Co-operation among CMEA Member Countries in the Development of Nuclear Energy Its Role in the Implementation of the NPT

by A.F. Panasenkov

An important aspect of the multilateral co-operation among the member countries of the Council for Mutual Economic Assistance (CMEA) is the development of nuclear power, a technology which can practically eliminate the threat of fuel and energy shortages and significantly reduce environmental pollution.

Nuclear power is gradually becoming an independent specialized branch of power generation. However, the presence of transmission lines and the interconnected fuel cycle, both of which cross national boundaries, make nuclear power an international activity within the framework of CMEA.

The nuclear power plants being installed in CMEA member countries use thermal-neutron pressurized-water-cooled water-moderated tank reactors (designated WWER) having power outputs of 440 and 1000 MWe and in the USSR plants with uranium-graphite boiling-water channel-type reactors (designated RBMK) having power outputs or 1000 and 1500 MWe are being built as well. All these reactors use uranium fuel slightly enriched in the isotope uranium-235.

Currently, the total power output of operating nuclear power plants in Bulgaria, Czechoslovakia, the German Democratic Republic and the USSR is over 17 000 MWe; the construction of a first nuclear power plant is nearing completion in Hungary, and preparatory design work for the construction of nuclear power plants in Cuba, Poland and Romania is being carried out.

However, in thermal-neutron reactors the nuclear fuel is not utilized effectively enough. For this reason, the future development of nuclear power plants in the CMEA member countries is to involve the use of fast-neutron reactors. The Co-ordinated Plan of Multilateral Integrative Action by the CMEA member countries for 1976–80, which was adopted by the twenty-ninth meeting of the CMEA Session (June 1975), includes, among its major scientific and technical endeavours, the performance of research and development work for the construction and operation of fast power reactors.

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In accordance with the Long-term Special Programme for Co-operation in the Fields of Energy, Fuel and Raw Materials, which was approved by the thirty-second meeting of the CMEA Session (June 1978), a major contribution to the solution of the energy problems in the European CMEA member countries and in Cuba will consist of the construction of nuclear power plants in those countries with the technical co-operation of the USSR. By 1990 plants with an aggregate output of 37 000 MWe are to be built in this way. The total power output of nuclear power plants in the CMEA member countries including the USSR will reach 110 000–130 000 MWe by 1990, which is equivalent to a saving of about 240 million tonnes of reference fuel per year. Nuclear power is thus to become one of the most important areas of growth in electricity generation in the CMEA member countries.

Implementation of the programme for future nuclear power development calls for efforts in the construction of nuclear machinery and for accelerated introduction of nuclear reactors with a unit capacity of 1000–1500 MWe. For this reason the heads of governments of the CMEA countries, during the thirty-third meeting of the Session in Moscow in June 1979, signed a comprehensive Agreement on Multilateral International Specialization and Co-operation in the Production and Mutual Supply of Equipment for Nuclear Power Plants in the Period 1981–90. With a volume of production and co-operative supplies worth several thousand million roubles, the value respresented by this agreement is greater than that of any other under CMEA. About 50 industrial corporations and entreprises from eight countries (Bulgaria, Czechoslovakia, German Democratic Republic, Hungary, Poland, Romania, USSR and also Yugoslavia) will take part. The entreprises that will participate include such important ones as the Volga-Don Atommash (Nuclear Machinery Plant) in the Soviet Union, the Škoda Works in Czechoslovakia, the Heavy Machinery Construction Combine in the German Democratic Republic, the Chemimach Corporation in Hungary, Zemak in Poland and others.

For the general co-ordination of the work of the CMEA member countries and Yugoslavia under this agreement, an Intergovernmental Commission has been established which will, in its practical work, draw on the resources of the international economic corporations Interatomenergo and Interatominstrument, which were founded by the CMEA member countries in 1972 and 1973. The manufacture of nuclear power plant equipment on the basis of unified technical plans and its acceptance in accordance with the requirements of the Designer-in-Chief and the Engineer-in-Chief further enhances the safety and reliability of nuclear power plants.

The strategy adopted by the CMEA member countries of developing nuclear power with thermal reactors and then gradually replacing some of these by fast breeders will considerably broaden the fuel base available for nuclear power.

However, this strategy is advantageous only if the spent fuel from nuclear power plants using both thermal and fast reactors is economically reprocessed for re-use in the reactors. Reprocessing of spent nuclear fuel involves dealing with extremely high levels of radioactivity. The management of radioactive waste, including storage, is one of the main problems in the normal operation of a nuclear power complex as well as in maintaining radiation safety under possible accident conditions. Reprocessing plants should therefore be located at considerable distances from industrial and residential areas. Associated with reprocessing is the need for a lasting solution to the problem of the disposal or burial of the high-level long-lived wastes which are inevitably produced during reprocessing.

An important factor in the economics of reprocessing is the capacity of the reprocessing plant. Technical and economic studies carried out by CMEA have shown that the optimum capacity of such a plant is 1500 tonnes of uranium per year; these studies have also led to criteria for the choice of a site. A plant of this capacity can serve a network of nuclear power plants with an output of 40 000–50 000 MWe.

Nuclear power development in the CMEA member countries, based on the use of standard reactor types, and the efforts of those countries to find a rational solution to the economic, technical and ecological problems of a nuclear power economy, have led to an arrangement whereby the USSR carries out isotopic enrichment in uranium-235, fabricates and supplies to the CMEA member countries "fresh" fuel for their nuclear power plants and takes back the spent fuel for reprocessing. All this creates favourable conditions for compliance with the provisions and requirements of NPT.

