Commercial banks
Pakistan State
Oil Company
Construction
agreement
ECO guarantee
(2:1)
Prime contractor consortium
(Mitsui, IHI, Xenel, Ansaldo,
CB, BEI, etc.)
World Bank
JEXIM
Guarantee and loss compensation agreement

would be financing up to 30% of the total, and the equity investors, financing about 25%. The Fund would be administered and operated by the NDFC and loans would be made to eligible privatization projects. The Hub Power Project was selected as the first such project of the Fund and a subordinated loan of $410 million is to be provided from the NDFC. The project would be reviewed and appraised by the World Bank and is to be approved as a World Bank assisted project. Even after completion of the project, it would be monitored continuously by the Bank. The financing scheme of the Hub Power Project is summarized in Fig. 13 [53].

6.5.4. Future implications

Using the experience gained through ECO arrangements for project development and implementation, the World Bank will actively apply the ECO approach to project financing in developing countries. New approaches to project financing based on private sector initiatives have been tried in developing countries. However, they turned out to be risky, encountering impediments in project implementation because of new policies and/or administrative procedures and requirements in the host country caused by a change of regimes. Although the Hub Power Project involves a completely private company, the 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 tend to diminish political risks, thus reducing substantially the risks assumed by the sponsor and participating lenders.

The level of co-operation between the official credit agencies of industrialized countries and the multilateral development institutions capable of policy dialogue with developing countries could be used as leverage to mobilize the resources of commercial lending institutions through partially guaranteed project financing. The ECO approach could be applied effectively to support privatization programmes to be undertaken in many developing countries in the future.

Owing to its highly capital intensive nature, long implementation period, 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.

FIG. 13. Financing scheme for the Hub Power Project in Pakistan [53]. (BEI: British Electric International; CB: Campenon Bernard; IHI: Ishikawajima-Harima Heavy Industries; JEXIM: Export Import Bank of Japan; PSEDF: Private Sector Energy Development Fund (Pakistan); WAPDA: Water and Power Development Authority (Pakistan); ——►: cash flow; -----►: guarantee; –·–·–►: key agreement.)

6.6. INVESTMENT GUARANTEE PROGRAMME

To encourage foreign investment for economic development in developing countries, the Multilateral Investment Guarantee Agency was established in April 1988 as the newest member of the World Bank Group. It provides:

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

The organization is owned by its member countries and is capitalized at approximately US $1100 million. Membership in MIGA is open to all member countries of the World Bank, and to Switzerland.

6.6.1. **Guarantee programme** [55, 56]

The guarantee programme of MIGA offers long term political risk insurance to eligible investors for qualified investments in developing member countries. Beyond insurance protection, MIGA's participation in a project enhances confidence that the investor's rights will be respected, an advantage inherent in MIGA's organization as a voluntary association of developing and developed countries. The coverages are as follows and can be purchased individually or in combination.

— *Currency transfer.* Protection against losses arising from the investor's inability to convert local currency returns, i.e. profits, principal, interest, royalties, capital and other remittances, into foreign exchange for transfer outside the host country. Currency transfer coverage insures against excessive delays in acquiring foreign exchange caused by the host government's action or inaction, by adverse changes in exchange control laws or regulations and by deterioration in the conditions governing the conversion and transfer of local currency. Currency devaluation is not covered. On receiving proof from the investor that the local currency is blocked, MIGA pays compensation in the currency of its guarantee.
— *Expropriation.* Protection against partial or total loss of the insured investment as a result of acts by the host government which may reduce or eliminate ownership of, control over, or rights to the insured investment. In addition to outright nationalization and confiscation, 'creeping' expropriation — a series of acts which, over time, have the effect of expropriation — is also covered. Coverage is available on a limited basis for partial expropriation, e.g. confiscation of funds or tangible assets. Bona fide non-discriminatory measures taken by the host government in the exercise of legitimate regulatory authority are not covered. For total expropriation of equity investments, MIGA pays the net

book value of the insured investment. For expropriation of funds or assets amounting to less than the total, MIGA pays the insured portion of the funds or the net book value of the expropriated assets. For loans and loan guarantees, MIGA insures the outstanding principal and any accrued and unpaid interest. Compensation will be paid upon assignment to MIGA of the investor's right, title and interest in the expropriated investment, such as equity shares or the loan agreement.

— *War and civil disturbance.* Protection against losses from damage to, or the destruction or disappearance of, tangible assets caused by politically motivated acts of war or civil disturbance in the host country, including revolution, insurrection, coup d'état, sabotage and terrorism. For equity investments, MIGA will pay the investor's share of the least of the book value of the assets, of their replacement cost, or, for damaged assets, of the cost of repair. For loans and loan guarantees, MIGA will pay the insured portion of the principal and interest payments in default as a direct result of damage to the assets of the project caused by war and civil disturbance. War and civil disturbance coverage also extends to events that result, for a period of one year, in an interruption of project operations essential to overall financial viability. The business interruption feature is effective when the investment is considered a total loss; at that point, MIGA will pay the book value of the total insured equity investment. For loans and loan guarantees, MIGA pays the insured portion of the principal and interest payments in default as a result of business interruption caused by covered events.

— *Breach of contract.* Protection of equity against losses arising from the host government's breach or repudiation of a contract with the investor. In the event of an alleged breach or repudiation, the investor must be able to invoke an arbitration clause in the underlying contract and obtain an award for damages. If, after a specified period of time, the investor has not received payment, MIGA will compensate.

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. A loan by a financial institution can be insured by MIGA if the loan is related to an investment covered or to be covered by it. The standard policy covers investments for 15 years, although coverage for a project may be extended to 20 years in exceptional cases. The Guarantee Agency also co-operates with national investment insurance agencies and private insurers to co-insure or reinsure eligible investments. The maximum amount of coverage MIGA will issue for a single project is currently US $50 million.

For each risk category, MIGA can insure equity investments for up to

— 90% of the investment contribution, plus

— An additional 180% to cover earnings attributable to the investment.

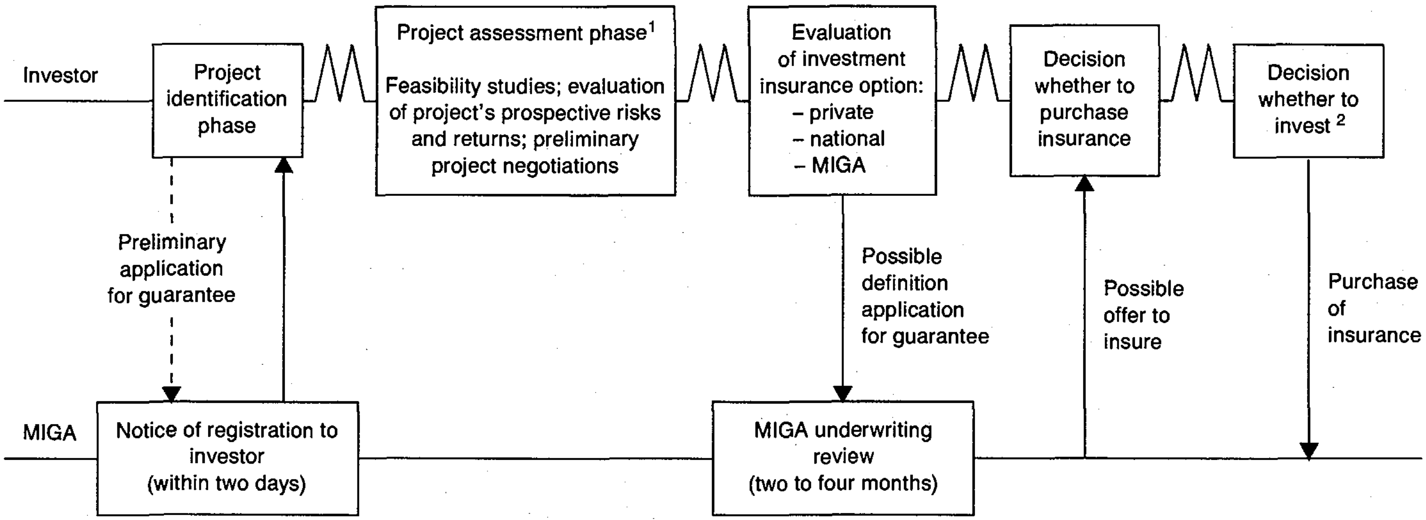


FIG. 14. The MIGA guarantee process [56]. (1: this phase can vary in duration from a few months to many years; 2: the decisions whether to invest in a project and to purchase investment insurance are often made simultaneously.)

For loans and loan guarantees, MIGA can insure up to 90% of the

— Principal, and
— Amount of interest that will accrue over the term of the loan.

Regardless of the nature of the project, the investor is required to remain at risk for at least 10% of any loss.

The amounts described above constitute the 'maximum amount of guarantee' available for each risk category and for the insured investment. The 'current amount of guarantee' corresponds to the amount of coverage in force for that portion of the investment at risk during any one contract year. The difference between the maximum amount of guarantee and the current amount of guarantee is the 'stand-by amount of guarantee', which represents a reserve of insurance coverage that the investor may put into effect at each annual election of coverage to take into account changes in the value or amount of investment that is at risk. The MIGA guarantee process is interactive, as shown in Fig. 14 [56].

For nuclear power projects, the limitations on insurance coverage of the investment per project and on the duration of a contract guarantee may be considered too low and too short to be of much use. Careful analysis for applying this scheme to a nuclear power project is necessary.

6.6.2. Application to power projects

During the brief period of its existence, MIGA has not 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. This agency was set up primarily to cover equity and it can provide political risk insurance to investors in private sector power projects. Taking into account 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 very unlikely that MIGA will significantly support a nuclear power project in these countries.

6.7. OTHER FINANCING APPROACHES

Some additional mechanisms can 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.

6.7.1. Countertrade arrangements [57]

For countertrade or barter arrangements, the financing and supplying 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 kinds of commodities or services the host country can provide;
— The kinds 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 price products of light industry or agriculture.

The supplier country will have to bear the market and price risks of the products it receives 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.

Countertrade could be profitable in cases where an additional export capacity can be created and inland production is available and marketable in sufficient amounts for repayment of the loans. One workable solution might be for the suppliers to commit themselves to co-operate with the local partners of the host country in setting up projects in other developing countries, such as engineering and civil works. Another idea would be to set up the nuclear power plant in a free trade zone so that part of the electricity and other energy could be sold to industries established in the zone and paid for in foreign currencies, thus alleviating the debt servicing problem of the project.

In practice, financing plans involving countertrade appear to be complicated and economically unfavourable compared with other conventional financing approaches and could probably contribute only to providing a part of the foreign currency requirements.

6.7.2. Whole to coal model [58]

The 'whole to coal' model was proposed by New Brunswick Power, a Canadian utility. As the name suggests, the essence of this concept is that 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 scheme is as follows:

— *Ownership:* The nuclear unit would be owned by a supplier entity.

— *Utility investment:* The utility would invest in the project the amount it would have invested in the construction of a reference coal unit according to the schedule that would have been necessary to achieve the agreed in-service date. All remaining funds needed to construct the nuclear unit would be provided by the owner, a supplier entity.
— *Reference coal unit:* The reference coal unit would be based on the costs of actual coal unit(s) of the same size being constructed in a similar area. The units include scrubbers and will burn imported coal.
— *Operating costs:* The supplier entity, as owner, would pay all costs to fuel, operate, maintain and decommission the nuclear unit. The utility would pay to the owner each month the costs of the reference coal unit, along with the fuel cost that would have been incurred to generate from the coal whatever energy was actually produced by the nuclear unit. Any gains or losses from selling nuclear power on a coal basis would accrue to the owner.
— *Delay protection:* If the nuclear unit completion date was to slip by more than 12 months, the supplier entity would pay the utility an amount intended to return the utility to the same economic position it would have been in if the reference coal unit had been available and operating. The 12 month deductible was intended to allow for the delay which could reasonably occur with a coal unit.
— *Outage protection:* Beyond a six month deductible for any given outage, the supplier would compensate the utility so as to return the utility to the same position it would have been in with an operating coal unit. In the case of abandonment, such compensation would continue for four years and the utility's coal equivalent investment would also be returned, with interest.
— *Buy-out provisions:* The utility would have the right to buy the unit during the first three years of operation at cost plus an amount to allow the owner to recover any economic losses incurred due to the whole to coal arrangement since the in-service date. In effect, the utility could enjoy all of the economic benefits of nuclear power during a three year demonstration period by making the owner the wholesaler. If the utility chooses not to buy the unit in the first three years, the buy-out price would be lowered to encourage the transfer of ownership, but the owner would retain an entitlement to 50% of the nuclear unit's lifetime economic benefits. The buy-out price would be the depreciated original cost (the utility's option) or such lower price as is necessary to make nuclear cheaper than coal generation (if buy-out is forced by the owner).

