

nuclear power

Nuclear energy is contributing today an ever-increasing share of world energy production.

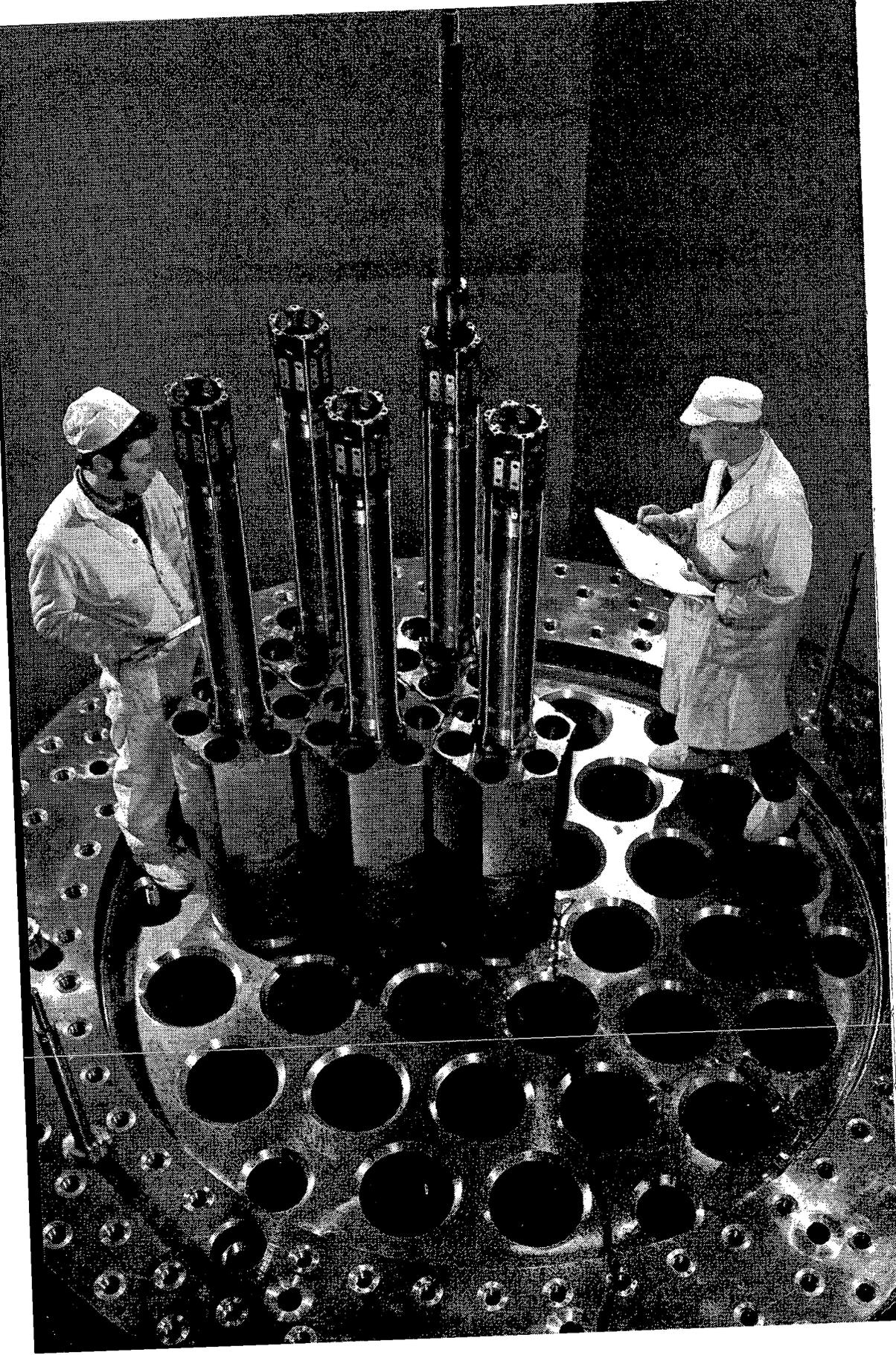
In this article, staff members of the IAEA Division of Nuclear Power and Reactors discuss some aspects of their work.

Activities in nuclear power

Broadly speaking the Agency's activities in the field of nuclear power and its applications cover the technical and economic aspects of nuclear reactors, dissemination of information on the latest developments in this field, and provision of advice and assistance to Member States in the development and implementation of the programmes for using nuclear power for electricity generation and desalination. These activities are carried out in two Sections, namely the Reactor Engineering and Economic Studies sections in the Division of Nuclear Power and Reactors.

The overall programme of work is aimed at serving all Member States of the Agency, both technically advanced and developing. The activities of primary interest to advanced countries include those relating to the latest technological developments in advanced reactor systems and breeders, optimum utilisation of nuclear fuels in reactors, and performance of various types of nuclear plants. While the present generation of nuclear plants which are termed thermal reactors have already attained competitive status, at least in large sizes in most areas of the world, research and development is going on to build even more economical systems. The current reactors burn only between 1—3% of the fuel loaded. To improve fuel utilization and reduce generating costs, the advanced countries are currently spending over \$250—300 million a year to develop fast breeder reactors. These would have the ability to produce more fissionable material than they consume; and could utilize as much as 75% of available uranium resources. Since the uranium and thorium fuel resources are large these reactors could help meet world's energy requirements for centuries to come.

In order to foster prompt exchange of information in the field of fast breeder reactors, the Agency has organised a standing International Working Group on Fast Reactors in which the leading six countries take part. The Group meets every year to review the progress concerning these reactors, and evolution of national programmes, and it coordinates the organisation of international meetings on the subject. It also holds two or three specialists meetings each year on subjects of topical interest.



