

Nuclear power programmes in developing countries: Promotion & financing

An IAEA senior expert group concludes its study of major problems

by L.L. Bennett

One function of the IAEA is to assist developing Member States in their efforts to utilize nuclear power in meeting their needs for energy, in particular electricity. Since its inception, the IAEA has worked to carry out this function. It is a fact, however, that so far — and notwithstanding that the nuclear power option could make a very useful contribution to energy supplies in a number of developing countries — nuclear power has been introduced only to a small extent in a few of these countries.

In some cases the non-use of nuclear power in developing countries can be explained by the availability of alternative sources of energy, such as hydropower. In many other cases insufficient trained manpower, inadequate infrastructures, economic problems, and financial constraints are the reason. The fact that such constraints can be overcome is demonstrated by a number of technologically advanced developing countries which are making excellent and extensive use of nuclear energy for electricity production and have developed a broad research capacity in the nuclear field.

Against this background it has appeared timely to take a fresh look at the prospects and problems for nuclear power in developing countries; and the role of the IAEA in this regard. For this reason, in 1986 the Agency's Director General established the Senior Expert Group (SEG) on Mechanisms to Assist Developing Countries in the Promotion and Financing of Nuclear Power Programmes. It was asked to: (a) identify and analyse the problems of and constraints on nuclear power introduction/expansion in developing countries, with particular attention being paid to the problems of financing nuclear power projects; (b) study mechanisms for dealing with the identified problems and constraints in order to assist developing countries with the promotion and financing of their nuclear power

programmes, and to determine the role of the IAEA in this context.

The SEG participants comprised 20 experts with extensive experience in the topics to be studied, coming from 15 Member States plus the World Bank. It completed its work in May 1987 and the report on its study was published in August 1987.*

Requirements for nuclear power programme

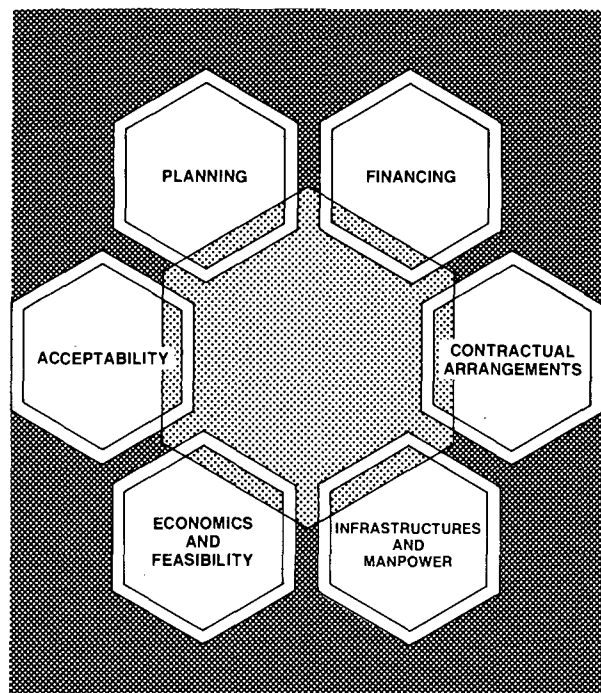
In order to identify the constraints that developing countries might face in the introduction and execution of a nuclear power programme, the SEG defined the items which need to be fulfilled for a successful programme. (*See accompanying table, where they are shown as general requirements.*)

It is clear that many of the requirements are interrelated. For example, it can be expected that availability of qualified manpower and industrial support will be interdependent. The size and in particular the quality of the electric grid will in many countries reflect the general level of industrial development. The government's commitment to and support of a nuclear power programme will be coupled to the country's overall long-term economic development and energy supply policies. Financing and contractual arrangements will be interrelated. Nevertheless, every country represents a unique situation and this makes it impossible to generalize, so it has not been possible to simplify the list of requirements further. The importance of each one as a constraint must be assessed specifically in each country so that the best ways of overcoming the particular problems may be chosen.

Some constraints which have become important have a subjective background. This is particularly true in regard to acceptance by the public and, through its

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* *Promotion and Financing of Nuclear Power Programmes in Developing Countries*, report to the IAEA by a Senior Expert Group. The report is available upon request to the IAEA Division of Publications.



impact on political movements, by the government and authorities. This type of constraint could be more difficult to overcome than those which can be defined in objective technical or economic terms and for which it would be possible to formulate concrete counter-measures. The subjective side of the long-term energy policy and the government commitment to nuclear power has now become a major concern to financing institutions, as decisions to complete and operate nuclear power plants have been changed in some cases.

