NUCLEAR POWER IN THE PHILIPPINES

The first United Nations project of its kind, where the prospects of using nuclear power in a developing country are being analysed, is being carried out in the Philippines. It is entitled, "Pre-Investment Study on Power, including Nuclear Power, in Luzon"; it is a United Nations Special Fund project, for which the International Atomic Energy Agency is acting as the executing body. Although directed specifically at the situation of the Luzon grid, the approach and the methods evolved should be useful in other countries also. The project was initiated in early 1964 and is expected to be completed by the end of 1965.

The Philippines have substantial reserves of hydro capacity, but very little of fossil fuels. The country has been interested for quite some time in the possibility of using nuclear power. In 1956 a study was made of a small nuclear power plant for the Manila area, but such a plant would not have been able to compete with the fossil fuel-fired station. The Philippine Government had in mind the development of Luzon Island, which is the largest and most industrialized part of the Philippines, accounting for 50 per cent of the population and 80 per cent of the power demand. In 1960, the Government invited an Agency mission, whose report entitled, "The Prospects of Nuclear Power for the Philippines", indicated that the possibilities of using a reasonably large nuclear plant in the Luzon grid deserved serious consideration.

In order to undertake a detailed study of the Luzon grid, the Government approached the United Nations Special Fund for assistance. In 1963, the Special Fund allocated about $477000 for the project, to be supplemented by another $223000 from the Philippine Government in counterpart funds.

The essential object of this study is to develop an optimum power programme. This will be accomplished by examining the relative economics of different ways of meeting the future load growth of the grid, taking into account first the extent of the contributions from the indigenous energy resources and then the possibility of supplementing them by using nuclear power. In this way the study will help determine whether it is technically feasible and economically desirable to use nuclear power to supply a part of the demand between 1965-75.

The study has been divided into two phases. Phase A, which was virtually concluded in February 1965, was aimed at the evaluation of local energy resources and estimation of local demand. Phase B, which is now under way, deals with the analysis of different expansion schemes in order to arrive at an optimum power plan. Such a plan would be based on the maximum economic exploitation of the country's resources, supplemented as necessary by imported fuel.

LOCAL ENERGY RESOURCES

The principal resources are hydro-electric, and the evaluation benefited greatly from a Water Resources Survey which had been conducted by the

United States Bureau of Reclamation. The Agency sent a hydro expert to the Philippines to review the available data. The main conclusions indicate a potential of 20000 to 25000 MWH per year, of which only 5 per cent has so far been exploited. Lack of hydrological and geological data, remoteness and difficulties of finance are obstacles to the rapid development of hydro resources. However, by 1975 an estimated additional 560 MW of hydro capacity could come into operation, increasing the exploitation of hydro potential from 5 to 15 per cent of what is available.

With the help of field experts provided by the United Nations Resources and Transport Branch, the Agency assessed other energy resources. Only two coal deposits were of interest, and at both places drilling was done to supplement information from earlier surveys. At Batan (10 kilometres from the south-east coast of Luzon) indicated reserves of some 7000000 tons could support a 25 MW power station. The Semirara field (250 kilometres south of Luzon) would yield 2000000 tons to support a 20 MW station. At both places the coal would perhaps best be used for regional electrification schemes.

Luzon has many hot springs, but most are too small for a geothermal power station of any size, although temperatures are high enough. Further extensive investigation would be needed, but perhaps a 15 MW station could be built near Luzon. Widespread exploration for oil and gas has so far brought no significant discoveries.

The country therefore depends on imported oil, at present costing $14.3 CIF per ton of crude and $16.6 per ton of fuel oil, delivered to the station. This last price, which is equivalent to 39.6 cents per million BTU, does not include any customs duty nor special import taxes.

RESOURCES AND NEEDS

A consulting engineering firm was engaged to carry out, with the help of local utility companies, the first thorough survey for 60 years of the power reauirements of all six Luzon load areas. This indicated that by 1975 the Luzon grid would need about 2600 MW net installed capacity as compared with 605 MW in 1963. The annual rate of growth of energy consumption would be about 12.7 per cent. For the period 1958-62, the growth would be no less than 17.1 per cent; for India it is estimated in the same period at 13.8 per cent, Japan 13.2 per cent, USA 6.8 per cent.

Careful evaluation of indigenous energy resources and the maximum economic contributions they could make to the projected load demand, indicated a likely gap of not less than 661 MW which would have to be met by additional importation of fuel. In determining the capacity of oil-fired thermal plants, due note was taken of the stations already in existence, under construction and committed, together with those which should be built to consume the expected fuel oil production from the expanded capacity of the oil refineries.

