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European organisation in the field of atomic energy

Report

Committee on Economic Affairs and Development

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1. Some technical and economic aspects of European organisation in the field of atomic energy

1.1. INTRODUCTION

During the first part of the Eighth Ordinary Session of the Assembly it was decided, in common accord between the Committee on Economic Questions and the Committee on General Affairs, that the former should continue to study the economic and, technical aspects of European organisation in the field of nuclear energy, in pursuance of Order 86. The wish was expressed that the report of the Committee on Economic Questions on these aspects of the subject be transmitted to the Committee on General Affairs in good time so that it could be taken into account by that Committee in drafting its report on the political and institutional aspects of the question.

The present report was considered by the Committee (as Doc. AS/EC (8) 6) at its Meeting held in Paris on 20th and 21st July 1956. It has since been revised in the light of that discussion and transmitted to the Committee on General Affairs, in preparation for the debate on European organisation in the field of atomic energy to be held in the Consultative Assembly during the second part of its Eighth Session.

The report is divided into four parts, followed by certain concluding remarks. The first part is devoted to a brief discussion of some

fundamental technical and economic problems involved in the development of a nuclear energy industry, to which it is necessary to give consideration in planning European collaboration. The second and third parts contain a brief description and analysis of the proposals of the Intergovernmental Committee and of O. E. E. C, viewed against this background. The fourth part rapidly reviews some other programmes and projects of international co-operation in the field of atomic energy which are likely to influence decisions concerning European co-operation.

1.2. I. Economic, technical and financial problems involved in the development of atomic energy

1.2.1. Security Control

The industrial exploitation of nuclear fission presents one technical characteristic that is not encountered in other branches of industry; the activities required for peaceful purposes and those leading to the production of atomic weapons are so intimately interrelated as to be almost inseparable. Each stage in the production, handling and use of nuclear fuels for peaceful purposes thus involves an element of danger, since attempts may be made to divert materials for military purposes. In order to prevent this, special safeguards are required, consisting essentially of a strict accounting of materials and inspection on the spot. It may be noted that the later the stage at which diversion occurs, the more immediate is the danger arising, because fewer subsequent operations, less time and fewer plants are required to produce weapons. Concentrated nuclear fuels—i.e. plutonium, highly enriched uranium and uranium 233—can thus be immediately used in the fabrication of mass destruction weapons. Nevertheless, security control to be effective must cover every stage of the transformation cycle. It is believed by experts that effective security control is technologically feasible.

A further danger which cannot, in theory, be overlooked is that of seizure of stocks of nuclear materials and of installations. This problem will obviously particularly affect the siting of secondary reactors, separation plants for enriching uranium as to U 235, plants for the separation of plutonium and U 233 from irradiated fuels and stocks of such concentrated fuels.

The control of peaceful uses of nuclear materials is thus essentially governed by considerations of military security. This means that the necessity for security control will remain as long as there is a practical possibility of nuclear weapons being produced. It has been suggested that nuclear materials might be denatured, i.e. inseparably combined with other materials in a way that made the compound unusable for the

production of mass destruction weapons (atomic bombs). However, even if a foolproof denaturing technique were technically feasible—which is not the case at present—nuclear materials would still have many uses in conventional defence weapons (for the propulsion of submarines and aircraft for instance). The inescapable conclusion is that security control must be considered a permanent feature in the development of nuclear energy for peaceful uses, in the absence of a universal system of military control within the framework of a general disarmament programme.

An important consequence of this state of affairs is that total international control of nuclear materials would only be possible within a group of countries that had once and for all renounced the use of nuclear energy for all military purposes or had completely integrated their military programmes. Barring these two possibilities, international security control can therefore only be a partial control, restricted to peaceful uses, in any group of countries so long as one or more of them maintain nuclear weapon programmes; with this limitation, however, it can technologically speaking be made effective.

Up to now, although some measure of intergovernmental co-operation has taken place both for military and for peaceful developments, security control has been initiated and implemented by the national Governments within their own territories, and there is at present no international system of security control in existence. But the question of devising such a system immediately arises for a group of countries that contemplate developing nuclear energy in close co-operation with one another—as the European countries intend to do. One obvious advantage that an international control system would present is that of facilitating trade in nuclear materials, and it would appear to become indispensable as soon as some or all the countries in the group decided to operate jointly-owned reactors or factories producing nuclear fuels or to pool such materials in one way or the other. As indicated above, such international control would have to be extended to all subsequent uses of materials entering the circuit. International control in this sense would require a uniform system of accounting as well as inspection on the spot in all enterprises concerned by the responsible international body, together with advance acceptance of its recommendations concerning sanctions in cases of infringement of security rules or actual diversion of materials. This would not necessarily prevent the countries concerned from maintaining a separate system of control over quantities of materials obtained from other sources, whether for peaceful or for military uses.

It is important to remember that for the present and until the European countries become independent of external sources of supply of nuclear materials any system of security control introduced by them singly or collectively will have to satisfy the requirements of the countries from which the materials are obtained.

1.2.2. International trade in nuclear materials

The exigencies of security control thus pervade the whole fabric of international trade in nuclear materials, and any realistic appraisal of development possibilities whether within the national units or in the framework of a European organisation will have to take into account the present state of affairs with regard to its incidence on the access to nuclear materials.

The known deposits of uranium and thorium in the continental European countries and their overseas territories are few and unimportant, with the exception of the Shinkolobwe uranium mines in the Belgian Congo—90 per cent of the production of which is currently contracted to the Combined Development Agency controlled by the U. S. A. and the United Kingdom—and rich deposits of uranothorianite in Southern Madagascar. Current production of ore and concentrates is insignificant. Moreover, the capacity of the few existing European plants for the processing of concentrates and tooling of fuel elements is slight. The European countries will therefore be obliged to import raw materials and fuels for a number of years ahead.

Their main sources of supply of raw materials in the free world are the United States and the United Kingdom which control the bulk of all available resources through the intermediary of the Combined Development Agency to which the production of the Belgian Congo (90 per cent), Canada, the Union of South Africa and Australia is contracted.