Financing issues and problems

The SEG recognized that financing represents one (but not the only) major constraint to nuclear power development in developing countries. Therefore, it formed a subgroup on financing to study the following four issues: (1) the circumstances specific to financing of nuclear power projects; (2) the present schemes of export finance and the extent to which they are responsive to the needs of developing countries for financing nuclear power projects; (3) methods of improving the present export finance schemes to make them more responsive; (4) other methods which could be used to alleviate the problems of financing nuclear power projects.

Three principal characteristics specific to nuclear power projects which make financing difficult were identified:

- *High investment costs of nuclear power plants.* The total investment cost of a nuclear power plant may approach or even exceed the available credit limits identified by bankers for individual developing countries. Lenders are likely to be reluctant to concentrate their financial risk in a single project of this magnitude.

- *Long duration of construction.* For planning purposes, about 8 years should be assumed for the construction period of the first nuclear power plant in a developing country. During this construction period the owner is confronted with two complementary problems, which are more severe for nuclear power projects than for other kinds of project owing to the longer construction time: (1) lack of revenue from the project, as the plant under construction is not yet producing electricity; (2) the requirement to pay interest during construction: for example, for a duration of 8 years and with an interest rate of 7-10% per year, the interest during construction will add some 30-45% to the plant construction cost.

- *High degree of uncertainties.* Owing to the large amount of money invested and the long construction time, as well as uncertainties about the eventual outcome with respect to both factors, lenders generally consider that financing of nuclear power projects is a highly complex undertaking.

Alleviating financing problems

The SEG gave extensive consideration to the overall complexities of nuclear power projects and how these complexities affect nuclear power financing. In particular, it is essential that every effort be made, by all parties involved in the development of nuclear power, to reduce the uncertainties linked to such large investments and long project times, in order to improve the overall climate for financing of nuclear power projects.

The group attempted to identify the main issues affecting the financing of nuclear power projects and suggested specific actions that each party involved (lenders and export credit agencies; suppliers and investors; multilateral organizations; developing countries) could undertake in order to reduce economic and financial risks and to make a nuclear project more predictable.

The various issues were grouped into five major domains: programme-project-related factors, investment climate, financing plan, export credits, and creditworthiness.

- *Programme-project-related factors.* All possible efforts should be made to reduce as far as possible the uncertainties surrounding the cost and schedule of a nuclear power project. The buyer government's commitment to, and demonstrated backing of, the nuclear power programme is essential in this respect. The government should take early and strong actions to put in place the legal and institutional arrangements which are required for the programme.

Although the initial commitment by the government will relate to a decision on a specific project, this decision must be taken in the context of a longer term commitment to a nuclear power programme involving a number of consecutive units. A strong commitment to conclude each project on schedule is considered to be a necessity for international financing. It is essential that

there be strongly committed organizations and leadership to implement and guide the programme, as interruption in programme and project implementation would lead to longer plant construction times and higher costs.

Experience in a number of countries, both developing and industrialized, has shown the importance of a study to identify and justify the role of nuclear power in a national energy plan and to establish long-term policy reasons for nuclear power in the country. The planning effort must consider opportunities for demand management as well as supply options and must place energy (in particular electric energy) needs and strategies in the context of overall national development plans, resource assessments, and potential uses of resources. Economic planning should be one basis for policy formulation, but the planning must not be too narrow and should take into account the environmental impacts and perceived risks of different supply options and the total costs of building up new supply structures, as these have an important influence on the choice of the "optimum" energy system, in addition to cost optimization. Although it is clear that the nuclear option must show promise of economic viability in order to be chosen, the long-term advantages of stable generation costs, diversity of supply, etc., must also be recognized.

Regional co-operation should be sought whenever feasible to obtain co-ordinated nuclear power and electricity supply policies from which benefits could be drawn through joint efforts in, for example, manpower development, use of available industries, and the establishment of larger grids through interconnection.

Manpower assessment and development programmes should be established at an early stage in preparation for project execution. The exact manpower requirements will depend upon the contractual arrangements for a project, and much can be gained by paying special attention to this aspect in the contract with the supplier and with an experienced utility in the supplier country. It is possible to overcome local deficiencies to a great extent through outside consultants and architect-engineering firms and through the services which can be offered under a turnkey contract, which is the customary form of contract for the first nuclear power plant in a country. The availability of qualified manpower can increase in importance as a constraint when increasing local participation is sought for subsequent nuclear power projects. This should be recognized from the beginning in manpower development planning, since a long time (10 years or more) is needed for building up the essential manpower.

The IAEA could have an important role in strengthening and assisting local capabilities for energy and power sector planning, project feasibility studies, manpower development, and other infrastructure developments. Objective information on nuclear power provided by the IAEA, for example through seminars for decision makers, could make a positive contribution to government commitment as well as to public attitudes towards nuclear power.

● **Investment climate.** Considering the complexities of nuclear power financing, it is very important that the investment climate surrounding a nuclear power project be favourable. It can be enhanced if the government and owner organization of the buyer country establish a record of consistent and fair dealings with lenders and investors, as well as an electricity tariff structure adequate for the financial strength of the utility.