The utility discussed here is New Brunswick Power Canada, which is owned by the Province of New Brunswick and is the monopoly supplier of electricity throughout the province, which has a population of 720 000. It reached peak demand, at about 2.6 GW, in 1990 and owns a 635 MW CANDU-6 unit (Lepreau I). The supplier is Atomic Energy of Canada Ltd (AECL), which has developed the

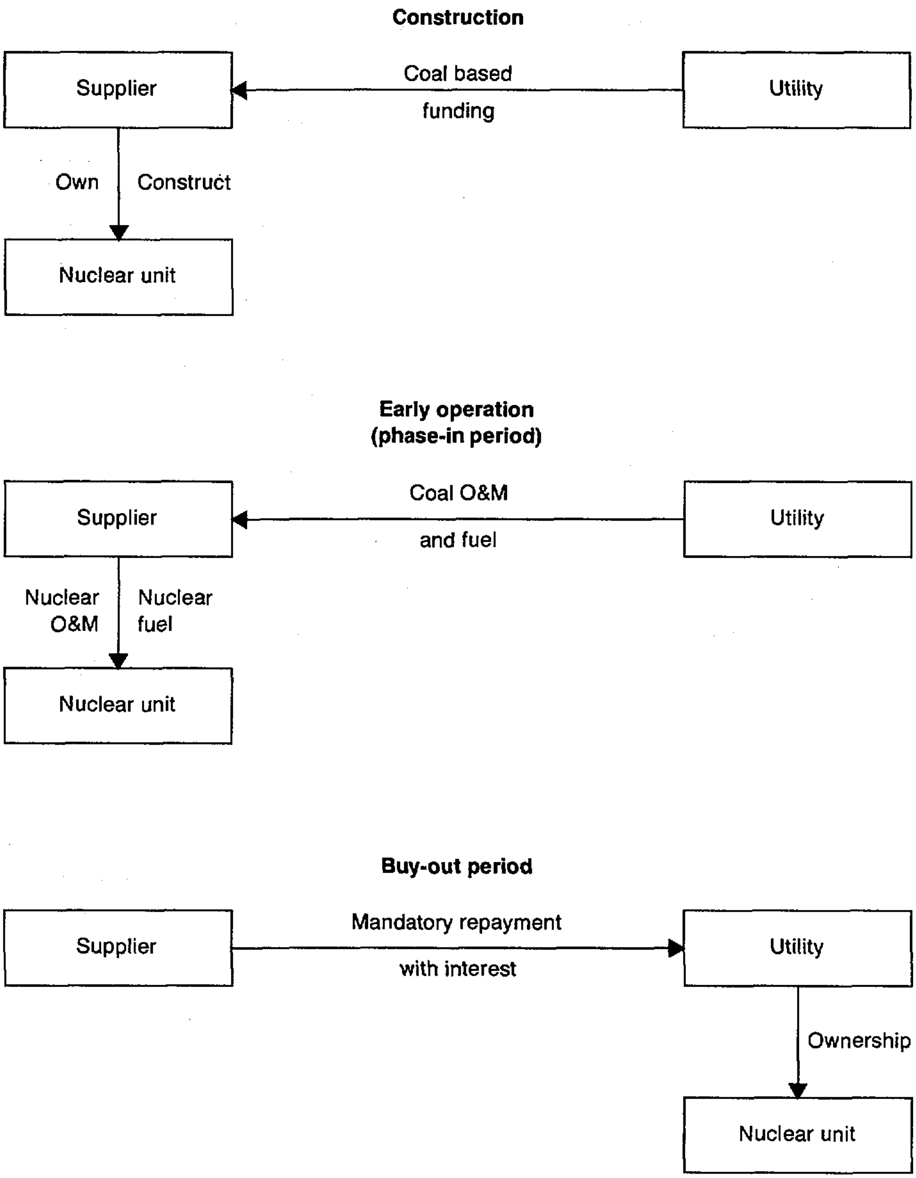


FIG. 15. Scheme of a modified whole to coal model [58].

CANDU-3 concept with an output capacity of 450 MW to appeal to small and medium sized utilities.

Certain features of New Brunswick's Lepreau II whole to coal model relate to the fact that:

- The unit would be a prototype,
- The unit would be available in the mid-1990s (New Brunswick Power would be unable to accept additional nuclear related financial and economic risks before that time).

Specifically, the extent of the delay and outage protection features, as well as the original nature of the buy-out provisions, would have to be considered unusual under more normal circumstances.

Omitting the foregoing special features would produce a modified model, as illustrated in Fig. 15 [58]. During the construction and early operating period, 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 an agreed upon schedule, the utility would pay back all earlier amounts of financing from the supplier (including any losses from selling power on a coal basis), together with interest.

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

- It limits the initial capital investment and early power generating costs for the buying utility to the level of an equivalent coal plant;
- It spreads out the financing requirements over a much longer 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 also has a tariff phase-in feature during the early operating years which removes a major concern over 'tariff shock', when a large, capital intensive facility is added to a utility. Whether or not the whole to coal concept or some variation thereon is applied to a demonstration CANDU-3 unit in Canada, elements of the model can also be of interest for developing countries which intend to launch or expand their nuclear power programmes.

Chapter 7

CONCLUSIONS

A major requirement for the implementation of nuclear power projects in developing countries is the ability to obtain the considerable financial resources required on reasonable terms. This is also one of the major constraints. The financing of such projects presents a critical problem not only because of the very large amount of funding needed, but also because of the low creditworthiness of countries as seen by various lending organizations. Also, 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 such countries involves complex issues that need to be fully understood and dealt with by all the parties involved, namely, high investment costs, generally long construction times, a high degree of uncertainty with respect to costs and schedules and public acceptance issues. A financial analysis is essential because it can lead to quite different conclusions than 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 this type of power plant are larger than those for a fossil fuel fired plant. This is clearly a problem in the short term and, in deciding 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 of the developing countries are facing difficulties in servicing their debts, commercial banks as well as the governmental organizations of exporting countries are reluctant to lend them additional funds, especially to build a nuclear power plant. Only countries with acceptable credit ratings can 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 contribute to this end.

A nuclear power project, operated for domestic use only, 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 financing schemes 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 the western European countries have agreed to comply with the OECD Consensus, which prevents supplier countries from making soft loans and other credit inducements for the export of nuclear power plants. Thus, there will be limited sources available for financing a nuclear power project in a developing country, and the cost of money is unlikely to be much below 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, the creditworthiness problems of these countries and the recent stringent regulation on the risk exposure of financial institutions, innovative financing approaches are being developed and tested, including the build-operate-transfer (BOT) and build-own-operate (BOO) approaches. However, to date no large power project in a developing country 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.

In order to successfully finance a nuclear power project, it is essential for the developing country's host government/utility to:

- Commit itself to the nuclear power programme with the necessary government support.
- Prepare 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 are often underestimated.
- Utilize thoroughly a full range of expertise to deal with technical, financial and legal complexities.
- Set electricity tariffs at a level necessary for sound financial strength, as one of the major sources of financial difficulties for utilities is their uneconomic pricing of electricity.

REFERENCES

[1] Financing of Nuclear Power Projects in Developing Countries (Proc. Seminar Jakarta, 1990), IAEA-TECDOC-610, IAEA, Vienna (1991).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Power Reactors in the World, April 1992 Edition, Reference Data Series No. 2, IAEA, Vienna (1992).

[3] SEMENOV, B.A., "The present status and trends in nuclear power and safety and the role of the IAEA", lecture at the Beijing Institute of Nuclear Engineering, 12 May 1992.

[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Energy, Electricity and Nuclear Power Estimates for the Period up to 2010, July 1992 Edition, Reference Data Series No. 1, IAEA, Vienna (1992).

[5] MOORE, E.A., SMITH, G., Capital Expenditures for Electric Power in the Developing Countries in the 1990s, World Bank Industry and Energy Department, Energy Series Paper 21, The World Bank, Washington, DC (1990).

[6] TATSUTA, Y., "Perspective of nuclear power with regard to CO_2 emissions and nuclear power planning in developing countries", Energy Policy Implications of the Climatic Effects of Fossil Fuel Use in the Asia–Pacific Region, United Nations, Bangkok (1991) 189–197.

[7] INTERNATIONAL ATOMIC ENERGY AGENCY, Promotion and Financing of Nuclear Power Programmes in Developing Countries: Report to the IAEA by a Senior Expert Group, IAEA, Vienna (1987).

[8] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Power, Nuclear Fuel Cycle and Waste Management: Status and Trends 1990, IAEA Yearbook 1990, IAEA, Vienna (1990) C64.

[9] MOLINA, P., IAEA support for energy, electricity and nuclear power planning in developing countries, Indian J. Power Riv. Val. Dev. (special issue Power — 1991).

[10] INTERNATIONAL ATOMIC ENERGY AGENCY, Energy and Nuclear Power Planning in Developing Countries, Technical Reports Series No. 245, IAEA, Vienna (1985) 467–488.

[11] NUCLEAR ENERGY AGENCY OF THE OECD, Decommissioning of Nuclear Facilities: An Analysis of the Variability of Decommissioning Cost Estimates, OECD, Paris (1991).

[12] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear and Conventional Baseload Electricity Generation Cost Experience, IAEA, Vienna (in preparation).

[13] INTERNATIONAL UNION OF PRODUCERS AND DISTRIBUTORS OF ELECTRICAL ENERGY, Electricity Generation Costs — Evaluation of Plants to be Commissioned in 2000, Group of Experts on Electricity Generation Costs, UNIPEDE, Paris (1991).

[14] NUCLEAR ENERGY AGENCY OF THE OECD, Projected Costs of Generating Electricity from Power Stations for Commissioning in the Period 1995–2000, OECD, Paris (1990).

[15] INTERNATIONAL ATOMIC ENERGY AGENCY, Projected Costs of Nuclear and Conventional Baseload Electricity Generation in Some IAEA Member States, IAEA-TECDOC-569, IAEA, Vienna (1990).

[16] MARQUES DE SOUZA, J.A., "Comparison of levelized costs as calculated in current and constant money", paper presented at a training course, Argonne National Laboratory, IL, 1984.

[17] INTERNATIONAL ATOMIC ENERGY AGENCY, Feasibility Study for Small and Medium Nuclear Power Plants (SMPRs) in Egypt, IAEA, Vienna (in preparation).

[18] "Status of and perspectives and constraints for nuclear power in developing countries", Costs and Financing of Nuclear Power Programmes in Developing Countries (Proc. Seminar Vienna, 1985), IAEA-TECDOC-378, IAEA, Vienna (1986) 32–36; 49–56.

[19] MUNASINGHE, M., et al., A Review of World Bank Lending for Electric Power, World Bank Industry and Energy Department, Energy Series Paper 2, World Bank, Washington, DC (1988).

[20] INTERNATIONAL ATOMIC ENERGY AGENCY, Energy and Nuclear Power Planning in Developing Countries, Technical Reports Series No. 245, IAEA, Vienna (1985), 489–515.

[21] Nuclear Power Plants Authority, Egypt, personal communication, 15 April 1992.

[22] ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, Arrangement on Guidelines for Officially Supported Export Credits, OECD, Paris (1990).

[23] RAY, J.E., The OECD 'Consensus' on Export Credits, OECD, Paris (1986).

[24] ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, The Export Credit Financing Systems in OECD Member Countries, OECD, Paris (1990).

[25] Division of Financing and Export Questions, OECD, Paris, personal communication 1991.

[26] WARD, D.A., "Sales of nuclear power stations to developing countries: Risk assessment for export credit insurance", Costs and Financing of Nuclear Power Programmes in Developing Countries (Proc. Seminar Vienna, 1985), IAEA-TECDOC-378, IAEA, Vienna (1986) 223–227.

[27] Annual Report for 1991, The World Bank, Washington, DC (1991).

[28] Annual Report for 1990, The World Bank, Washington, DC (1990).