For their imports of enriched uranium, the European countries are again entirely dependent on the American and British Governments.

Imports from these countries are covered by bilateral agreements which regularly carry strict provisions for security control. Numerous such agreements are presently in force between European countries and the U. S. A. or the United Kingdom, the security conditions being in principle the same in all of them. As a general rule, the agreements provide that the irradiated, i.e. consumed, fuels shall be returned to the exporting country for reprocessing. This provision is of little consequence at present, since the capacity of the only continental

European plant for this purpose is insignificant, but will acquire great importance subsequently for the development of a fully fledged nuclear industry in Europe. It is clear that it will also have important commercial repercussions in the future

There is thus at present no free market for nuclear materials and fuels, and for security reasons little prospects that the market will become free in the ordinary commercial sense. On the other hand, there is no shortage at the present time. In fact, the experts appear to agree that supply prospects are fairly bright, partly on account of the "breeding" phenomenon whereby secondary fuels are produced that more than replace the energy usefully consumed in burning the primary fuel.

1.2.3. The main components of a nuclear development programme

A fact which is sometimes overlooked is that nuclear science and its industrial application are still at the experimental stage. All experts thus agree that the main emphasis in any nuclear development plan, national or international, will be on research and technology for the next 15-20 years. Essentially the problem is to develop fuels, reactors and heat exchange systems that together give the highest thermal efficiency at the lowest possible cost. As will be readily understood, the field of research and technological experimentation is extremely wide, and it is also common knowledge that a diversified development programme makes very heavy claims in terms of capital, industrial activities and scientific and technical knowledge on the resources of a country.

In the present essentially experimental phase of developments any estimates of the cost price of nuclear energy inevitably contain a wide margin of guesswork, since such estimates are based on forecasts for reactors and powerstations still under construction and not on actual results. Very little is thus known of the life-span of reactors, and the future sales price of plutonium produced in the reactors which may contribute to reducing costs is also a very uncertain element in cost evaluation.

This is borne out by a Report entitled Nuclear Energy and the Production of Electric Power in Europe published by the Secretariat of the Economic Commission for Europe in February 1956. The conclusions of this Report emphasize that "There is considerable uncertainty concerning the cost price of electric power produced by a nuclear station, so that it would be premature to affirm that such power can already compete with power produced in thermal stations. Although, with continued progress, the cost price may be expected to decrease in the near future, the additional production that may be obtained from nuclear energy will still be far from providing a magic remedy which would permit any considerable reduction in the cost price of electric power."¹

Very schematically, the main components of a nuclear development programme may be grouped under three headings : research, the industrial effort, training of scientists and technicians.

1.2.3.1. A. Research

Pure nuclear science is mainly carried on in universities and in Government establishments. The rate of progress in the future will largely depend on the volume of Government credits allocated to the appropriate institutions, since much of the laboratory equipment required for certain types of research is very costly. Much of this equipment is also technically very difficult to produce and operate. In some cases the financial requirements and the technical problems raised are so great that a joint effort between two or more countries is indicated. The European Organisation for Nuclear Research (C. E. R. N.)² is an example of such a pooling of national resources in a multinationally owned research establishment based on a Convention, and new ventures in financial and technical co-operation between one or more groups of countries for the advancement of nuclear science may impose themselves in the future for reasons of economy.

As regards the development of applied research in the nuclear fields, the situation is different in as much as a considerable proportion of such research is carried on outside Government establishment in industrial or semi-industrial laboratories working independently or under Government contract. The rate of progress in the development of applied research at the national level will depend on direct Government activities but also on Government subsidies to industry and on research activities and investment programmes of industry itself. The establishment of close collaboration between Government and industry will be particularly important. The complexity in the field of applied research is such that it is difficult to visualize a fixed procedure for Government promotion of applied research which could be practically extended to all or a large group of European countries. Considering the scale of many tasks in nuclear technology, it will also be

1. Doc. E / ECE / EP / 181.

2. See Part IV A of this report.

necessary to foster cooperation, between industries, both at the national and the international level. The vital role private industry will have to play in applied research makes it important to find forms of co-operation that will maintain the spirit of free competition.

Dissemination of information concerning applied research, however, presents special problems in as much as such information has a commercial value and for this reason and others is generally protected. In the case of Government-owned patents the question of international exchange of information would normally be one of direct negotiation between Governments. In fact, exchange of such secret information is a common ingredient in bilateral agreements for co-operation in the peaceful uses of nuclear energy. Where privately-owned patents are concerned, the right to exploit a patent, domestic or foreign, is a matter of commercial bargaining. The exchange and use of privately-held patented information may, however, be obstructed by exorbitant conditions for the granting of a licence or refusal to grant a licence. That some system of arbitration procedure and compulsory licence procedure will be required, seems to be fairly universally agreed, as also that a harmonisation of national legislation in this field would offer considerable advantages.

Again, in the field of applied research, the fact that a few countries, principally the U. S. and the U. K., and to a lesser extent Canada, have a considerable advance in applied nuclear research and technology over all continental European countries, must be taken into account. Any form of European organisation of applied nuclear research will therefore in practice have to be organised and planned in close collaboration with the above mentioned countries with an eye to ensuring the most rapid possible progress in the interest of all the countries concerned.

Co-ordination of national applied research programmes would appear to be a necessity. As far as Government programmes are concerned, this should not present insuperable difficulties, and it is also believed that the operation of the control system would enable Governments to be adequately informed of the research programmes of private industry. Assuming that commercial secrets would be respected within the limits of national interest a comparison of programmes would possibly be sufficient to avoid wasteful duplication of effort. The caveat should be entered, however, that, as with scientific research, it is extremely difficult to determine in advance when duplication of effort in applied research will prove to be wasteful. The main advantage of a comparison of programmes might well be to give relative advantages of an economic and technical character fuller play than otherwise, i.e. promote specialisation.

However, certain research projects may only be realisable if several interested countries pool their resources in materials and skills in a joint undertaking, whether public, semi-public or private in character. This would particularly apply to projects where the costs involved and the attending financial risks make the venture appear too hazardous for a single country to embark upon.