The World Bank plays a useful role by assisting the buyer organizations to determine tariff structures which would be appropriate to meet the needs of investment programmes, for instance on the basis of long-run marginal costs of generation. The IAEA methodologies for economic evaluation and optimization of electricity generation systems could be usefully applied in co-operation with the World Bank.

● **Financing plan.** The financing plan must be designed to meet the special needs of nuclear power project financing, such as a long construction time, a large capital requirement at 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 a nuclear project, such as taking steps to shorten project times and reduce costs as well as minimizing the likelihood of delays and cost overruns.

● **Export credits.** Some specific steps could be taken to alleviate the problems of export credit. In particular, opportunities for multivendor and multibuyer projects should be investigated and where appropriate promoted as a means to overcome limitations on export credit guarantees and distribute the financial risk.

● **Creditworthiness.** Doubts about the creditworthiness of a buyer country can be a very serious obstacle to nuclear project financing. Indeed, it is unlikely that any scheme could be found to finance nuclear power projects in countries with very poor creditworthiness, especially in view of the large investment cost of nuclear power plants. However, for countries with generally acceptable credit ratings, some steps could be taken to improve possibilities for financing a nuclear power project, for example in terms of economic policies, debt management, and project risk sharing.

● **Innovative schemes for nuclear project financing.** Workable arrangements to share the economic and financial risks, such as multisupplier and multibuyer projects, and co-financing with multilateral financing institutions (e.g. the World Bank), would be very helpful in obtaining financing for a nuclear power project. As one example, the build-operate-transfer (BOT) approach would make use of project financing for part of the investment requirements, but would also involve equity investors in the project. A distinctive feature of the model is the inclusion of foreign investors in the ownership and management of the nuclear power station.

It must be emphasized that while the BOT model might offer an alternative financing scheme for countries

which have a generally acceptable creditworthiness, it does not in itself overcome the basic problems of creditworthiness. The contractual arrangements which would be necessary for identifying the responsibilities and risks for the various involved parties are very complex and can, in themselves, introduce new uncertainties into the project.

To date, no nuclear power project has been implemented using the BOT model. However, some countries (e.g., Turkey and Indonesia) are in the process of negotiating or studying the feasibility of BOT projects. The results of these efforts could give an indication of the potential for this model to be applied to other projects.

Conclusions of senior expert group

On the basis of its study, the SEG concluded that:

- Energy in all available forms will be needed to facilitate economic growth and improvements in the quality of life in developing countries
- Increasing use of electricity produced in bulk will be essential
- There is a need for nuclear power in some developing countries
- The IAEA has an important role in assisting its developing Member States to plan and execute nuclear power programmes, including advice and assistance on financing issues.

Requirements for nuclear power introduction and implementation

- **Requirements which must be met at the national level before the introduction of nuclear power**

- Long-term policy reasons for nuclear power
- Government/national commitment to a nuclear power programme
- National legislation to create the organizational and regulatory basis for radiation protection and nuclear safety, provide for enforcement of such regulations, and define nuclear liability
- An electric grid with size and characteristics adequate for accepting a series of units, which at the time are likely to be the largest units on the grid and should be operable at a high load factor
- Acceptability of the nuclear power option from the viewpoint of those who prepare and take decisions, and the public.

- **Requirements which must be met for the successful implementation of a programme**

- Feasibility study covering the technical and economic viability of a project and the national infrastructures to support it, as a basis for the decision to be taken on the project
- Qualified manpower for all activities which are either required (e.g., planning, project management, operation, and regulation) or desired within the country
- A general level of technical and scientific development which can effectively support the operation and maintenance of a nuclear power plant, including, e.g., support in scientific and technical problem diagnosis
- An industrial support structure capable of meeting the desired level of participation in project execution, operation, and maintenance, and meeting specified levels of quality
- An organizational structure with entities which have clearly defined tasks and responsibilities for planning, project execution, ownership and operation of the plant, and regulation
- A national quality assurance/quality control system at different levels to meet regulatory safety requirements and to serve as a management tool to ensure good operating performance of the project

- **Requirements necessitating international action for the successful launching of a project**

- An international, intergovernmental agreement structure to provide the basis for supplies and transfer of technology
- Establishment of contractual arrangements for supplies of equipment, fuel, services, spares, and technology on a continuing basis
- Definition of the most effective channels for technical assistance and technology transfer for each area of weakness or deficiency

- **Requirements for maintaining the programme**

- A long-term policy for assuring supply of fuel, equipment, and technology
- A long-term policy for waste management and disposal

- **Requirements for financing the projects**

- Adequate and supportable financing for each project
 - Financing schemes responsive to the needs of developing countries in terms of interest rate, periods of grace, and repayment profiles
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