[29] HERON, A., "Financing electric power in developing countries", Costs and Financing of Nuclear Power Programmes in Developing Countries (Proc. Seminar Vienna, 1985), IAEA-TECDOC-378, IAEA, Vienna (1986) 289–290.

[30] ZEDER, F.M., "Existing and new roles for public and private sector cooperation in stimulating financing and insuring successful electrical development projects in developing nations" (Proc. Conf. Tokyo, 1989), Vol. 1, Electric Power Development Corporation, Tokyo (1990) 241–254.

[31] BESANT-JONES, J., et al., Review of Electricity Tariffs in Developing Countries During the 1980s, The World Bank, Washington, DC (1990).

[32] HEROLD, H., "Experience in the financing of nuclear power projects", Financing of Nuclear Power Projects in Developing Countries (Proc. Seminar Jakarta, 1990), IAEA-TECDOC-610, IAEA, Vienna (1991) 265–271.

[33] BASU, R., "Financing of nuclear power programmes in developing countries: The Indian experience", ibid., pp. 219–236.

[34] Korea Electric Power Corporation, information and presentation, 1992.

[35] Japan Atomic Industrial Forum and Japan Electric Power Information Center, Inc., personal communications, 1991, 1992.
[36] Guangdong Nuclear Power Station, Progress Report, Guangdong Nuclear Power Joint Venture Co. Ltd, Shenzhen (1991).
[37] Guangdong Daya Bay Nuclear Power Station, Under Construction, brochure, Guangdong Nuclear Power Joint Venture Co. Ltd, Shenzhen (1991).
[38] LAVRIL, F.X., ''Financing a nuclear power plant in a developing country: Experience with the Daya Bay nuclear power plant, China'', Financing of Nuclear Power Projects in Developing Countries (Proc. Seminar Jakarta, 1990), IAEA-TECDOC-610, IAEA, Vienna (1991) 213-217.
[39] Status of Nuclear Energy Project Development in Brazil, The Japan Machinery Federation, Tokyo (1983) 67-91.
[40] ENERGY INFORMATION ADMINISTRATION, Commercial Nuclear Power, Washington, DC (1991) 63.
[41] ELLIOT, W.R, et al., ''The BOT approach: Implications for nuclear power plants'', Financing of Nuclear Power Projects in Developing Countries (Proc. Seminar Jakarta, 1990), IAEA-TECDOC-610, IAEA, Vienna (1991) 369-389.
[42] MUNASINGHE, M., ''Electric sector policy in developing countries: Status and prospects'' (Proc. Conf. Tokyo, 1989), Vol. 1, Electric Power Development Corporation, Tokyo (1990) 381-419.
[43] Project Finance, Clifford Chance, London (1991) 1-15.
[44] International Project Financing, Credit Lyonnais, Paris (1989).
[45] YOKOI, S., et al., Project Finance, Yuhikaku Business Books, Tokyo (1985) 34-60.
[46] Electric Power Development Corporation, Japan, personal communications, 1991, 1992.
[47] ''The build, operate, transfer scheme'', Japanese Committee for Pacific Coal Flow, Electric Power Development Corporation and Industrial Bank of Japan, Tokyo (1989) (discussion paper).
[48] AUGENBLICK, M., SCOTT, C., Jr., The Build, Operate, and Transfer (''BOT'') Approach to Infrastructure Projects in Developing Countries, WPS-498, The World Bank, Washington, DC (1990) 35-40.
[49] TUCHIDA, H., ''Imported coal fired thermal power plant project on BOT basis in Turkey'', Financing of Nuclear Power Projects in Developing Countries (Proc. Seminar Jakarta, 1990), IAEA-TECDOC-610, IAEA, Vienna (1991) 341-346.
[50] RUESS, F., LEBRETON, G., ''The BOT model for nuclear power plant projects from a supplier's point of view'', ibid., 361-368.
[51] Cofinancing, The World Bank, Washington, DC (1989).
[52] Private Cofinancing, The World Bank, Washington, DC (1991).
[53] Private Cofinancing Group, The World Bank, Washington, DC, personal communications, 1991, 1992.
[54] AUGENBLICK, M., SCOTT, C., Jr., ''Review of selected major BOT projects'', The Build, Operate, and Transfer (''BOT'') Approach to Infrastructure Projects in Developing Countries, WPS-498, The World Bank, Washington, DC (1990) Annex 2, 10-12.
[55] MULTILATERAL INVESTMENT GUARANTEE AGENCY, Investment Guarantee Guide, MIGA, Washington, DC (1988).

[56] MULTILATERAL INVESTMENT GUARANTEE AGENCY, Annual Report 1991, MIGA, Washington, DC (1991).

[57] "Conclusions of Working Group 5", Costs and Financing of Nuclear Power Programmes in Developing Countries (Proc. Seminar, Vienna, 1985), IAEA-TECDOC-378, IAEA, Vienna (1986) 306.

[58] LITTLE, K.B., "Nuclear development potential in New Brunswick: The whole-to-coal model", Financing of Nuclear Power Projects in Developing Countries (Proc. Seminar Jakarta, 1990), IAEA-TECDOC-610, IAEA, Vienna (1991) 325–330.

GLOSSARY

The explanations given below[1] are intended for use with this reference book and may not necessarily conform to explanations adopted elsewhere for international use.

amortization. The progressive reduction of a **debt** by means of equal periodic payments sufficient to meet current **interest** and liquidate the **debt** at **maturity**.

appropriation. An authorized sum of money set aside, frequently in a separate fund, to pay certain known or anticipated **costs** of a given item or service.

back end of the nuclear fuel cycle. Activities involving spent fuel shipping, storage, reprocessing and **waste management**, and final disposal of reprocessing wastes and spent fuel.

back end costs. Includes such **costs** as spent fuel storage, transport, fuel reprocessing and **waste management**.

balance sheet. An itemized statement which lists the total liabilities of a given business to portray its net worth at a given moment in time.

bank loan. A fixed amount lent by a bank to a customer for an agreed upon period of time and on specified terms.

barter. The direct exchange of goods or services by way of trade, without the use of an intermediate and neutral currency.

bids (*and* offers). A bid is the quotation of a prospective buyer for the purchase; an offer is the quotation of a seller for the sale of a trading unit, or other specified amount of a security.

bond. A certificate of indebtedness issued by a government or public company which promises to repay a specified sum of money at a certain date in the future, or periodically over the course of a **loan**. **Interest** is paid at fixed, specified dates.

borrower. Any legal entity which obtains funds from a lender by the extension of **credit** for a considered period of time.

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[1] Main sources: GREENER, M., The Penguin Business Dictionary, Penguin Books, Harmondsworth, Middlesex (1987); BANNOCK, G., BAXTER, R.E., DAVIS, E., Dictionary of Economics, Penguin Books, Harmondsworth, Middlesex (1987); TODARO, M.P., Economic Development in the Third World, 3rd edn, Longman's, New York (1985).

budget. An itemized listing, and frequently the allotment, of the amount of all estimated revenue which a given business anticipates receiving and the listing, and frequently the segregation, of the amount of all estimated **costs** and expenses that will be incurred in obtaining the above mentioned income during a given period of time.

build–operate–transfer (BOT). A financing method in which project sponsors are given the right to develop and exploit a particular site or product for a defined time, after which the concession is handed back to the host government.

buyer's credit. See **export credits.**

capital. Any assets or resources, whether financial or physical, capable of generating income.

capital flows. International movements of **capital** may come from either official or private sources. Official sources are: (a) bilateral lenders (governments and governmental agencies), and (b) multilateral lenders (international organizations). Private sources are: (i) commercial suppliers and manufacturers who provide **export credits** for the purchase of their goods; (ii) commercial banks, which provide **export credits** or cash **loans**; (iii) other private investors, who invest in foreign enterprises in which they seek a lasting interest **(direct investment)**, or purchase stocks or **bonds** issued by foreign companies or governments (portfolio **investment**), and (iv) charitable organizations, which provide financial aid, goods and services as grants.

capital intensive. Using more **capital** for production; that is, using a higher proportion of **capital** relative to other factors of production, such as labour or land per unit of output.

capital investment. A collective term representing the amounts invested in **capital** or fixed assets, or in long term securities, as contrasted with those funds invested in current assets or short term securities.

capital market. The market for long term loanable funds as distinct from the money market, which deals in short term funds, although there is no clear-cut distinction between the two.

cash flow. Concept used in analysing financial statements to determine cash earnings from the operation of an enterprise. It is usually conceived to be the net income before **depreciation**. In principle, it should be determined before all non-cash **costs** and expenses are charged to current earnings. A conventional method of computing **cash flow** is to deduct cash expenditures, which are capitalized as part of the fixed asset account, from fixed asset accounting. These expenditures represent the outlay for the replacement of depreciated fixed assets or new additions to fixed assets.

commercial bank. A financial institution that provides a wide range of services, including accepting deposits and making **loans** for commercial purposes.

commercial paper (promissory note). A legal document between a lender and a **borrower**, whereby the latter agrees to certain conditions for the repayment of the sum of money borrowed.

commercial risk. A type of project **risk** contingent on the business activities of a company, which is attributable to the company's responsibility. (See **political risk**.)

consortium. Large contracts are often tendered for by a group of companies or firms, none of which is competent to fulfil the contract alone. It is generally a once-only combination for the purpose of bringing together a number of quite different operative skills, or areas of specialized knowledge.

constraint (economic). A barrier to the attainment of a set target (e.g. economic growth) during a particular period of time. For example, physical **capital** has long been thought of as the major constraint on **economic growth** in developing countries.

contingency. Specific provision for unforeseeable elements of **cost** within the defined scope of the project.

contingent liabilities. A term for liabilities that may or may not arise. A **debt** which is contingent on an uncertain event.

cost. The value of what must be given up to acquire or achieve something.

countertrade. A form of barter in international trade in which the buyer requires the seller to accept goods of the buyer's choosing in lieu of currency. The seller has the task of marketing the goods. Another form of countertrade is the agreement by a seller of plant and machinery to buy back the products produced by the plant and machinery in settlement of the **debt**.

country risk. The **risk** that most or all economic agents (including the government) in a particular country will, for some common reasons, become unable or unwilling to fulfil international **financing obligations**. Country **risk** exists only in the case of cross-border lending. For example, when a bank in country A lends to a company in country B, it bears the **risk** that country B will not provide the company with the necessary **foreign exchange** to repay the **loan**, even though the **borrower** company is perfectly solvent and willing to pay.

credit. The opposite of cash. A term associated with the ability of a legal entity to borrow from a lender. The extension of **credit** is based upon the lender's faith and confidence in the **borrower's** promise to repay the funds borrowed from the lender. Usually this faith and confidence is based upon the lender's knowledge of the **borrower's** past performance in repaying **debts**, the **borrower's** financial history, his assets, standard of living and manner of conducting business.

credit insurance. A form of insurance which covers losses from bad **debts**. The ordinary insurance company does not normally offer this service, but leaves it to specialist companies.

credit line. The amount of **credit** a bank is prepared to provide to a **borrower**.

credit risk. The probability of the possible non-payment of **credit** resulting from **commercial** or **country risk**.

creditworthy. A potential **borrower** who is deemed to be willing and able to pay back a **credit**, thus being considered a low **credit risk.**

cross-default. If a **borrower** defaults on a certain indebtedness with regard to the lender, then automatically another **credit/loan** becomes immediately repayable, provided a **cross-default** has been agreed upon in the relevant documentation.

debenture. Fixed **interest** securities issued by limited companies in return for a long term **loan**; usually secured. It is the most common form of **loan capital**.

debt. A sum of money or other property owed by one person or organization to another. **Debt** comes into being through the granting of **credit** or through raising **loan capital**. Debt servicing means paying the interest on a **debt**.

decommissioning. The work required for the planned permanent retirement of a nuclear facility from active service.

default. The failure to do that which is required by law, or to perform an **obligation** for which there was a previous commitment. The term is commonly used when some legally constituted governing body fails to pay the **principal** or **interest** on its **bonds**, or to meet other financial **obligations** on **maturity**.

depreciation. The reduction in value of an asset through wear and tear, or any other factor that lowers its usefulness.

development banks. Specialized public and private financial intermediaries providing medium and long term **credit** for development projects.