It may be recalled that a first beginning in European Co-operation in the field of applied research was made in 1954 by the creation of the European Atomic Energy Society ³ which provides a meeting-ground for scientists of eight European countries.

1.2.3.2. B. The industrial effort

The nuclear energy industry may for convenience be sub-divided into three broadfields of activity : production of primary and secondary fuels, design and construction of reactors, and special materials and equipment.

The main stages in the production of fuels are : prospecting and mining of uranium and thorium ores, concentration of nuclear metals, treatment of metals to obtain fuel elements and tooling of these elements; at a second stage, after combustion of the fuels, treatment of the irradiated elements to separate plutonium or uranium 233 from waste products.

Prospecting for uranium and thorium ores is being carried on at the national level either by the public authorities or by licensed private enterprises in most European countries and in many of their dependent territories. In contrast to prospecting for other materials, it does not to the same extent require trained geologists. Aerial prospection with radio-sensitive equipment permits coverage of large areas. Mining of uranium and thorium ores does not generally present any special technical problems beyond certain measures of health control, nor is the scale of capital investment greater than in other mining operations. The production and tooling of fuel elements require chemical and other industrial plant of some size and, particularly, large numbers of skilled staff. Investment costs in plants and equipment and the requisite

3. See Part IV B of this Report.

technical qualifications of personnel increase considerably in the re-processing of the irradiated materials to separate secondary fuels from fission waste products. Health control measures constitute an important element of costs in handling these highly radioactive materials.

The treatment of irradiated fuels is a problem of fundamental importance for the general development and the economics of the nuclear energy industry, since it permits the obtaining of fissile materials and particularly plutonium which is used in self-regenerating " breeder " reactors. It is possible t h a t the optimum size of a plant would surpass the requirements of many European countries. Although it presents many problems, the transporting of irradiated fuels is feasible, and it would therefore be possible, as a beginning, for a small number of strategically situated reprocessing plants to handle the whole European output of irradiated fuels under jobbing contracts. Later, as nuclear programmes expand, other European countries may wish to possess their own facilities for treating irradiated fuels for military reasons or out of concern for energy supplies.

However, there would remain a solid economic argument for concentrating the reprocessing of irradiated materials to a few plants since experts agree that costs decrease, the larger the volume of reprocessed materials. The need for facilities for treatment of irradiated fuels will grow slowly in the beginning and gather momentum as the number of reactors in operation in Europe increases. At present, European reactors operate almost exclusively on imported primary fuels and the irradiated fuels are returned for treatment to the country supplying the primary fuels. As mentioned above, the capacity of the only existing European plant is very small.

There is a third phase of fuel production t h a t deserves special attention : the enriching of uranium in the fissile isotope U-235 by separation of this isotope and the non-fissile isotope U-238. Enriched uranium fuels are important in t h a t they permit greater diversity in the choice of reactor materials, i.e. construction materials and materials used as moderators, coolants, etc., and hence in reactor design and development of prototype reactors generally. But t h e most important consideration is t h a t these fuels permit a more complete transformation of fertile materials (thorium, uranium 238) into fissile materials, simultaneously with a more intense generation of heat. Virtually all present breeder reactors, i.e. reactors generating more fissile materials t h a n consumed in the process, use enriched uranium charges.

There exist two known and proven methods of isotope separation, the older magnetic method being gradually supplanted by the gaseous diffusion method. It should be observed that the technique of gaseous diffusion was among the few important bodies of information t h a t were not divulged at Geneva. It is not certain whether at present any European country possesses the technical know-how for making a complete blue-print of a gaseous diffusion plant. Unless such information were obtained it is almost certain that much time and money would be spent on experimentation during construction of the separation plant.

It is estimated that the construction of a separation plant of " economical size " would take upwards of four years at the minimum. The time factor is of capital importance in this connection. In t h e first place, t h e importance of enriched uranium as a fuel will diminish as the stocks of plutonium available to Europe either from its own reactors burning natural or enriched uranium or by importation from other countries increase, since plutonium can also be used in breeder reactors. In the second place, experts agree t h a t other and very much cheaper methods of isotope separation may be perfected in the meantime. Thirdly —and most important of all perhaps—there are indications t h a t European countries will be able to obtain all the enriched uranium they can handle from the United States and the United Kingdom. The latest information which strengthens this belief is the announcement made on 22nd February 1956 by President Eisenhower that the United States Government is prepared to make available 20 tons of enriched uranium to the countries of the free world. Enriched uranium is already being made available under bilateral agreements to European countries by the U. S. A. and the United Kingdom in quantities t h a t are probably fairly adequate for their present research needs.

The technical uncertainties are aggravated by the scale of the investment effort required for the construction of a diffusion plant and the drain it would make on technical and material resources during construction and on power resources once in operation. The Nuclear Energy Commission of the Intergovernmental Committee estimates that a plant with an annual input capacity of about 1,000 tons of natural uranium and turning out fuels of up to 90 % U 235 content would cost between 290 and 390 million dollars. It might be added t h a t the plant in operation would absorb between 500 and 600 megawatts of electric power. (The cost of building the electricity plant for supplying the diffusion plant is estimated at between 80 and 90 million dollars and has been included in the figures mentioned above). The experts agree t h a t a diffusion plant would have to be written off in not more than 15 years and possibly much less—and t h a t t h e production cost of the fuels would in all probability be considerably higher than United States and United Kingdom prices.

In spite of the great interest which an adequate supply of enriched uranium presents for any European country undertaking a nuclear development programme on an industrial scale, it is thus far from certain that all continental European countries will wish to embark on the construction of a gaseous diffusion plant in view of the hazards that attach to it. Be it added that it would not for many years resolve Europe's dependence on the United States for its supplies of raw materials and, equally importantly, for its access to technological know-how. It has also been argued that a diffusion plant is under all circumstances necessary in order to ensure the necessary breadth for scientific and technological research, but the technicians do not seem to agree entirely on this point.