Centralized reprocessing of nuclear fuel in a large plant solves not only problems related to the economics of nuclear power, but also some very important problems related to the localization of radioactive wastes from the nuclear industry at a limited number of points. On the other hand, centralized reprocessing poses a number of problems in connection with the safe transport of spent fuel from nuclear power plants in CMEA member countries to the place where it is reprocessed.

The development of nuclear power in the CMEA member countries on such a scale as described above makes it necessary to transport significant quantities of spent fuel. In this connection the co-operation of the CMEA member countries is aimed both at the solution of a number of scientific and technical problems related to the development of special means of transport and at the preparation of international standards and legal instruments regulating this transport.

A considerable amount of work in this field has been carried out within the framework of CMEA, relating to the design and standardization of means of transport. This includes the development of special containers, which satisfy the requirements of mechanical and thermal stability, leak-tightness and radiological and nuclear safety, for the safe transport of spent fuel from nuclear power plants with WWER-type reactors. These containers are subject to the approval of the competent authorities of the countries involved in the transport. Technical requirements with respect to (spent) fuel assemblies from nuclear power plants with WWER-440 reactors have been prepared for transport by rail and by water, taking into account their transfer onto railway wagons.

One of the principal results of this co-operation has been the preparation of Regulations for the Safe Transport of Spent Nuclear Fuel from Nuclear Power Plants in CMEA Member States; these Regulations were prepared by the CMEA Permanent Commission on the Peaceful Uses of Atomic Energy and approved by the CMEA Executive Committee in 1977. They provide that the country in which the nuclear power plant is situated and the country in which the reprocessing plant is located shall ensure that the provisions of NPT and the IAEA requirements are observed when nuclear materials are transferred from one country to another. These Regulations also provide that the participating countries shall take into consideration such dangerous properties of the load as the risk of criticality, high radioactivity, toxicity, and explosion, corrosion and fire hazards.

The Regulations also require measures to be taken for the physical protection of nuclear materials such as will reduce to a minimum the possibility of any unauthorized removal of nuclear material or of sabotage.

To ensure radiological and nuclear safety in the preparation, organization and transport of spent nuclear fuel, the Agency's Regulations for the Safe Transport of Radioactive Materials are to be applied (IAEA Safety Standards, Safety Series No.6, 1973 Revised Edition).

The CMEA member countries, having accepted the regulations for safe transport, are now working on a convention concerning liability for damage caused by accidents during international transport of spent fuel from nuclear power plants in CMEA member countries. The principal purposes of the convention are to provide legal standards for radiological and nuclear safety in the transport of spent fuel and for dealing with the consequences of possible radiation accidents.

When the positive aspects of the development of nuclear power are reviewed it must not be forgotten that a considerable increase in the quantity of fissile materials and the number of countries possessing them also increases the potential danger that the accumulated nuclear materials might be used to make nuclear weapons, risking incalculable harm to all mankind. For this reason there is no more urgent task than taking effective action against the proliferation of nuclear weapons. An important step in this direction was the conclusion of NPT, which most of the CMEA countries were among the first to sign in 1969/70.

The CMEA member countries, recognizing that the IAEA safeguards system is an important instrument for fulfilling the requirements of NPT, are continuously working to refine and perfect that system. To this end, meetings of specialists from the socialist countries are held each year on the technical problems of safeguards. The co-operative efforts to strengthen and enhance the technical effectiveness of IAEA safeguards lie in the following principal directions:

- Perfection of methods and instruments for the measurement of nuclear materials;
- Application of the methods of mathematical statistics in nuclear materials accountancy and control;
- Development and perfection of computer programs for nuclear materials accountancy;
- Research on the isotopic composition of irradiated fuel;
- Methods of evaluating the effectiveness of IAEA safeguards;
- National accounting systems; and
- Accountancy for international transfers of nuclear materials, among others.

A most important sphere of international co-operation for securing a global solution to the problem of providing energy for mankind and at the same time reducing appreciably the dangers of proliferation, is the practical use of controlled thermonuclear fusion. The scientific advances of recent years will probably lead to the establishment, with the next 15 to 20 years, of power plants using the principle of thermonuclear reactions. The achievements of physics, the successful experimental development of the principal components and the apparent possibility of broad international co-operation in this field form the basis for such hopes.

In 1979 the CMEA Permanent Commission on the Peaceful Uses of Atomic Energy approved a programme extending to 1990 for scientific and technical co-operation among CMEA member countries on the problems of controlled thermonuclear fusion.

The principal aim of this programme is to conduct joint research and development work on the design of a new energy source based on tokamak-type devices. The programme contains several sections and lists specific topics of research on the problems to be solved.

The main fields of co-operation are:

- Joint scientific research and engineering work on existing devices with a view to studying ways of obtaining a plasma with the desired thermonuclear parameters, methods of measuring these parameters, determining the laws its behaviour follows, and testing and improving various engineering solutions;

- Construction of the tokamak-15 complex and subsequent joint research on it with a view to obtaining a plasma with the required parameters, confirming the scientific feasibility of fusion and developing various engineering solutions for a tokamak-type thermonuclear power reactor; and

- Development of the design of future tokamak-type fusion reactors.

In the future, nuclear power seems likely to take the form of multi-purpose complexes which will generate electricity, supply centralized heat and be used in other branches of the national economy as well. As it develops, the multilateral co-operation of scientists and experts, and of intergovernmental and other organizations is bound to become increasingly valuable for the acceleration of scientific and technical progress and for the implementation of the provisions of NPT.

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