development plan. The documentation by a government planning agency of the current national economic conditions, proposed public expenditures, likely developments in the private sector, macroeconomic projection of the economy and review of government policies. Many developing countries publish five year development plans to announce their economic objectives to their citizens and to others.

direct costs. The direct **capital cost** of a power plant includes those **costs** associated with the purchase and installation of plant components. It consists of factory equipment and site installation costs. The latter include the site labour **costs** (which in turn include both wages and benefits for the labour force) and the **cost** of installation materials (e.g. welding material, reinforcement rods and wiring).

discounted cash flow. A method of evaluating **investments** based essentially on the idea that the value of a specific amount of money to an investor depends on precisely when it is to be received.

discount rate. The **interest rate** reflecting the time value of money that is used to convert benefits and **costs** occurring at different times to equivalent values at a common time. Theoretically, it reflects the opportunity **cost** of money to a particular investor (or, in broad terms, to a particular country).

dividend. The amount of a company's profits that the board of directors decides to distribute to ordinary shareholders.

economic development. The growth of national income per capita of (developing) countries.

economic growth. The steady process by which the productive capacity of the economy is increased over time to bring about rising levels of national income. Rapid **economic growth** has been a major preoccupation of economists, planners and politicians in developing countries in the last two or three decades because it has been thought to be a major precondition determining living standards. The emphasis is now shifting to problems of income inequality, poverty and unemployment.

economic infrastructure (*or* social overhead **capital**). The underlying amount of **capital** accumulation embodied in roads, railways, waterways, airways and other forms of transportation and communication, plus water supplies, financial institutions, electricity and public services, such as health and education. The level of infrastructural development in a country is a crucial factor in determining the pace and diversity of **economic development**.

endorse(ment). Signing one's signature on the back of an instrument. This is the legal act of transferring and passing title to the instrument to another party.

equity. The part of the company's **capital** belonging to the shareholders. In a quoted company this is worth the price per share multiplied by the number of shares. On the company's balance sheet, it can also be described as the monetary value of a property or business which exceeds the claims and/or liens against it by others.

escrow. A written agreement or instrument setting up the allocation of funds or securities deposited by the giver or grantor to a third party, called the escrow agent, for the eventual benefit of the second party, called the grantee. The escrow agent holds the deposit until certain conditions have been met. The grantor cannot get the deposit back except if the grantee fails to comply with the terms of the contract, nor can the grantee receive the deposit until the conditions have been met.

escrow account. A liability account in the books of the **escrow** agent. All funds are deposited as **escrow** by the mortgagor and are posted to this account. When the funds are to be disbursed under the agreement, this account is debited and the disbursement is the **credit**. **Escrow accounts** usually have a preferred status in trust companies.

export credits. **Finance** provided by lenders in a given country for exports of specific goods or services. Conventionally, a distinction is made between private and official **export credits**. Private **export credits** consist of: (a) *supplier's credits*, which are extended by the exporting company to the foreign buyer, and (b) *buyer's credits*, which are extended by commercial banks in the exporting country on behalf of the exporters. Official **export credits** are extended by an agency of the exporting country's government.

export credit insurance. Insurance against the additional risks attendant on foreign trade. Commercial credit insurance companies provide normal cover, but the export credit guarantee agencies, such as ECGD in the United Kingdom, are available for providing normal cover against bad **debts** and the very valuable extra cover against political and exchange **risks**.

exposure. A potential market **risk.**

fees. An amount of money payable for a certain service (usually commitment and management fees); this may be included in a **loan** agreement either as a lump sum payment during the first **loan** instalment disbursement, or as an added margin on the **loan** repayments.

finance. The provision of money when and where required. Finance may be required for consumption or for **investment**. For **investment**, when provided, it becomes **capital.**

financial intermediary. Any financial institution, public or private, that serves to channel loanable funds from savers to borrowers. Examples include commercial banks, savings banks, development banks and finance companies.

fixed costs. **Costs** independent of short term variations in output for the system under consideration. Includes such **costs** as labour, maintenance, technical services and laboratory expenses, taxes and insurance, plant overheads and administration.

fore cost. The overnight construction **costs** of a power generation facility, including all **direct** and **indirect costs**, owner's **costs** and commissioning expenses, spare parts and **contingencies**. These **costs** exclude escalation and **interest** charges.

foreign exchange. Claims on another country held in the form of the currency of that country or **interest** bearing **bonds.**

free trade zone (FTZ). A customs defined area in which goods or services may be processed or be involved in transactions without attracting taxes or duties or being subject to certain governmental regulations.

front end of the nuclear fuel cycle. Those activities involving the preparation of nuclear fuel, ranging from exploration for natural uranium to the fabrication of nuclear fuel assemblies, and delivery of the fuel assemblies to the power plant.

funding. In general, the process of raising money for a specified purpose.

futures. Contracts made in a future market for the purchase or sale of commodities or financial assets on a specified future date.

gross domestic product (GDP). A measure of the total final output of goods and services produced by the country's economy, i.e. within the country's territory by residents and non-residents, regardless of its allocation between domestic and foreign claims. It is obtained by assigning a value to the output of goods and services at market **prices** and then aggregating. All intermediate products are excluded and only goods used for final consumption, or **investment** goods or changes in stocks are included.

gross national product (GNP). The GDP plus the income accruing to domestic residents arising from **investment** abroad less income earned in the domestic market accruing to foreigners abroad.

grace period. The period of time between disbursement of the first **loan** instalment to the buyer and the first repayment by the buyer (**interest** may be paid during this period).

grants. An outright transfer payment, usually from one government to another (foreign aid), i.e. a gift of money or technical assistance which does not have to be repaid.

grid. The transmission network interconnecting electric power systems or bulk power components of a single system.

guarantee. An agreement to be answerable for the **debt**, default or miscarriage of another. The indemnifier assumes primary liability. A guarantor assumes secondary liability, agreeing to pay if the debtor **defaults**. The guarantor or surety must have no interest in the contract between the debtor and creditor.

hard currency. Any currency which is generally safe, i.e. in no apparent danger of losing its value through the loss of confidence or by devaluation. The demand for it is persistently high relative to the supply.

heavy water. Water containing the heavy isotope of hydrogen (deuterium). It is used as a moderator in some reactors because it slows down neutrons effectively and permits the use of natural uranium as a fuel.

indirect costs. The **costs** of production other than direct labour and materials **costs**.

inflation. A process of above normal general **price** increases as reflected, for example, in the consumer and wholesale **price** indexes. More generally, the phenomenon of rising **prices**.

interest. The price paid for the borrowed use of a commodity, especially money, is called interest. It has also been termed the 'rental payment' for money borrowed.

interest during construction (IDC). The accumulated money disbursed by a utility to pay off **interest** on the **capital** invested in the plant during construction. Associated with every project are financial **costs** related to the use of **capital**. Money borrowed or committed for project implementation must eventually be paid back or recovered, with **interest**. A generic term in wide use is *allowance for funds used during construction*, which includes the IDC as well as certain brokerage fees and other expenses related to the procurement of the **loans**.

interest rate. The *nominal rate* on a given **loan** is the percentage stipulated in the loan contract. It may be expressed as a *fixed rate*, i.e. an interest rate that is constant over the duration of the loan, or as a variable or *floating rate*, i.e. an interest rate that is recalculated at fixed intervals (for instance, every six months). Variable interest rates consist of a base rate (such as the six month LIBOR) plus a *margin*, or *spread. Market rates*, or world rates, reflect the terms of borrowing at any given time in private **capital** markets. Market rates are usually differentiated as long term rates, i.e. the current rates payable on financial instruments, such as **bonds**, with **maturities** of more than one year, and short term rates, i.e. the current rates payable on financial instruments **maturing** in one year or less. The *real interest rate* is the interest rate adjusted so as to account for changes in the **price** level.

investment. Real **capital** formation, such as the production or maintenance of machinery or the construction of plants, that will produce a stream of goods and services for future consumption.

lease. A contract, usually made in writing, whereby one party, known as the lessor, grants to another party, known as the lessee, the rights of use, tenancy, or occupancy to property owned by the lessor. This property may be land, buildings, equipment, or other chattel property. The **lease** agreement describes the rights of the owner (lessor) and the renter (lessee) and recites the terms of periodic payment and the tenure of the **lease**. The property leased reverts to the owner at the expiration of the **lease** agreement.

levelized discounted electricity generation costs. Costs calculated by assuming that the present worth value of all revenues produced by the electricity generated (**price** at the level **cost** of the kW·h) equals the present worth value of all expenditures incurred in the implementation and operation of a plant.

liability insurance. Insurance provided by casualty and surety companies as a protection against the loss of property, or of the earning power of an individual or company. Such insurance covers a wide variety of property **risks** — accident, health, fidelity, property damage, collision, workmen's compensation, etc.

life, economic. That period of time after which a machine or facility should be discarded or replaced because of its excessive **costs** or reduced profitability.

loan. A business transaction between two legal entities whereby one party, known as the lender, agrees to 'rent' funds to the second party, known as the **borrower**. The funds may be rented with or without a fee. This fee is called the **interest**, or discount, in banking circles. Banks are the principal lenders of funds for commercial purposes. **Loans** may be demand or time **loans**, depending upon the agreement as to **maturity**. They may also be secured or unsecured within the above categories. When secured, the **loans** are supported by hypothecated securities acceptable to the lender and these securities may be used by the lender to recover the **loan** in case of non-payment by the **borrower**. **Loans** may also be short term or long term. Hard **loans** refer to those made at market rates of **interest**, whereas soft **loans** are made at concessionary, or low, rates of **interest**.

loan repayment schedule. Time schedule agreed upon for repaying a **loan**. It may include equal payments throughout the amortization period, or unequal payments which increase either monotonically or in steps.

marginal cost. The addition to the total **cost** incurred by the producer as a result of varying output by one more unit.

maturity. For a **loan**, the date at which the final repayment of **principal** is to be made. Short term **loans** have an original **maturity** of a year or less; medium term and long term **loans** have an original **maturity** or an extended **maturity** of more than one year.

non-proliferation (of nuclear weapons). Compliance with international obligations in the interest of preventing the further proliferation of nuclear weapons. To this end, the IAEA safeguards system is an integral component of the world's commitment to inhibit the spread of nuclear weapons.

non-recourse. Lenders will have no financial **recourse** for repayment of their **loans** against either the project sponsors or the host government. **Recourse** is limited to the project company and its assets.

nuclear fuel cycle. The steps in supplying fuel for **nuclear reactors**. These include mining, uranium refinement, uranium conversion, uranium enrichment, fabrication of fuel elements, their use in a **nuclear reactor**, chemical processing to recover the remaining fissile material, re-enrichment of the fuel, fabrication into new fuel elements and waste storage and disposal.

nuclear power plant. A **nuclear reactor** or reactors, together with all structures, systems and components necessary for the safe generation of electricity and/or heat.

nuclear reactor. A facility in which a fission chain reaction can be initiated, maintained and controlled. Its essential component is a core with fissile fuel. It usually has a moderator, reflector, shielding, coolant and control mechanisms.

obligation. The legal responsibility and duty of the debtor (the obligor) to pay a **debt** when due, and the legal right of the creditor (the obligee) to enforce payment in the event of **default**.

operation and maintenance (O&M) costs. All non-fuel **costs**, such as the **direct** and **indirect** costs of labour and supervisory personnel, consumable supplies and equipment, outside support services and (if applicable) moderator and coolant make-up and nuclear **liability insurance**. **O&M costs** are made up of two components: **fixed costs** (those that are invariant with the electrical output of the plant) and **variable costs** (those non-fuel **costs** that are incurred as a consequence of plant operation, e.g. waste disposal **costs**).

option. An agreement with a seller or buyer permitting the holder to buy or sell, if he/she chooses to do so, at a given **price** within a given period.

payback period. (1) With regard to an **investment**, the number of years (or months) required for the related profit or saving in operating **costs** to equal the amount of the **investment**. (2) The period of time over which a machine, facility, or other **investment** has produced sufficient net revenue to recover its **investment** costs.

payment guarantee. Security for a contractual **obligation** or a **loan**. The guarantor contracts with the creditor of a debtor to be responsible to him for the whole or part of the **debt** if the debtor defaults.

price. Monetary or real value of a resource, commodity, or service. The role of **prices** in a market economy is to ration or allocate resources in accordance with supply and demand; additionally, relative **prices** should reflect the relative scarcity values of different resources, goods, or services.