In all respects a diffusion plant constitutes the largest single investment item of a nuclear energy industry. It is the only one which might exceed the investment capacities of any single continental European country and would perhaps need a larger market than the domestic market. In view of the financial risks involved in this one component of the nuclear industry, it would appear an obvious necessity that the question of constructing a diffusion plant in Europe should be evaluated in relation to the total investment effort required for the development of a nuclear energy industry and particularly the reactor programme.

Assuming that fuels can be obtained in sufficient quantities and in the desired grades, the construction and perfection of reactors constitutes the most important component of a nuclear energy development programme. It cannot be stressed too often that reactor design and technology is still in its infancy and that it is not until after another decade or more of experimentation that all practical and economical types of reactors for commercial production of energy will have been developed.

Development of reactor design and technology goes hand in hand with applied research in a vast number of fields affecting strength of materials, precision tooling of materials, automatic operation and distant control of processes as well as heat exchange problems, and it is also closely connected—as said above—with experimentation on the composition of fuel charges. The reactor is thus at present the main laboratory of nuclear research and technology. In this field again, Europe lags far behind the more advanced countries both with regard to the number of reactor types operating and their size.

Generally, reactor development proceeds in three steps : design, construction of a low-power pilot model and finally construction of a pre-industrial prototype generating at least 20.000 kw electric power. Production costs for the prototype reactor vary within wide limits, but a standard figure quoted by many experts is about 30 million dollars. Pilot models also vary considerably in cost from a few hundred thousand dollars up to several million dollars.

In view of the experimental character of reactor construction and development, its financing will mainly rest on Governments. Nevertheless, experience proves that an industry is taking an increasing interest in reactor development. The technical effort will, of course, have to come predominantly from private industry and a close co-operation between Government and industry would therefore appear to promise the best results.

The scale of the investment effort for the development and construction of a prototype reactor indicates that all but the very smallest of the European States could construct one or two on their own. It is a different matter that a broad reactor development programme involving the construction of several different types of reactors could only be undertaken by the largest European countries singly and that much might be gained by the co-ordination of national reactor development programmes and joint planning and construction of particularly costly reactors.

In principle, the confrontation of reactor development programmes combined with freedom of trade in materials and equipment required for reactor development and freedom of capital movements would appear to be the key elements in a European policy to promote a rational development of the nuclear energy industry. A reasonable formula whereby restrictive abuse of patent rights may be avoided while preserving the spirit of free competition is of course here again of great importance. Finally, it must be stressed that in reactor development, as in research, training and fuel production, progress in the continental European countries will largely be determined by exchanges of information and technical co-operation with the United Kingdom, the United States and Canada. The main obstacle to be feared is that national policies maybe influenced towards autarchy by military considerations.

The question of special materials and equipment has been touched upon lightly in the preceding discussion of fuel and reactor development. Since a detailed survey of these problems would hardly serve any useful purpose here, may it suffice to observe that this is properly the field of private enterprise, although Governments will occasionally find it in the national interest to supply financial incentives or assist in acquiring techniques or raw materials from other countries and to intervene against restrictive business practices generally and abuse of patent rights specifically.

1.2.3.3. C. Training of scientists and technicians

All competent authorities recognise that the training of scientists and technicians constitutes a major element in the development of a nuclear energy industry. The need for expansion in this field applies even to the most advanced countries, such as the U. S. A. and the United Kingdom, and, a fortiori, to Europe, where opportunities for advanced nuclear research are still inadequate, and facilities for obtaining practical experience are still very restricted. In fact the shortage of qualified staff at all levels is considered to be one of the main bottle-necks in the development of nuclear energy for peaceful uses in Europe.

Basically, in countries where the labour market is free, this is a question of financial incentives and psychological persuasion and thus a long-term problem, one of the most important elements of which is to increase the number of science teachers at the secondary school level and upwards. In the short run, it would appear to be essentially a matter of making the most rational use of existing facilities and of the opportunities offered in Government research institutions and in operating reactors and processing plants. Valuable teaming opportunities are already being offered to scientists of all nationalities by various research establishments in the U. S. A. and the United Kingdom. This type of collaboration with the more advanced countries and among the European countries should, as experience proves, offer great advantages and should be vigorously expanded.

Governments will obviously bear the main responsibility for ensuring the expansion of teaching and training facilities and for promoting the recruitment of scientists and technicians. Such programmes will inevitably be linked up with the development of research equipment undertaken by Governments separately or jointly. Co-ordination of national teaching and training programmes combined with exchange of teachers and students between countries are thus a first necessity to improve the situation and may be expected to yield appreciable results. In the course of such co-ordination of programmes, it may well prove convenient for groups of countries to combine their technical resources and finance and staff in one or more joint centres for specialised training to complete that given in national centres. It may be added that there would not appear to exist any major obstacles to the free movement of scientists and technical trainees in Europe today.

The legal framework

It is generally recognised that the peaceful use of nuclear energy must in practically all stages of operations be surrounded with adequate safeguards for the protection of the health and safety of the general public and of persons handling nuclear materials and to prevent abuse, diversion or seizure. It has been seen that the latter form of control, security control, is already required under bilateral agreements covering the sale or loan of nuclear materials. It can be assumed that any country producing and using these materials would in its own interest introduce similar regulations. It has also been indicated that co-operation among a group of countries for the development of nuclear energy would, particularly if exploitation of joint enterprises and pooling of materials is considered, require some form of international security control.

Just as it would represent a great advantage and probably be a necessity for such countries to adopt a uniform system of security control, the standardisation of safety control measures would undoubtedly also greatly facilitate closer co-operation between a group of countries.

As said above, the legal framework required by the doubly dangerous nature of fissile materials extends to all phases of operations, affecting prospecting and mining rights, transportation and insurance, localisation of nuclear plant and international trade as well as ownership and patent rights.