All uranium fuelled power reactors produce plutonium as a by-product. It has been estimated that the amount of Pu produced per year will increase from 30 tons/year in 1975 to 80 tons/year in 1980. This fissile material is a very valuable energy resource worth about \$10 per gram, which should be utilized as efficiently as practicable. Its best use would be in fast breeder reactors, but pending their full development it could also be used in current types of thermal reactors. The Agency has been organizing meetings on the subject of plutonium utilization regularly, the last one being held in early 1971.

By mid 1971 there were 115 power reactors in operation in 14 Member States of IAEA. By 1975 the number will increase to about 250 and will exceed 450 by 1980. The current plants are yielding valuable operating experience which can help in improving designs of new reactors, and increasing their reliability and safety. Further, the performance of these plants can have an important influence on the rate of ordering of new nuclear plants in the coming years. The Agency has been organising international symposia on this subject. It is also issuing an annual review of operating experience with nuclear power plants in Member States. The success of nuclear power stations will depend largely on the reliability and integrity of the key components such as pressure vessels. The Agency in 1966 established an International Working Group on Reactor Pressure Vessels which meets every two years to review progress in the development of steel and prestressed-concrete pressure vessels for power reactors.

The Agency also keeps a close check on the cost of nuclear plants and their comparative economics in relation to conventional stations. For this purpose it follows the changes in the prices and availability of fossil fuels. It also concerns itself with the special problems of integrating nuclear power stations into existing grids, on which subject a symposium was held in 1970.

On the basis of indicated energy requirements, cost of various types of fuels, power demands and planned power expansion programs, the Agency prepares its own forecast of the likely installed nuclear capacity in various parts of the world. This provides an indication of the overall requirements for nuclear fuel reprocessing, fabrication, uranium enrichment and related nuclear industry. With regard to the nuclear fuel cycle, nuclear fuel costs for present type thermal reactors are expected to remain relatively stable or even decrease in terms of constant dollars. No shortages are likely in the supply of uranium. Improvements will continue in reprocessing and enrichment plants through advances in technology and scaling effects as larger units are built. The interaction of these factors is kept under continuous review by the Agency to project nuclear fuel cycle costs under varying conditions.

Spreading the benefit

Nuclear energy can produce low cost heat which is well suited for the production of fresh water in large nuclear desalination plants at a reasonable cost. This could be extremely attractive for the desert regions of the world bordering on the sea and for large urban centers which have outgrown their natural sources of fresh water. Further, the availability of cheap water and power from nuclear stations could be used to plan and build agro-industrial complexes which could have a special rôle in accelerating the economic and industrial development in less industrialized countries. The Agency has an active programme in the field of nuclear desalination and in 1971 organized two panels relating to this subject. It also cooperates closely with the joint IAEA/FAO Division regarding the use of desalted water in agriculture. It has been encouraging studies on agro-industrial complexes. It helped organize the IAEA/Mexico/US study team to examine the possibility of building large nuclear desalination plants for meeting the water needs in areas bordering the two countries.

While the advanced countries are rapidly expanding their nuclear power programme the Agency is anxious to assure that the benefits from the exploitation of nuclear power becomes more widespread. It therefore pays special attention to the needs of developing countries. It provides them with technical assistance and advisory services in determining the feasibility of nuclear power in the context of their own circumstances and in planning and executing their nuclear power programmes.

The developing and less industrialized countries generally have relatively small electric power grids and are unable to absorb the large size nuclear plants which are becoming standardized in industrialized countries. Most of the developing countries require small and medium power reactors in the range of 100—600 MW, which could be competitive under their conditions which include the importation of fossil fuel at relatively high costs. The Agency has undertaken an active programme on small and medium power reactors, and has been making internal reviews and publishing studies on the subject. In 1970 it organized an international symposium on such reactors. It has also initiated a coordinated programme on technical and cost assessment of intermediate size nuclear power plants under which certain industrial organisations are carrying out investigations to develop data which could be useful to the developing countries. It appears that if the capital cost of such plants could be reduced somewhat a substantial market would develop. The Agency is planning to convene a panel of experts in late 1971 to discuss the advisability of undertaking a survey to make a better assessment of the potential market of small and medium power reactors. It is believed that such information could help stimulate manufacturers' interest in developing and marketing such plants.

The Agency has been sending missions and providing advisory services to assist several developing countries in making feasibility studies for nuclear power, and developing long-range nuclear programmes for the introduction of nuclear power. In some instances, comprehensive studies of long duration are financed under the UNDP programme. Shorter missions are under the Agency's Regular Programme of Technical Assistance. Earlier this year the Agency sent a mission on nuclear power to the Philippines and Singapore and another mission is planned for Latin

America towards the end of this year. It appears that with recent sharp increases in the price of oil, nuclear power could become competitive in more areas in developing countries which lack indigenous energy resources.

To keep the scientists and engineers from developing countries informed about the latest developments in the field of nuclear power, the Agency has been organizing international and regional survey courses on the technical and economic aspects of nuclear power. These have been held at the Agency's headquarters and at locations in the Far East and Latin America. Towards the end of 1971 a regional course on Bid Evaluation and Implementation of Nuclear Power Projects will be held at Tokyo for the countries in the Far East and South Asia.

Assistance is also provided to developing countries in areas of special interest such as evaluation of proposals for nuclear plants, staffing requirements and training of operators and supervisors for nuclear plants, planning of local industry participation in nuclear projects, and construction of nuclear stations.