principal. The face value or par value of an instrument which becomes the **obligation** of the maker or drawee to pay to a holder in due course. It is upon the **principal** amount that **interest** may be charged, although in some instances the **obligation** is on the **principal** only. This is termed 'non-interest bearing' **principal**.

private sector. That part of an economy whose activities are under the control and direction of non-governmental economic units, such as households or firms. Each economic unit owns its own resources and uses them mainly to maximize its own well-being.

privatization. The sale of government owned **equity** in nationalized industries or other commercial enterprises to private investors, with or without the loss of government control in these organizations.

project finance. The financing of a viable independent economic unit which is expected to generate sufficient revenues to cover operating **costs** and **debt** servicing, while providing an adequate return on **investment**. Financing is granted on the strength of the project's **cash flow**, not on the basis of a **guarantee** of the sponsors and with full **recourse** against the income and assets of the **borrower** and/or the guarantor.

public acceptance/public awareness. Social acceptability. Understanding and **acceptance** by the local inhabitants, or by the general public.

public debt (also national **debt**). Public loans are external **obligations** of public debtors, including national governments, their agencies and autonomous public bodies. *Publicly guaranteed* **loans** are external **obligations** of private debtors that are guaranteed for repayment by a public entity of the debtor country.

public sector. That portion of an economy whose activities (economic and non-economic) are under the control and direction of the state. The state owns all resources in this sector and uses them to achieve whatever goals it may have.

put. An **option** to sell.

put-through clause. An **obligation** undertaken by the buyer of minerals or the user of a pipeline (a project sponsor under a **project finance** scheme) to pay the amounts required for operation and **debt** service of the project regardless of the receipt of goods or services.

rate of return on investment. The **interest rate** at which the present worth of annual benefits equals the present worth of annual **costs**.

recourse. A term used to define the rights of a holder in due course of a negotiable instrument to force prior endorsers on the instrument to meet their legal **obligations** by making good the payment of the instrument if dishonoured by the maker or acceptor. The holder in due course must have met the legal requirements of presentation and delivery of the instrument to the maker of a note or acceptor of a draft, and must have found that this legal entity has refused to pay for, or defaulted in payment of, the instrument.

redemption. The liquidation of an indebtedness whether on or prior to **maturity**, such as the retirement of a **bond** issue prior to its **maturity** date.

reprocessing (of spent fuel). The chemical recovery of unburnt uranium and plutonium and certain fission products from spent nuclear fuel elements.

repudiation. The intentional and wilful refusal to pay a **debt** in whole or in part. The term usually refers to the wilful act of a government or a subdivision thereof.

rescheduling (debt). When a country or business entity has serious liquidity problems which it is convinced are a temporary phenomenon only, creditors for **loans** due for payment in the near or immediate future agree to convert the outstanding **loans** into **loans** which are not repayable until some more distant date. On the international scene, rescheduling arrangements are often set up and supervised by the International Monetary Fund.

risk. A situation in which the probability of obtaining some outcome of an event is not precisely known, i.e. known probabilities cannot be precisely assigned to these outcomes, but their general level can be inferred. In every day usage, a risky situation is one in which one of the outcomes involves some loss to the decision maker (e.g. changes in demand).

savings. The term gross domestic **savings** is defined as the difference between GDP and total consumption, and gross national **savings** are obtained by adding the net factor income from abroad and net current transfers from abroad to gross domestic **savings**.

security. The degree of legal protection, right of **recourse** and degree of a claim on the **borrower's** assets of a lender in the event of **default**.

shadow price. The opportunity **cost** (the amount the asset would have earned in another use) to a society of engaging in some economic activity. It is a concept applied to situations where actual **prices** cannot be charged, or where the actual **prices** charged do not reflect the real sacrifice made when some activity is pursued.

soft loan. Money lent on terms more generous than those available in the market, in the forms of lower **interest rates** and/or longer **maturities**.

sovereign risk. Country risk attributable to the **borrower** country. Either the **borrower** is a country or the **loan** is secured by a **guarantee** issued by (or for) the government; under this circumstance, it is assumed that there is no **commercial risk**.

standard of living. The extent to which a person, a family, or group of people can satisfy their material and spiritual wants.

supplier's credit. A **loan** to an importer for up to 85% of the purchaser **price** of the imported goods which normally is **guaranteed** by the **export credit insurance** of the country of the exporter.

syndicate. A group of bankers who, by agreement among themselves, have joined together for the purpose of distributing a particular lot of securities. The **syndicate** manager is usually the bank that has made a successful **bid** for the wholesale purchase of the securities as a lot. The other banks in the **syndicate** agree to distribute a specified number of the securities and the manager allots the securities to them on a pro rata basis. Upon final distribution of all securities, the **syndicate** is closed and the **obligations** of all members terminated.

take-or-pay. Obligation to pay the agreed upon **price** for an agreed upon quantity of a product, even if the purchaser does not take the agreed upon product for various reasons.

take-out. A **loan** subrogation by a lender or lessor of the long term **loan**.

tied aid. Foreign aid in the form of bilateral **loans** or grants that require the recipient country to use the funds to purchase goods and/or services from the donor country; thus, the **aid** is said to be **'tied'** to purchases from the assisting country.

total capital investment cost. The total **costs** incurred throughout a project schedule, including escalation and **interest** charges, up to commercial operation of the power generation facility.

trustee. A person who handles money or property on behalf of another in a trust.

turnkey (contract). A **contract**, usually on a large scale, where the person paying leaves the contractor, usually a specialist organization, to see to all the details and settle all problems that may occur during the period of the **contract**. The contractee, if satisfied, can merely 'turn the key' and take over an operational unit.

uncertainty. A situation in which the probability of obtaining the outcome(s) of an event is not known. There is thus a plurality of possible outcomes to which no objective probability can be attached.

variable costs. Raw materials **costs**, by-product **credits** and those processing **costs** which vary with plant output (such as utilities, catalysts and chemicals, packaging and labour for batch operations).

waste management. All activities, administrative and operational, involved in the handling, treatment, conditioning, transport, storage and disposal of wastes.

Annex I

ISSUES AFFECTING THE FINANCING OF NUCLEAR POWER PLANTS AND THE ACTIONS PROPOSED FOR VARIOUS ACTORS[1]

PROGRAMME/PROJECT RELATED FACTORS

Issues	Lenders and export credit agencies	Suppliers/investors	Multilateral organizations	Developing countries	
				Government and authorities	Owner organization
Pre-project studies and project preparation	Explore financing possibilities; co-operate in studies of financial feasibility of project; in later phase, arrange offers of financing packages Arrange bilateral soft loans to finance feasibility studies and site studies	Assist in investigating local infrastructures and industrial capabilities for project participation Ensure that environmental requirements and local conditions are properly considered in design	IAEA-World Bank: assist and/or finance long term energy and power sector studies and feasibility studies; include studies of project financial feasibility IAEA: assist in establishing manpower development and training programmes IAEA: assist in establishing licensing procedures/ requirements	Prepare long term energy planning studies; establish sector policies and make commitment to sector development programmes, including nuclear power Make commitment for continuity of power programmes Assess local infrastructures and domestic participation possibilities Explore/define financing possibilities; feasibility to finance project	Carry out long term supply and demand studies for power sector, with participation of relevant national authorities Explore and define financing possibilities; determine feasibility to finance project Prepare and execute manpower development and training programmes at early stage Prepare feasibility studies, with participation of relevant national authorities

Issues	Lenders and export credit agencies	Suppliers/investors	Multilateral organizations	Developing countries: Government and authorities	Developing countries: Owner organization
Pre-project studies and project preparation (cont.)			IAEA (with World Bank financial assistance if necessary): — assist in site studies, — assist in providing objective information for public and decision makers	Establish institutional and legal infrastructures, including licensing authority, procedures and requirements Make land, land rights available before start of project Approve site before start of project Issue generic licences of standardized designs	Select site and carry out extensive site studies Prepare site infrastructures Prepare environmental studies before start of project Provide timely information to relevant authorities and public
Project management during construction and operation		Provide strong management team with authority appropriate to responsibilities for project	IAEA: assist in strengthening and upgrading national project management capabilities (IAEA-World Bank co-operation)	Provide approvals and import licences on schedule to avoid delays in delivery of equipment Eliminate or minimize customs requirements on project Give utility managers proper authority	Co-operate with consultants, including suppliers and utilities with nuclear experience, as appropriate to needs of utility and phase of project

PROGRAMME/PROJECT RELATED FACTORS (cont.)

Issues	Lenders and export credit agencies	Suppliers/investors	Multilateral organizations	Developing countries: Government and authorities	Developing countries: Owner organization
Government commitment to nuclear projects; justification for nuclear power versus fossil fuels			IAEA: hold nuclear power seminars for decision makers IAEA-World Bank: assist and/or finance long term energy and power sector studies IAEA: provide objective information on economic performance of nuclear power	Show evidence of strong national government support of nuclear power by: — strong and consistent support of nuclear power agency — including nuclear power in national and power sector plans — appropriating required funds and approving guarantee and foreign exchange borrowing	Prepare long term expansion plans for generation system, including nuclear power programme
Delays/cost overruns (project completion risk)	Assume share of completion risk through commitment to reschedule repayments (extend grace period and finance cost overruns)	Ensure timely issuance of export licences and continuity of contracts and licences Assume liability for completion risks when fault lies with supplier Ensure that detailed design is complete before start of construction; provide strong justification for any changes Establish realistic project schedules	IAEA: assist in establishing strong and effective project management	Establish consistent and clearly understood policies and procedures Make commitment to finance local share of cost overruns Ensure timely issuance of import licences Ensure timely funding Ensure appropriate licensing procedures to avoid subsequent need for design changes as far as possible	Avoid interruptions in project management (minimize disruptive reorganizations) Fix design as early as possible Establish procedures for rapid examination and decision on any proposal for design change

INVESTMENT CLIMATE

Issues	Lenders and export credit agencies	Suppliers/investors	Multilateral organizations	Developing countries: Government and authorities	Developing countries: Owner organization
Long delay/high risk on returns to equity investors		Compound equity Use convertible debentures	Finance early costs (e.g. feasibility studies, site studies, site preparation)	Invest government funds early; cover down payments and other early costs	Seek supplementary equity investors in later stages of construction
Political risks	Utilize existing insurance schemes		Utilize existing insurance schemes Promote new insurance schemes (e.g. MIGA[2])	Enact clear, consistent and fair investment code; establish record of equitable treatment of investors (including fair compensation in the event of expropriation) Take necessary actions to make operative MIGA[2] and bilateral investment insurance programmes (e.g. COFACE[3], OPIC[4])	
Tariff structures/fair returns in power sector			IAEA-World Bank: encourage/require realistic tariff structures as essential condition in project feasibility evaluations	Establish record of satisfactory tariffs; make commitment of long term tariffs adequate to contribute to financial strength of utility; and commitment to allow transfer of interest/dividends	Establish record of satisfactory tariffs; make commitment to long term tariffs adequate to contribute to financial strength of utility; and commitment to allow transfer of interest/dividends

FINANCING PLAN

Issues	Lenders and export credit agencies	Suppliers/investors	Multilateral organizations	Developing countries	
				Government and authorities	Owner organization
Long period of construction	Provide appropriate schemes for financing (grace period, financing of interest during construction, schedules for repayment, etc.)	Make available as early as possible all information on design and licensing Clearly establish responsibilities for project execution (single responsibility contract)	IAEA: stimulate study of economical and standardized designs, including SMPRs IAEA-World Bank: assist in strengthening and upgrading local project management capabilities	Establish streamlined and effective licensing and design approval procedures Establish rapid administrative procedures (customs clearance, etc.)	Construct multiple units at site, where possible Select standard and proven design Make contract with clear responsibilities Establish incentives for timely completion Establish effective project management
Large capital requirements on extraordinary terms	Arrange appropriate consortium of financing sources Review and revise financing terms under OECD Consensus	Search for sources of equity financing	IAEA-World Bank: assist in strengthening local capabilities for financial planning and debt management World Bank with International Finance Corporation: participate in financing	Make available local loans and equity	Search for equity partners Set up suitable financing plan, including self-financing, foreign and local borrowing and budget funds Contract for all financing required Provide for adequate financial planning and debt management