Up to the present time, the legal framework is still undeveloped in most continental European countries owing, on the one hand, to the small scale of operations and lack of experience and, on the other, to the fact that these activities have so far been concentrated in the hands of the Governments and their agencies. With the increasing participation of private industry in the development of nuclear energy the need for an articulate legal framework is increasingly felt and is gaining in substance. With increasing international trade in nuclear materials and equipment and with increasing international co-operation this need is strengthened at the same time as the advantages to countries co-operating closely with one another in aligning their legislation in accordance with agreed norms becomes more apparent.

Although this is, obviously, particularly important for countries co-operating very closely with one another, universal norms would in many cases be even more desirable. For certain problems relating to safety standards international collaboration on a very wide scale appears to be the most fruitful and has, in fact, already been initiated within the U. N.

A suitable form for such international co-operation in standardising legislation might be to work out an international convention acceptable to the largest possible number of countries, possibly in the framework of the United Nations or of the proposed International Atomic Energy Agency.

Finally, it should be mentioned that international standardisation of terminology and equipment would also present considerable advantages for all countries concerned.

1.3. II. The Proposals of the Intergovernmental Committee

The communiqué issued after the Conference of the Foreign Ministers of the ECSC countries in Messina in June 1955 stated that " studies must be put in hand for the establishment of a joint organisation with the necessary means at its disposal to promote the peaceful development of atomic energy... " Accordingly, the Nuclear Energy Committee was instructed to " determine the technical possibilities of common action " in the various fields of industrial application of nuclear energy. Basing themselves on the findings of the Nuclear Energy Commission the Heads of Delegations of the Intergovernmental Committee in their Report to the Foreign Ministers confirm that joint action must be taken in the field of nuclear energy and that such action by the very nature of nuclear energy " cannot be realised without a common organisation. " Subsequently, the Foreign Ministers, meeting in Venice on 29th and 30th May 1956, agreed to adopt the proposals contained in the Report of the Heads of Delegations as a basis for negotiating a treaty setting up Euratom.

Euratom, the common organisation or Community which it is proposed to set up, would consist of an Atomic Energy Commission jointly appointed by the Member Governments, with a joint mandate and acting on its own authority within the limits of its mandaté. Matters of general policy and certain other specific questions would be decided by a Council of Ministers. The Commission would be responsible to an Assembly, and appeals against its decisions could be brought before a court⁴.

Security control and supply of nuclear materials

The security control system proposed by the Heads of Delegations would be based on a first option to purchase the entire production of nuclear materials of member countries that is not contracted to foreign Governments and the corresponding obligation of users to take their supplies exclusively from Euratom. In fact, the requirements of security control appear to be one of the fundamental arguments in favour of the granting of this first option to purchase to Euratom. The other arguments are that Euratom would thus be in a position to ensure adequate supplies and a fair association in the event of a shortage. It would also have certain powers to fix prices and to promote production by entering into long-term contracts with producers.

The security control exercised by Euratom would cover all stages of operations and affect all plants or installations producing materials to be bought by or using materials sold by it. Euratom would control directly all stocks of such materials not in use and could seize materials in cases of infringement against security or safety regulations.

Euratom would further exert a certain influence over sales to third countries of nuclear materials produced in the territories of member countries which it does not wish to buy, particularly in determining the security guarantees to be given by the buying countries and in bargaining for exchange advantages in the form of technical information.

Although the text of the Report is not quite clear, it is understood that Euratom's purchasing priority would also extend to imports from third countries, the idea being that member countries would gain in bargaining power by centralising their imports through a common purchasing agency. The present types of bilateral agreements between individual countries would probably remain in force until they expired, but would gradually be supplanted by agreements between Euratom, on the one hand, and a supplying country, on the other. Euratom would thus in time hold a monopoly of supply and exercise complete security control over all materials used for peaceful purposes in its member countries. This control over the supply and use of nuclear materials might constitute an important basis of strength for such powers of impulsion or direction as Euratom would dispose of with regard to development programmes.

With respect to property rights the Report suggests that Euratom retain ownership title to all highly enriched fuels and other particularly dangerous materials. These materials would thus be made available to users on a hire contract basis. This would also apply to materials which Euratom has itself obtained on similar conditions. Other materials would be sold by Euratom to the individual users if they so desire.

4. 1. A Résumé of the Heads of Delegations, Report on Euratom, is contained in Doc. AS/EC (8) 2.

Finally, it should be observed that the Heads of Delegations have not expressed themselves on the problem of the possible military utilisation of nuclear energy. The communique issued after the meeting in Venice states that the Foreign Ministers will be required to give their views on this problem.

Trade

With regard to trade, the Report proposes the establishment of a common market between the Six for fissile materials as well as for other special materials and equipment interesting the nuclear energy industry. Member countries should without delay negotiate a standstill agreement, i.e., agree not to introduce new tariffs, quotas or discriminatory taxes. The common market would also ensure the free movement of specialists and of capital for investment in the nuclear industry.

The common market for the nuclear industry should be instituted without awaiting the establishment of the General Common Market with which it should later be integrated.

Research and exchange of information

The Report recognises that research is not an activity that can be planned, and that the greater part of research work will continue to be carried on by public, semi-public or private enterprises. Nevertheless, there remain many research fields where close co-operation will be of the greatest value, and it is proposed that the European Atomic Energy Commission should create a Research Centre—complementing national existing centres—and a training centre for specialists. The Research Centre would ensure the establishment and application of a uniform terminology and work out an international system of weights and measures. The training centres would particularly be devoted to production of fuel elements, treatment of irradiated materials, atomic engineering and production of radio-isotopes.

In order to avoid duplication of effort on the national level, the Commission would also receive reports on national research programmes on which it would express its considered opinion.

As regards exchange of information, where a vast wealth of knowledge and experience is already available, it is proposed that Member States who enjoy privileged access under bilateral agreements should seek the consent of the other party to place such information at the disposal of Euratom. It is also envisaged that Governments should accept the obligation from the start to grant licences to exploit patents held by them. This would appear to involve very unequal Government contributions. As for privately-held patents, it would be necessary to have recourse to a compulsory licence system whenever it is deemed that a patent is necessary for the pursuit of Euratom's research or the operation of plants in which Euratom has an interest.