LUZON GRID - 1975		
Energy Source	*Power Capacity MW*	*Annual Output (1 000 000 kWH)*
Hydro	786	3 370
Oil	1093	5 750
Coal	45	240
Geothermal	15	80
	1939	9 440
Projected Demand in 1975	2600	12060

Having made this assessment, the Agency recommended to the Philippine Government and the Special Fund that the next phase should be to consider the possibility of using nuclear power as one means of filling the gap, and that economic comparisons should be made between fossil fuel and nuclear power stations. It was pointed out that in the early 1970's, the Luzon grid would use thermal stations of 200 - 300 MW capacity at high load factors and the existing fuel oil price of 39.6 cents per million BTU, exclusive of import duty and local taxes, was high enough to warrant consideration of nuclear plants. The Special Fund and the Philippine authorities accepted the recommendations of the Agency and approved the consideration of nuclear power as an alternative.

This paved the way for Phase B of the project, which was initiated in February 1965. A contract was awarded to a consultant firm for making detailed cost estimates of nuclear and oil-fired thermal stations of 200, 300 and 400 MW sizes. These estimates should clearly indicate the capital costs for various plants in terms of local and foreign currency and operation and maintenance costs as they were likely to vary over the lifetime of the plants. These estimates would be based only on those proven and well-established reactor systems, which had provided sufficient operating experience to justify their use in a developing country in the immediate future. The resulting cost data would be used for any system optimisation studies.

THE SECOND PHASE

Major elements of the second phase of the project are:

site investigations;
cost analysis of conventional and nuclear plants;
programme planning;
financial analysis;
legislation;
organisation of the electric power industry; and
training.

In order to obtain realistic cost estimates, they were referred to specific sites. With the help of a Panel of siting experts from outside and the local specialists, four sites were evaluated and an order of preference established. A special consideration was the safety aspect of nuclear plants, in view of the earthquake frequency in certain parts of the Philippines.

In drawing up the most economic and optimum system expansion programme for the Luzon grid until 1975, the cost data for various types of plant will be used. A number of patterns of expansion will be considered and compared, to arrive at the best in terms of economics, technical feasibility, and practicality. The Agency has obtained the cooperation of Electricité de France, who have provided a group of specialists under the guidance of a senior system planning engineer, to carry out this task. Computer analysis will be employed to arrive at the best solution.

Financial implications, and the capacity of the utility companies concerned to raise the necessary capital, must be taken into account in devising the programme. A financial expert will be sent to review the investment requirements so that the system planning can be based upon realistic assumptions.

A country considering the use of nuclear plant must have appropriate legislation covering insurance and third party aspects of an atomic installation. The drafting of the necessary legislation was initiated in 1964 and the draft will be reviewed by a highly qualified outside consultant before submission to the Government.

ORGANISATION AND TRAINING

Luzon Island has one major private utility company serving Manila (Meralco), a Government-owned corporation dealing with power generation and household distribution (Nash Power Corporation) and a large number of small privately-owned utilities for small towns and rural areas. It may be necessary to review the organisational and regulatory problems before embarking upon an ambitious programme of system expansion covering urban and rural areas. These problems may be reviewed by a small group of high-level consultants.

Important objectives of this study are to train the Philippine engineers in various aspects of power generation and utilization, and to encourage maximum participation of the Philippino personnel in every phase of the project. The load survey was conducted almost entirely by the Philippino personnel, under the supervision of the consultant firm, and the local staff now has enough experience to conduct similar surveys in other parts of the country without much outside help. The system planning is being carried out with the participation of four senior Philippino engineers who, will be able to design programmes for the future. Similarly, considerable know-how has been gained by the Philippino counterpart staff in evaluation of hydro and coal resources, in reviewing oil and gas exploratory work, and in investigating geothermal resources. So far, eight Philippino scientists and engineers have

received training in such subjects as load survey, nuclear engineering, hazards evlauation, reactor construction, reactor operation and fuel fabrication.

At this stage it is not possible to predict whether the results of Phase B would indicate that nuclear power is economic or not for the Luzon grid. A final report will be submitted to the Government by the end of 1965. Whatever be the results of this study, it is clear that the use of nuclear power in any country, and especially a developing country, should be based upon thorough economic analysis of the alternatives available. Nuclear power is but another form of power and the chief object is to have the lowest cost power, whether the system is thermal, hydro or nuclear. The recent advances in nuclear power technology which were discussed in detail at the Third Geneva Conference have clearly indicated that nuclear power offers an attractive alternative in many situations, especially in reasonably large sizes, for areas where the fuel costs are about average. If the countries which import their fossil fuels have well-developed electric power grids in so-called industrial enclaves, the consideration of nuclear power as an alternative merits attention.