Issues	Lenders and *export credit agencies*	Suppliers/investors	Multilateral organizations	Developing countries	
				Government and authorities	Owner organization
Availability of local financing	Agree to finance local expenses and interest during construction	Attract local lenders and equity investors	World Bank: assist in alleviating problems of local financing	Guarantee reimbursement of local expenses Approve tariffs which will provide internal cash generation for investment programmes Facilitate access to local debt/equity markets	Access local debt/equity markets
Financing for cost overruns	Make provisions for financing cost overruns	Make careful advance analysis of project schedule and requirements Establish effective control of construction schedule to minimize delays and cost overruns	IAEA-World Bank: assist in strengthening local capabilities for project planning, management and control	Avoid overly ambitious plans for local participation, in particular for a first nuclear power project Assume responsibility for financing local cost overruns	Improve and strengthen planning and project management capabilities Establish flexible provisions allowing change from local to foreign suppliers when appropriate to avoid delays and cost overruns
Participation of multilateral lending agencies			World Bank and other multilateral lending agencies: participate in project financing	Take action to request participation of World Bank and other multilateral lending agencies	

EXPORT CREDITS

Issues	Lenders and export credit agencies	Suppliers/investors	Multilateral organizations	Developing countries	
				Government and authorities	Owner organization
Repayment profile	Revise terms of OECD Consensus Establish repayment profiles which alleviate cash requirement burden in early years of plant operation (e.g. levelized payments instead of equal instalments on principal)		IAEA: stimulate review of OECD Consensus		
Financing local costs and interest during construction	Examine possibilities for capitalizing interest during construction		World Bank: advise and assist on schemes for financing local costs	Provide access to local finance market	Seek local sources for financing
Interest rates	Review OECD Consensus, with aim to reduce or eliminate higher interest rates for nuclear power projects		IAEA: stimulate review of OECD Consensus regarding terms of financing for nuclear power projects		
Mixed credits/soft loans/grants	Review OECD Consensus, with aim to achieve consistency of policies for nuclear and fossil fuel power plants		IAEA: stimulate review of OECD Consensus regarding terms of financing for nuclear power projects		
Limitations on credit guarantees	Share loans among various credit guarantee agencies Establish multinational sources of financing (financial consortia)	Develop multivendor projects (multinational sources of supply and credits)	Involve MIGA[2] IAEA: promote/stimulate economical and standardized SMPR designs	Accept multinational projects: — multivendor sources of supply — multibuyer projects (regional co-operation)	Investigate possibilities for regional co-operation between utilities in nuclear power projects

CREDITWORTHINESS

Issues	Lenders and export credit agencies	Suppliers/investors	Multilateral organizations	Developing countries	
				Government and authorities	Owner organization
Magnitude of risk on single project (large investment cost)	Diversify financing sources and utilize existing credit insurance schemes	Develop multivendor project; diversify sources of supply and credit (multinational sources) Ensure sound project management	World Bank: establish and promote use of institutions for guarantees related to multilateral financing (e.g. MIGA) IAEA: promote development of SMPRs IAEA-World Bank: promote/assist regional power sector planning studies; assist development of multinational projects	Promote regional co-operation in multinational projects	Investigate possibilities for sharing project with utilities in adjacent countries Select appropriate unit size
Credit limits of commercial banks and export credit agencies	Establish multisource financing	Establish co-financing with multilateral financing institutions Arrange multisupplier credits	Establish co-financing with multilateral financing institutions	Establish sound economic policies and debt management programmes Use expert advisers (World Bank, IMF, IAEA) Promote multinational projects	Establish sound tariff and debt management policies

CREDITWORTHINESS (cont.)

Issues	Lenders and export credit agencies	Suppliers/investors	Multilateral organizations	Developing countries	
				Government and authorities	Owner organization
Developing country borrowing capacity			World Bank, IMF: advise countries on sound economic and debt management policies	Establish sound economic policies and debt management programmes Use expert advisers (World Bank, IMF, IAEA) Promote multinational projects	Establish sound tariff and debt management policies
Project finance/risk sharing	Ensure appropriate sharing of risk	Ensure appropriate sharing of risk	IAEA-World Bank: guide and advise on project financing schemes	Adhere to principles of project financing model, with risk sharing	Establish sound tariff and debt management policies

[1] Taken from Promotion and Financing of Nuclear Power Programmes in Developing Countries (Report to the IAEA by a Senior Expert Group), IAEA, Vienna (1987).

[2] MIGA: Multilateral Investment Guarantee Agency.

[3] COFACE: Companie française pour le commerce extérieur.

[4] OPIC: Overseas Private Investment Corporation (USA).

Annex II

ALTERNATIVE ENERGY FUND OF EGYPT[1]

(provisional translation from the official Journal, issue 26, of June 25 1981)

1. THE LAW

Law 45 of 1981
The Establishment of the Alternate Energy
Project's Financing Reserve

Law 45 of 1981
Concerning Financing of Alternative Energy Projects

In the Name of the people, the President of the Republic, the People's Assembly has ratified the following law. And it is hereby promulgated:

Article 1

The Finance Minister may issue bonds in foreign currency to be called alternative energy bonds within the limit of the amount of the Alternative Energy Projects Financing Reserve provided for in **Article 2** of this law.

Article 2

The Egyptian General Petroleum Company (EGPC) shall retain from the oil sector's annual profits the amount of the foreign currencies net balance in excess of the set amount as spelled out in **Article 3** of this law. And shall enter the said excess in a special account to be called the Alternative Energy Projects' Financing Reserve. Effective the end of the Fiscal Year 1980/1981.

The amount of excess in the currencies' net balance referred to in the preceding paragraph which is to be entered in the Alternative Energy Financing's Reserve account, shall be exempted from all taxes.

[1] Provided by the Nuclear Power Plants Authority of Egypt. The text is reproduced here verbatim.

Article 3

Sale to the Egyptian Central Bank of the foreign currencies' excess realized by the oil sector in the Fiscal Year 1980/81 shall be limited to the amount approved for the oil sector's foreign currencies' net balance for the said year. Sales to the said bank shall become effective in FY 1980/81 and the following years on the basis of the account of the foreign currencies' net balance approved for the year 1980/1981 plus a consecutive annual increase of 15 percent. If the realized surplus is less than this, sales to the Central Bank shall be limited in accordance with this Article to the actually realized surplus.

Article 4

The Egyptian General Petroleum Company shall, in the conformity with the program to be agreed upon with the Finance Ministry, deposit the retained surplus as set out in **Article 2** of this Law with Egyptian Central Bank in return for acquisition of the bonds issued by the Ministry of Finance in Foreign currency in the EGPC's name, depositable and collectable at any time at an interest of 6 percent. The interest due on such bonds shall be compounded every six months, and it shall be transformed into new bonds of the same kind.

The amount of the said bonds and their interest shall be exempted from all taxes and duties.

The amount of the bonds referred to shall be assigned for financing Alternative Energy Projects.

Article 5

The machines, equipment and materials received for the Alternative Energy Projects and required for carrying out their activity shall enjoy customs exemption and shall be exempted from other taxes and duties. Use of the items exempted for a purpose other than that for which they were imported is prohibited except after notifying the customs department and settling the customs duties and other taxes and dues according to their conditional and their respective customs tariff valid on the settlement date.

Article 6

The Egyptian General Petroleum Company shall — upon Agreement of the Minister of Petroleum — be refunded the value of the said bonds or part thereof and deposit the same with the investment bank for its utilization in financing the projects set forth in **Article 2** of this law in accordance with the investment project approved by the

Ministry of Planning and in consonance with the funding program functioned by the National Investment Bank for such projects, and as expedient for their execution phases.

Article 7

The competent authorities are hereby charged with implementation of this law.

Article 8

And shall be valid effective the day following the date of its publication. It shall be imposed by the state's seal and executed as one of its laws.

Issued at the presidency of June 17, 1981

(sgd)
(Anwar Sadat)

2. BACKGROUND AND FINANCING SCHEMES

MEMO

On Financing of "Alternative Energy" Projects[2]

Date: 12/4/1981

Energy consumption in EGYPT has been increasing with high rates lately due to the increase in economic development rates. The electric energy consumption has jumped from 8.5 to 18 million kW/h during the period between 1974–1980, while oil and gas increased from 6.5 to 14 million tons during the same period.

As we come closer to reaching the maximum limit of utilization from the river Nile, we find that the dependability on oil to generate electricity has begun to increase enormously. Oil products used in the electricity sector have jumped from 1 million tons to about 3 million tons between 1974/1980.

If we are going to keep depending on oil completely to generate electricity, we have to use about 30 million tons of oil per year to satisfy all the programs by year 2000, in addition to all the other oil usages which are expected to reach 35 million tons per year by the end of this century.

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[2] Reproduced verbatim.

Needless to say that because of the growing escalation of oil prices after 1973, generating electricity from oil has become the most expensive source and represents some kind of waste and extravagance that even the rich countries cannot afford. Therefore, they turned to less expensive sources to generate electricity, such as coal, nuclear power and pump storage to face peak loads. On the other hand the increase of oil prices has encouraged oil producing countries to fund costly programs to extract more oil from the depleting fields.

According to the right economical planning in the field of energy and to reduce the consumption of oil, countries must diversify their sources of energy by relying on nuclear energy and other sources, and to expand extracting more oil from the existing fields which prove to be economically justifiable.

Since the financing requirements for projects of alternative energy planned to be implemented by the year 2000 would amount to no less than US $20 billion (1980 prices). It was the subject of discussion between the Deputy Prime Minister for Production and Minister of Petroleum, and Deputy Prime Minister for Finance and Economic Affairs and Minister of Planning, Finance and Economy.

It was found appropriate to keep aside part of the excess foreign currency revenues of the Oil Sector starting from fiscal year 1980/81, for the purpose of creating a foreign currency reserve fund to finance the above mentioned projects. Helping to achieve this is the expectation that the net foreign currency balance for the Oil Sector will increase more than the set amount of net foreign currency balance in the 1980/81 Budget of the Oil Sector. (The net foreign currency balance means: the value of exports minus all the need to the Oil Sector in foreign currency to cover the importation of consumables, supporting and capital goods, unforeseen expenditures and all due payments according to provision 6 of Law 20/1976).

Indications show that this increase will reach 15% yearly in the coming years. However, because of international oil price escalation and the development of oil production sources in Egypt, the rate of increase will surpass this percent. That is why it was agreed to set aside whatever is more than this yearly percent increase in net balance (i.e. the 15%) to finance the project of alternative energy. The set aside amounts plus their interest (at a rate of 6%) will be kept in the form of bonds issued by Ministry of Finance in foreign currency, in the name of the Egyptian General Petroleum Authority. These bonds would be due at times conforming with implementation progammes of those projects. The due dates should be agreed upon between the concerned sectors. The value of the bonds would then be transferred to the account of the authority responsible of the executive of those projects with the approval of the Minister of Petroleum.

It will be deposited in National Investment Bank to be used for financing project of alternative energy according to their financing programmes approved by the National

Investment Bank, and within the investment budgets certified by Ministry of Planning and according to the actual execution stages.

The Egyptian General Petroleum Authority will deposit the set aside amounts of foreign currency in the Central Bank of Egypt to the account of the Ministry of Finance, and, in return, it will get the bonds issued by the Ministry of Finance payable at any time.

The draft Law takes into consideration exempting the set aside reserve fund for financing alternative energy projects, its bonds, interest, machines and equipment imported for those projects, from all kinds of taxes and levels, and at the same time prohibits the use of exempted machines or equipment for purposes other than what it was imported for.

This draft Law has been prepared incorporating all provision agreed upon in this regard between the two Deputy Prime Ministers.

Deputy Prime Minister for Production
and
Minister of Petroleum

A.E. Helal

Deputy Prime Minister for Finance
and
Economic Affairs

Dr. A.A. Meguid

Annex III

SECTOR UNDERSTANDING ON EXPORT CREDITS FOR NUCLEAR POWER PLANTS[1,2]

A. Form and Scope

This Sector Understanding

- complements the Arrangement on Guidelines for Officially Supported Export Credits;
- sets out the particular Complementary Guidelines which are applicable to officially supported export credits relating to new contracts for the export of complete nuclear power stations or parts thereof, comprising all components, equipment, materials and services, including the training of personnel, directly required for the construction and commissioning of such nuclear power stations.[3]
- does not apply to items for which the buyer is usually responsible, in particular, costs associated with land development, roads, construction village, power lines, switchyard and water supply, as well as costs arising in the buyer's country from official approval procedures (e.g. site permit, construction permit, fuel loading permit).