Patent holders will under all circumstances be entitled to full indemnity and appeals against decisions of the Commission could be brought before the Court.

Joint undertakings and investment policy

The general principle of Euratom's activities in the field of investment would be to promote and guide public and private investments by establishing an overall programme and by recommending financial assistance by the investment fund envisaged in connection with the common market. Euratom would thus not have powers to advise on the economic viability of national enterprises or on their localisation. On the other hand, it is envisaged that it should initiate and set up undertakings of common interest that are beyond the means of individual States or industries. It would also participate in public, semi-public or private enterprises. Particularly, it is recommended that Euratom be responsible for the production of concentrated fissile materials and that it should for this purpose set up with the least possible delay a joint isotope separation plant and a joint chemical plant for treatment of irradiated fuels.

As in the field of research, the activities of Euratom in the field of investments and industrial enterprise would thus essentially have the purpose of furthering a rational general planning of national programmes, public as well as private, and to supplement such programmes where the need is felt, particularly as regards such ventures that most Governments would probably under all circumstances reserve for themselves or have to undertake themselves.

Legislation

The Report stresses that legislation and regulations established or to be established by Member States, particularly pertaining to the health and safety of workers and the population at large, must fulfil certain common minimum requirements. It is recommended that the basic principles of such regulations should be laid down in a convention appended to the treaty setting up Euratom.

It would later be incumbent upon the Atomic Energy Commission to work out detailed norms for the stocking, transport and treatment of nuclear materials.

Co-operation with other countries and organisations

The Report of the Heads of Delegations proposes that Euratom should be open to all European countries which are prepared to accept its rules and that it should particularly seek close association with the United Kingdom. The Foreign Ministers' meeting in Venice decided that invitations should whenever appropriate be sent to OEEC countries with a view to obtaining their participation in or association with the Euratom treaty.

In any case, Euratom would establish permanent relations with the other European countries within the framework of O. E. E. C. and with non-European countries through the intermediary of the planned International Atomic Energy Agency.

1.4. III. The proposals of O. E. E. C.

By a decision of the Council of the O. E. E. C. meeting at Ministerial level on 10th June 1955, the organisation set up a Working Party (No. 10) for Nuclear Energy. Its terms of reference were "to examine... the possible scope, form and methods of co-operation between member countries." This fundamental principle of voluntary co-operation embracing all 17 Member States runs through the Report submitted in January 1956. The Report was adopted in its main lines by the Council which by its Resolution of 29th February 1956 set up a Special Committee to deal with matters relating to nuclear energy and instructed it to submit proposals on the joint action to be taken by member countries, taking into account the action undertaken by other international bodies, meaning particularly the Intergovernmental Committee, all six member countries of which also belong to O. E. E. C.

While the emphasis squarely remained on a voluntary, flexible system of co-operation, the Special Committee in its concrete proposals for action actually envisages a very comprehensive system of European co-operation. At its meeting from 17th to 19th July 1956 the Council approved the Report of the Special Committee as a basis for its future work in this field and took a number of decisions which mark the start of the Organisation's activities.

The main decision of the Council relates to the setting up of a Steering Committee for Nuclear Energy to pursue the joint action proposed in the Report of the Special Committee "in order to promote, co-ordinate and complement the individual efforts of the member countries". While it still has study tasks, the Steering Committee is intended to become, by a subsequent decision of the Council, the nucleus of the future European Nuclear Energy Agency, the statute of which it is instructed to draft.

The joint action which the OEEC countries have, in principle, decided upon covers four fields of activity : Joint undertakings; Security control; International trade; Legislation, training and standardisation.

Joint undertakings

The joint undertakings proposed are the following : a plant for the separation of uranium isotopes; a plant for the chemical processing of irradiated fuels; and prototype reactors, testing reactors and research reactors.

With regard to the first of these it should be observed that although further studies will be initiated forthwith, the Steering Committee is instructed to endeavour to obtain fuller information concerning the United States offer of 22nd February before final decisions are taken concerning the necessary arrangements for ensuring supplies of uranium. For the joint reactor development programme a Working Group has been set up to study the technical, legal and financial problems involved and to make concrete suggestions as to types. The studies for the chemical processing plant will also be carried on by a Study Group.

In principle, joint undertakings will be formed by agreement among interested countries and within the organisation, whatever the position adopted by other countries. Such agreements shall lay down the conditions in which countries not taking part may subsequently accede to the joint undertaking or benefit by its results.

Owing to their great diversity, these joint undertakings may be set up in very different ways ranging from private agreements to international conventions.

The Steering Committee shall follow the progress of the joint undertakings and may initiate studies for other joint ventures and make suggestions. Its relations with the joint undertakings, once these are in operation, have not been defined and will probably vary considerably from case to case.

Security control

The international security control system to be established would in the first place cover the operation of joint undertakings and materials originating from them. It should also cover the implementation of multilateral or bilateral agreements involving the application of such control. Further, the possibility of extending it to any international agreements to be concluded with other countries or international organisations will also have to be examined. The control system would not cover military uses, but it would cover a very substantial part of peaceful uses in member countries, the intention being to extend it progressively as far as possible.

The Steering Committee has been instructed to draft a Statute for the control organisation and also to study the arrangements to be concluded with Euratom with a view to co-ordinating and even unifying the control systems envisaged within the organisation and Euratom.

International Trade

No special measures have been envisaged by O. E. E. C. to organise the supply of nuclear materials of member countries by international action, except insofar as some form of distribution of the products of joint undertakings would have to be considered. With this exception each country would import and export materials independently.

It has been mentioned that the Steering Committee has been instructed to pursue negotiations with the United States Government concerning its offer to put 20 tons of enriched uranium at the disposal of countries of the free world. The negotiations should particularly serve to clarify the conditions on which enriched uranium would be made available, quantities and qualities—and whether fuels after use must be returned to the U. S. for treatment, as has been the case so far, or not.

With regard to intra-European trade in materials and equipment of interest to the nuclear industry, it is proposed that member countries should make provision for a more liberal form of trade than in other sectors, and the Steering Committee is instructed to consider the extension of such liberalisation measures to the overseas territories.

For security reasons trade in primary and secondary fuels would remain subject to State control, but other products specific to the field of nuclear energy (specialised equipment, auxiliary materials and isotopes) should not be subject to quantitative restrictions, customs duties or artificial export subsidies. Complete freedom of trade should also be extended to other products which are used in producing nuclear energy—and which may have other uses as well—subject to a system of certificates showing that they are intended for or originate from the nuclear industry.

Proposals to this effect will be submitted jointly by the Steering Committee and the Steering Board for Trade within six months. The possibilities of ensuring a greater freedom of trade with the U. S. A. and Canada on a reciprocal basis are also to be examined.

By a separate decision, the Council further instituted a standstill agreement in respect of intra-European trade in the field of nuclear energy, valid for one year, to prevent the situation from deteriorating in the meantime.

Legislation, training and standardisation

The Special Committee's study having led to the conclusion that the moment is particularly opportune for a common study of the requirements for legislation relating to nuclear energy in member countries, the Steering Committee has been instructed to study the problems connected, in particular, with public health, protection against radiation hazards in mining and in the transporting of radioactive substances. It is required to submit proposals concerning common standards to serve as a basis for national laws and regulations. It will also study the harmonisation of national legislations in respect of security control and patents and submit a report on atomic risk insurance.

With regard to training, the Steering Committee is instructed to take the necessary steps in order to implement the proposals of the special Committee. These may be summarised as follows :

Immediate action should be taken to expand the educational facilities of universities and equivalent institutions.

Member countries more advanced in the nuclear energy field should be requested to open their research centres to participants from member countries and expand these courses to meet the growing needs for specialised training.

The Organisation should sponsor courses or symposia for professors to be run by one or two of the more advanced countries. It should also organise international discussions of the problems facing the universities—and compile and distribute annually a survey of all courses open to foreign students in the field of nuclear energy.

While the Steering Committee will thus have certain limited functions of its own in the field of training, its main task will be to make recommendations to Member Governments.

The Steering Committee is instructed to continue, in consultation with the European Productivity Agency, the work begun with a view to defining standards for nuclear materials and equipment and shall report thereon within six months.

It may be noted further, that no special measures are envisaged by O. E. E. C. for promoting international exchange of information, beyond the fact that the Steering Committee might establish relations with the European Atomic Energy Society, with C. E. R. N. and with the United Nations.

With regard to O. E. E. C.'s relations with Euratom, it should be observed, finally, that the Resolution of the Council of 29th February takes note of the decision of the Six to establish a closer co-operation with one another and states that there is no incompatibility between the objectives pursued by the two organisations. Be it added that the joint undertakings would open up possibilities in this respect and that they would also provide a starting-point for common research work.

Co-operation with other countries and organisations

It has been seen that the work of O. E. E. C. is to proceed in very close co-operation with the Associated Countries, the United States and Canada, these countries being directly associated with the work of the Steering Committee. As regards relations with Euratom, a special working party is being set up for maintaining liaison with the Intergovernmental Committee, and the Steering Committee is expressly instructed to keep itself informed of the progress and results of the current negotiations concerned with the setting up of Euratom and likewise with those relating to the proposed International Atomic Energy Agency.

1.5. IV. Other International Organisations

1.5.1. A. The European Organisation for Nuclear Research (C. E. R. N.)

C. E. R. N. was set up in 1954 after many years of preparatory work to provide a fully modern establishment for basic nuclear research which requires very costly machinery of an entirely new kind, particularly powerful particle accelerators and considerable laboratory facilities. It is jointly financed and staffed with eminent scientists from the participating countries. It is expected that by late 1957 it will be able to install all its major services.

C. E. R. N. is thus a multinationally owned research establishment in which national resources have been combined in a vast and extremely complex joint undertaking. The signatures to the Convention of C. E. R. N. are the following twelve countries : Belgium, Denmark, France, Germany, Greece, Italy, Norway, the Netherlands, Sweden, Switzerland, the United Kingdom and Yugoslavia.

C. E. R. N.'s seat is at Meyrin, near Geneva, Switzerland.

1.5.2. B. The European Atomic Energy Society

The European Atomic Energy Society was created in June 1954 with the aims of promoting nuclear energy research and techniques and developing industrial applications of nuclear energy. It pursues this aim by organising periodical meetings of scientists and engineers and by the dissemination of reports and information. Its task is also to study the standardisation of nomenclature for symbols relating to nuclear energy and encourage studies on appropriate safety precautions.

Eight countries have joined this Society : Belgium, France, Italy, Norway, the Netherlands, Sweden, Switzerland and the United Kingdom.

The headquarters of the Society are in London.

1.5.3. C. The proposed International Atomic Energy Agency

The draft statute of the proposed International Atomic Energy Agency (the text of which has been reproduced in Doc. AS/EC (8) 5) was made public recently after having been unanimously approved by the Twelve-Nation Working Level Meeting in Washington on 18th April 1956, composed of representatives of Australia, Belgium, Brazil, Canada, Czechoslovakia, France, India, Portugal, Union of South Africa, the Union of Socialist Soviet Republics, the United Kingdom and the United States.

The idea of the Agency was launched by President Eisenhower in December 1953 in a speech to the General Assembly of the United Nations. In December 1954 the General Assembly of the United Nations unanimously passed a resolution which took note of the negotiations in hand for the creation of such an Agency and expressed the hope that it would come into being in the near future. The first draft elaborated by the eight original sponsoring countries was discussed by the United Nations General Assembly in the second half of 1955. An International Conference to decide the constitutional set-up of the International Atomic Energy Agency will take place in September 1956 on which most Members of the United Nations are expected to be present.