B. Credit Terms and Conditions

a) *Maximum repayment term*
The maximum repayment terms of an officially supported credit shall be 15 years.

b) *Minimum interest rate*

  i) *Cat. I destination countries*
  Special commercial interest reference rate (SCIRR)

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[1] Material in this annex is reproduced from The Export Credit Financing System in OECD Member Countries, OECD, Paris (1990) 291–293.

[2] All outstanding offers not in conformity with this Sector Understanding and their repayment term, interest rate and expiry date are identified in [OECD] document TD/CSUS/84.33. Upon their expiry, any outstanding offer will then be brought into conformity with this Sector Understanding.

[3] Where a partial supplier provides equipment for which he has no responsibility of commissioning he may offer CIRRs as an alternative, providing that the maximum period from date of contract does not exceed 10 years.

ii) *Cat. II and Cat. III destination countries*
Current Arrangement matrix rate plus 100 basis points or SCIRR, where the "matrix rate" is defined as the relevant minimum interest rate specified in paragraph 5 b) of the Arrangement applicable to credits with the longest repayment terms destined for Cat. II and Cat. III, respectively.

iii) Notwithstanding sub-paragraphs i) and ii) above, in cases where the fixed interest rate commitment is limited initially to a maximum period not exceeding 15 years starting from the date of contract award, the minimum interest rate for that period shall be the current Arrangement matrix rate plus 75 basis points or the SCIRR. For the remaining period until the complete repayment of the loan, official support shall be limited to guarantees or interest rate support at the appropriate SCIRR prevailing at the time of rollover. In no event shall the maximum repayment period exceed fifteen years.

iv) For all currencies that are used by participants in officially supported export credits, the special commercial interest reference rates (SCIRRs) are the appropriate Arrangement CIRRs plus 75 basis points.[4] If a currency has more than one CIRR, the CIRR for the longest term shall be used.

c) *Local cost and capitalisation of interest*
Official financing support at rates other than SCIRRs for both local cost and capitalisation of interest accruing before the starting point taken together shall not cover an amount exceeding 15 per cent of the export value.

C. Official Support for Nuclear Fuel[5]

i) The initial fuel load shall consist of no more than:

- The initially installed nuclear core, plus
- Two subsequent reloads, together consisting of up to two-thirds of a nuclear core.

Official support for the initial fuel load shall cover a maximum repayment term of four years from delivery. The minimum interest rate on the initial fuel load shall be at the rates in the Arrangement.

[4] Except that for the Japanese yen, the SCIRR is the Arrangement CIRR plus 40 basis points.

[5] It is understood that for the time being the separate provision of Uranium Enrichment Services shall not be subject to financing conditions more favorable than those applicable to the provision of nuclear fuel.

ii) Official support for subsequent reloads of nuclear fuel shall be made available without interest rate support (i.e. only guarantees or financing at CIRRs may be offered) and shall be on repayment terms no longer than two years from delivery. It is understood that repayment terms of over 6 months are exceptional in recognition of which the procedures of paragraph 14 a) of the Arrangement will apply.

iii) Reprocessing and spent fuel management (including waste disposal) shall be paid for on a cash basis.

D. Free Fuel or Services

Participants shall not provide free nuclear fuel or services.

E. Tied Aid Credits

Participants shall not provide tied aid credits, associated financing (as defined by the DAC), aid loans or grants or provide any other kind of financing at credit conditions that are more favorable than those set out in this Understanding.

F. Prior Notification and Consultation

Participants shall notify and consult each other under the terms agreed upon in the Appendix to this Understanding.

G. Review

The provisions of the Sector Understanding are subject to review each year, normally at the spring meeting of the Participants.

Annex IV

ALIAGA THERMAL POWER PROJECT IN TURKEY[1]

(a) Project description

(1)	Planned site:	Aliaga area, Izmir, Turkey
(2)	Plant specifications:	
	(i) Rated power:	500 MW(e) (two units)
	(ii) Net annual sale of generated electricity:	6.2 billion kW·h (at sending end, availability factor at 75.2%)
	(iii) Main fuel:	Imported coal
	(iv) Fuel consumption:	About 2.3 million tons per year
	(v) Environmental protection facilities:	FGD, electrostatic precipitator, etc.
(3)	Total investments:	Yen 150 billion (some US $1.15 billion)
(4)	Financing plan:	Equity capital (Yen 18 billion) — Japanese contribution: 70% — Turkish contribution: 30% Loans (Yen 132 billion) — EXIM–Japan's export credit — commercial bank loan
(5)	Schedule:	Construction work for 4 years, operation period for 15.5 years (from the point of the first unit's operation)
(6)	Purchaser:	Turkiye Electrik Kurum (TEK) Electricity transaction is based on take-or-pay contract

(b) Project implementation scheme

(1) *Establishment of a vehicle company for commercial loans:* The following eight companies are to establish a vehicle company in Japan for providing commercial Japanese loans to a joint venture company (JVC) in Turkey:

Electric Power Development Corporation (EPDC)
Mitsubishi Corporation (MC)
Mitsubishi Heavy Industries (MHI)

[1] Based on information provided by the Electric Power Development Corporation of Japan.

Hitachi
Ishikawajima-Harima Heavy Industries (IHI)
Hazama Corporation (HAZAMA)
Kajima Corporation (KAJIMA)
Nippon Yusen Kaisha (NYK)

(2) *Establishment of a JVC:* Upon a request from the host country, a JVC that will implement the project is to be established in Turkey through a joint contribution from Japan of 70% and from Turkey of 30%. From Japan, the eight companies listed above are to invest directly in the JVC.

(3) *Construction work at the power plants:* An unincorporated joint enterprise or consortium comprising the following companies is to receive the order en bloc from the JVC under a turnkey contract. Each company is to perform the following work:

- EPDC: Leading company in the construction consortium, in charge of general co-ordination of schedule control, designing the plants, construction supervision, commissioning, etc.
- MC: In charge of the plant export activities and miscellaneous work.
- MHI: In charge of manufacturing boilers for the thermal power plants and relevant facilities.
- HITACHI/ C. ITOH Group: In charge of manufacturing turbine generators and electrical equipment for the thermal power plants.
- IHI: In charge of manufacturing FGD, unloading facilities and incidental equipment for the thermal power plants.
- HAZAMA: In charge of civil works related to the thermal power plants.
- KAJIMA: In charge of architectural works related to the thermal power plants.

(4) *Operation and maintenance of the power station:* As the operator, EPDC will conduct operation and maintenance of the power plants under an en bloc commission from the JVC, with transfer of technology and know-how to Turkish personnel. The JVC will repay, through electricity tariff revenues, its debt acquired for the construction works of the plants.

(5) *Procurement of coal:* The EPDC will procure the necessary amount of coal for operating the power plants as part of the contract for operation and maintenance concluded with the JVC. Coal will be procured from Australia, China, Colombia, the East Coast of the USA, etc., and surface transportation will be carried out by NYK, one of the sponsors of the JVC, among others.

3. Background and history

" The coal fired power station project involved a large number of foreign firms invited to submit proposals under a competitive bidding procedure; some reached the stage of advanced negotiations with the Turkish authorities. The lengthy and intermittent discussions which have taken place during the last several years have led to some changes in the policy originally established by the government and to the elaboration of complex arrangements.

The history of these projects started in 1984, with the pre-feasibility study carried out by Bechtel at the request of the Turkish Government for a 600 to 1000 MW coal fired electric plant that was to be financed and built on the BOT model. In September 1985, on the basis of the positive results of this study, Bechtel submitted an offer for a 960 MW plant to be built at Takirdag, on the Sea of Marmara, at a cost of about US $1 billion; to carry out this project Bechtel formed a consortium including Combustion Engineering, a US manufacturer of steam generators, and the German company Kraftwerk Union (KWU).

During the negotiations with Bechtel, which started at the end of 1985, the basic conditions which were then used by the Turkish Government to establish the terms of reference for similar projects were negotiated. In the meantime, other consortia made proposals for coal fired plants at other sites. At the end of February 1987, the Ministry of Energy and Natural Resources sent a letter to the five consortia that had made proposals defining the most important criteria for the evaluation and selection of the best offer as well as the security package granted by the government. Proposals were submitted by the following consortia, each consortium bidding for a project at a different site:

(i) Bechtel (USA) and KWU (then West Germany) for a plant in Tekirdag;
(ii) Seapac (Australia), Chiyoda (Japan) and Westinghouse (USA) for a plant in Yummurtalik, near Gazi;
(iii) Asea Brown Boveri (Sweden/Switzerland) for a plant on the Sea of Marmara;
(iv) Electric Power Development Corporation and Mitsubishi Corporation group (Japan) for a plant at Aliaga; and
(v) Alsthom (France) and Ansaldo (Italy) for a plant near Izmir.

The bidders were ranked in September 1987, and the Turkish authorities declared that three plants would be built in the following eighteen months.

The first ranked bidder was the Seapac–Chiyoda–Westinghouse consortium which benefitted from the support of the Queensland (Australia) Government with respect to equity funds and coal supply. Contractual documents were initialled by the parties in December 1987. The Government of Queensland however, soon withdrew its support, and Chiyoda and Westinghouse took over the leadership of the consortium. The Turkish Government spent the first half of 1988 negotiating with all of the sponsor groups in turn, but returned in August 1988 to exclusive negotiations with the consortium now led by Chiyoda and Westinghouse. By June 1989, members of the Chiyoda consortium claimed they had reached final agreement with the Government on all points. A month later however, the Gazi project had reportedly been put on hold by the Turkish Government. In late October, the Government announced that it had signed an agreement in principle with one of the other competing sponsor groups, the Japanese consortium led by EPDC for a $950 million coal fired power plant at Aliaga. This project now appears to be held up on environmental grounds.

Legislation is being submitted to the Turkish Parliament for the creation of an Energy Fund. This Fund would serve, amongst other purposes, as a vehicle for financing the various guarantees offered by the Government for BOT projects in the energy sector."[2]

In October 1989, the Turkish Government made a Cabinet Decision on designation of the planned site as a Free Trade Zone and approval was given for construction and operation of a 1000 MW plant (2 × 500 MW) by a JVC to be established by an EPDC/Mitsubishi led consortium at the site. The decision was decreed in an official gazette. However, just after the announcement of the decree, a parliament member selected from the Aliaga constituency appealed to the Supreme Court of Administrative Litigation against the Cabinet to revoke the cabinet decision on the ground that the decision has not involved taking the necessary licensing procedures for environmental protection. Upon receiving this appeal, on 17 November 1989, the Court decided to suspend the execution of the cabinet decision for three months pending investigations. In March 1990, the Court finally ruled that licensing procedures related to the site's environment have to be followed independent of the en bloc decision designating the FTZ and giving permission to the electric utility.

As a result of this court judgement, the Turkish Government has had to take the following steps:

— Withdrawal of the Cabinet Decision of October 1989,
— Decision in the Cabinet to designate the FTZ in the Aliaga area but without specifying a plant,
— Establishing a pilot company which will apply for licensing procedures related to site environment, after getting approval on environmental issues,
— Letting the applicant (JVC) apply for permission on an independent electricity utility business in the Aliaga area.

[2] Quoted from LECAT, J.-J., An Overview of BOT Projects Proposed in Turkey, WPS-498, The World Bank, Washington, DC (1990) Annex 3, 23–25.

On 7 May 1990 the official gazette announced that the Cabinet Decision of October 1989 was revoked and that the Cabinet decided to designate the Aliaga area to be a FTZ.

The EPDC/Mitsubishi Corporation group has established a pilot company that precedes the JVC, with minimum equity capital under the Turkish Foreign Investment and Encouragement Law. As of the end of March 1992, the group was still waiting for a decision by the Turkish authorities over whether or not the siting of the project is environmentally acceptable.

Annex V

BOT PROJECT DEVELOPMENT CYCLE[1]

1. Feasibility and Commercial Aspects

A BOT project generally has three phases:

(a) Phase I involves a pre-feasibility assessment arrived at by defining the project market and technical, economic, and commercial parameters to establish project viability. In a nuclear power plant much attention must be given to the type of technology, project site, and environment factors.

(b) Phase II further assesses project feasibility with emphasis on the commercial, financial, and legal structure. In the case of nuclear power plants, regulatory and licensing arrangements are most important.

(c) Phase III provides for negotiation of the arrangements agreed to in Phase II, e.g. the electricity tariff under the power sales agreement and other key agreements to bring the project to financial closing.

Organizational, financial, and commercial aspects are central to the development of a BOT project, and are important from inception to financial close. The process of creating an "owner" and a "project company" that are tied together under a commercial structure is time consuming, complex and costly.

2. Project Developer/Sponsor/Owner

The sponsorship of project development can take a number of different forms. Typically, several parties may join in a development consortium which involves companies with direct interest in the power project. Such companies are represented by suppliers of equipment, engineering, construction services, and operation and maintenance services. These entities generally are the "active" investors, make up key members of the project company, and share in the project development costs. The host country can also participate in the project as an equity investor.

The key to project success is the involvement of confident, responsible, and credit worthy sponsors/developers which help attract additional equity investment and are key to creating lender confidence.

[1] Reproduced verbatim from ELLIOTT, W.R., RUTGERS, J.A., SIEGEL, J.R., TAUBENBLATT, S.A., "The BOT approach: Implications for nuclear power plants", Financing of Nuclear Power Projects in Developing Countries (Proc. Seminar Jakarta, 1990), IAEA-TECDOC-610, IAEA, Vienna (1991). With the permission of the authors.

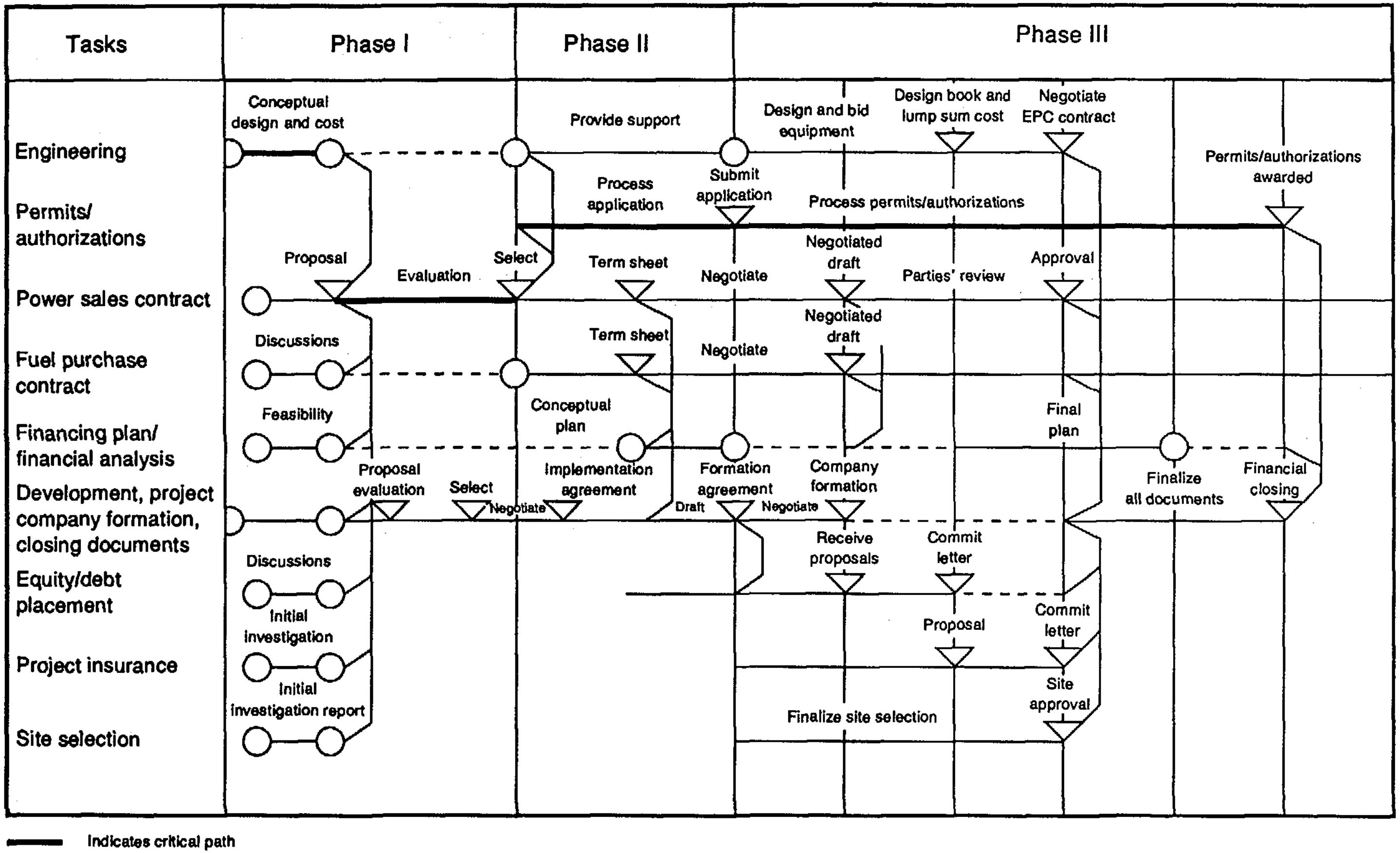

FIG. 1. The BOT project development schedule.

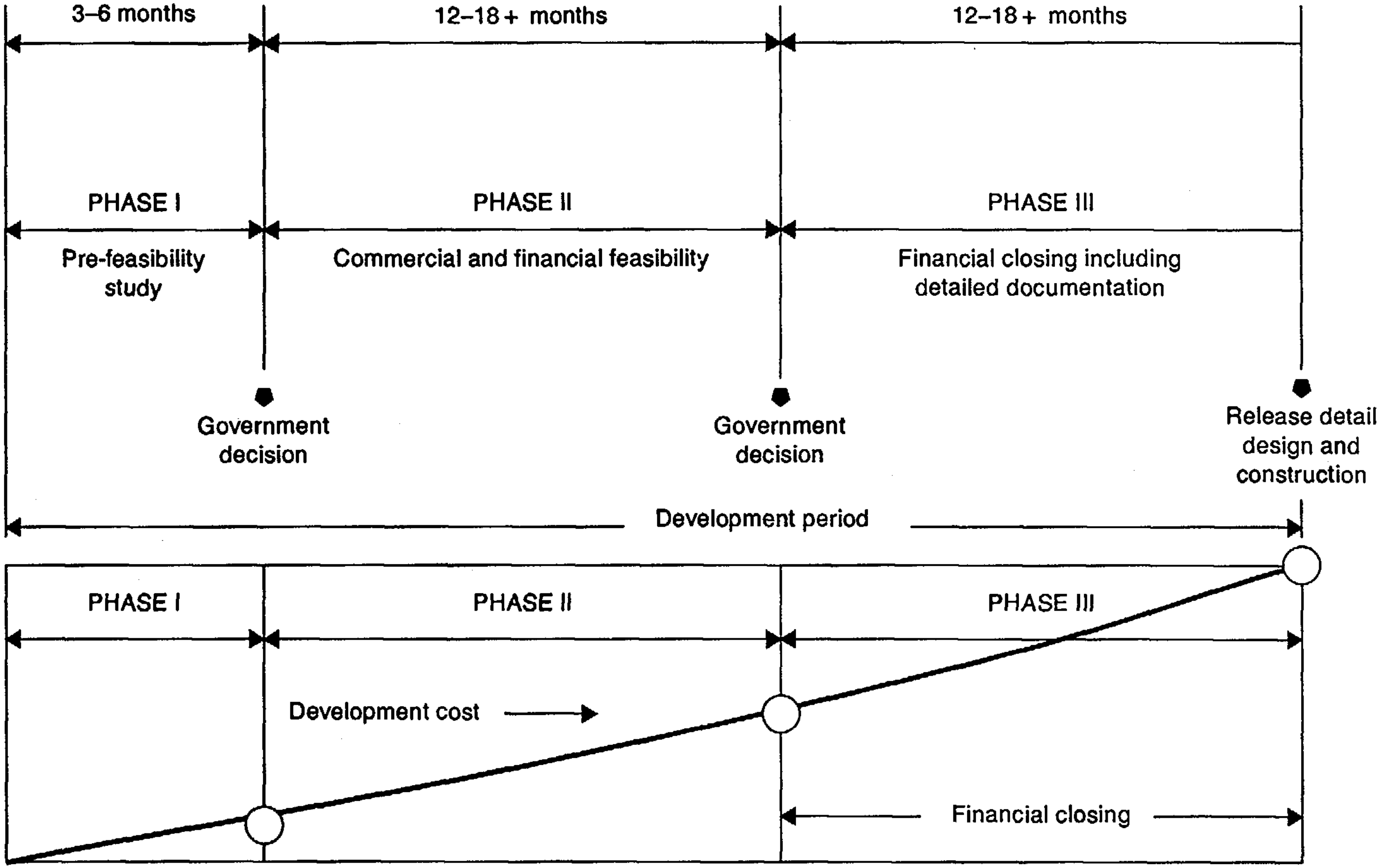

FIG. 2. The BOT project development pattern/cost.

3. Development of Agreements

A sound, cost effective project development effort requires the same project management discipline involved in successful construction management. Of key importance is a step-by-step "milestone" approach with clear go or no go decision points for sponsors/investors. Ideally, this takes the form of a series of written agreements between the host country and the project sponsor formalizing the evolving understandings between the parties.

For, example, following completion of certain pre-feasibility work, the sponsor and host government enter into a *Memorandum of Understanding* that sets forth a development schedule specifying project milestones and deadlines for achieving them. After the milestones specified in the *Memorandum of Understanding* have been accomplished, the parties then enter into a full *Implementation Agreement* specifying obligations and responsibilities including cost sharing for both parties up to financial close.

The *Power Sales Agreement* is probably the most important financial security arrangement. This provides for the government-owned utility to buy electric power from the private project company at a price that covers operating costs, fuel, debt services, repatriation of equity, and a fair return for the services provided and risks assumed. In turn, the project company agrees to deliver a base amount of electricity at negotiated prices. The power sales agreement can also provide incentives in the form of bonuses of penalties to encourage efficient plant operations. Figure 1 shows a project development schedule including the key actions to be carried out in the three phases.

4. Project Development Costs

The cost of implementing a BOT model should not be underestimated. It may amount to 3 to 5% of total project costs, much of which must be expended prior to any assurance that the project will be approved and implemented. For large fossil fired power plants, this equates to the cost of detailed engineering design. Because these costs are high, involving expert legal and financial skills, the examination of the host country's objectives, and the assurance that there is a government consensus, appear to be prudent.

The special considerations that are inherent in a nuclear power plant must be added to the already complex and costly BOT process. Even with the new generation technology, nuclear power projects will likely have large capital costs (about US $1 billion) and may take from 5 to 8 years to develop, license, and construct.

The workability of the BOT model for major fossil power plants in LDCs is yet to be proven conclusively. If the BOT model is proven beneficial for a fossil project, then its application to nuclear power plants can be addressed. Figure 2 shows a project development schedule for a nuclear power plant and its related development costs in the different phases.

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Advisory Group Meetings

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RELATED AGENCY PUBLICATIONS

Bid Invitation Specifications for Nuclear Power Plants: A Guidebook, Technical Reports Series No. 275 (1987).

Costs and Financing of Nuclear Power Programmes in Developing Countries (Proc. Seminar Vienna, 1985), IAEA-TECDOC-378 (1986).

Economic Evaluation of Bids for Nuclear Power Plants: A Guidebook, Technical Reports Series No. 269 (1986).

Energy and Nuclear Power Planning in Developing Countries, Technical Reports Series No. 245 (1985).

Expansion Planning for Electrical Generating Systems: A Guidebook, Technical Reports Series No. 241 (1984).

Financing of Nuclear Power Projects in Developing Countries (Proc. Seminar Jakarta, 1990), IAEA-TECDOC-610 (1991).

Nuclear Power Project Management: A Guidebook, Technical Reports Series No. 279 (1988).

Projected Costs of Nuclear and Conventional Base Load Electricity Generation in some IAEA Member States, IAEA-TECDOC-569 (1990).

Promotion and Financing of Nuclear Power Programmes in Developing Countries: Report by a Senior Expert Group (1987).

Technical Evaluation of Bids for Nuclear Power Plants: A Guidebook, Technical Reports Series No. 204 (1981).

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