The objectives of the Agency are to seek to accelerate and enlarge the contribution of atomic energy to the peace, health and prosperity of the world. In fulfilling this objective the Agency will be authorised, inter alia, to receive from Members and in its turn make available to other Members or groups of Members special fissionable materials and act as an intermediary for the exchange of information services and equipment between Members. The Agency will also be authorised to assist in all ways in setting up projects for research, or development or practical application of atomic energy for peaceful purposes at the request of any Member or group of Members. It shall have rights and responsibilities to apply safeguards -(health and safety measures, accountability of nuclear materials) with respect to any Agency project or other arrangement where the Agency is requested by the parties concerned to apply such safeguards. At the request of the parties to any bilateral or multilateral arrangement not otherwise under the Agency's supervision or control, the Agency shall be authorised to apply the safeguards established by it to these arrangements.

The Agency shall be authorised to enter into agreements establishing appropriate relationships with the United Nations or any other organisation the work of which is related to that of the Agency.

1.6. CONCLUDING REMARKS

1. The vital importance of the advent of nuclear energy to the European countries, as consumers of energy and producers of industrial equipment, is incontestable. Not only will the development of this new source of energy have the greatest influence on their own living standards in the future, but it will also decisively affect their ability—absolutely and in relation to the other industrial nations—to help in raising the standards of living in the underdeveloped regions. No doubt then of the importance of the problem : the issue at stake is nothing less than the international standing of the European countries.

2. The case in favour of European organisation in the development of nuclear energy for peaceful purposes is no less clear, since the financial, industrial and human resources required to develop this new science and its practical and industrial applications are so extensive as to be beyond the practical possibilities of the smaller countries, and even perhaps, for certain undertakings, those of the larger countries, taken individually. Moreover, time is all-important : the continent of Europe lags far behind the United States, the U. S. S. R. and the United Kingdom. This competitive element increases the urgency of a rapid and rational development of European resources.

3. Opinions vary as to when electricity generated by nuclear energy will begin to meet a substantial proportion of requirements—and this will of course depend largely on present and future costs of conventional sources of energy in different places—but it is generally admitted that this day is at least ten or fifteen years away. With regard therefore to nuclear energy, the main effort in the near future lies in the fields of research and experimentation. Simultaneously every effort should be made to develop and ensure the most rational use of conventional sources of energy, particularly hydro power.

The scale of investments devoted to the development of nuclear energy in Europe will thus have to be evaluated against the equally pressing requirements of the conventional sectors of the power industry, and the many other investment needs of the European economy. In view of the many competing investment demands and the limited resources, it will be important when programming nuclear investments to consider the possibilities of saving money and gaining time by acquiring materials and know-how from the more advanced countries. These possibilities should be exploited to the fullest extent, insofar as this can be done without jeopardising the development of a broadly based nuclear energy industry.

4. Owing to the fact that much of the development work in the field of nuclear energy is commercially unprofitable and that the scale of the resources required is so large, Governments have a responsibility to supply funds for research and project work. These reasons and others—public safety and the measures required to prevent diversion of materials or disclosure of secret information—will oblige Governments to undertake certain research tasks and certain industrial activities themselves.

The first task of a European atomic organisation would, obviously, be to co-ordinate such Government activities, including wherever practical, the pooling of national resources, with a view to ensuring the most rational use of those resources, avoiding wasteful duplication and reaping the benefits of economical size.

5. Furthermore, the dangers of diversion and the radiological hazards inherent in this industry place a special responsibility on Governments to regulate the use of nuclear materials. As has been demonstrated, security control will have to be watertight and health and safety control far-reaching.

The closer the degree of co-operation between the European countries the more vital will it be to secure a uniform development of the necessary legal framework, especially as regards security control, health and safety control and industrial secrets.

If joint European enterprises producing, using or treating nuclear materials are set up, security control would probably have to be exercised by a joint international body.

Delicate problems arise with regard to industrial secrets in connection with security and safety control. On the one hand, inventions, private and public, must be protected; on the other, the protection at present afforded by the existing patent legislation will have to be modified in the public interest by some sort of compulsory licence procedure.

There is much to be said in favour of instituting international co-operation for the standardisation of legislation affecting nuclear energy on the widest possible basis, to include from the start both the technically more advanced countries and the major raw material suppliers.

6. Since the control over the utilisation of nuclear energy will extend to the private sector also, and will involve advance information on designs and plans as well as operational results, Governments will be in a good position to exert an influence over investment policies.

Nevertheless, in view of the experimental nature of the present phase of nuclear development, national planning and international co-operation should allow for a considerable degree of flexibility as between the public, semi-public and private sectors of the economy and the scientific community. This applies particularly to pure research which by its very nature is extremely difficult to plan.

7. The very unequal stage of advancement of the European countries with regard to nuclear energy, and the differences they display economically and industrially, particularly with respect to energy resources and requirements, would appear to argue strongly in favour of a system of voluntary co-operation. However, this system must make it possible for smaller groups of countries, which have reason to do so, to integrate their nuclear industries more closely than would be acceptable to the other countries concerned.

8. The leading nations of the West in the field of nuclear technology are the United States and the United Kingdom. Through the Combined Development Agency, these countries also control the bulk of the raw material resources of the free world. The continental European countries thus have every reason to organise their separate and joint efforts in close collaboration with these countries and Canada.

Obviously, every effort should be made to develop Europe's own resources of raw materials. But, with regard to enriched uranium, it remains an open question whether the European countries should embark on the costly and hazardous construction of a gas diffusion separation plant. A decision on this important issue would seem to depend very largely on what further information is obtained concerning the United States Government's offer to make 20 tons of enriched uranium available to the countries of the free world.

9. It will have been seen t h a t the proposals for European organisation in the field of nuclear energy elaborated by the Intergovernmental Committee and those put forward by O. E. E. C. present many similarities. Both agree on the necessity of undertaking certain research and development projects, of setting up certain joint enterprises in common and of instituting international security control. Nevertheless, important differences remain between the two sets of proposals as to the scope and form of these joint activities.

It will therefore be very important to avoid overlapping between the two organisations and to prevent dispersion of the European effort and it will be equally important to co-ordinate their activities with those of the proposed International Atomic Energy Agency in order to ensure the widest possible basis for international co-operation.