EUROPEAN ATOMIC ENERGY COMMUNITY

EURATOM

THE COMMISSION

NINTH

General Report

on the

Activities of the Community

(March 1965 - February 1966)

APRIL 1966

EUROPEAN ATOMIC ENERGY COMMUNITY
EURATOM

THE COMMISSION

NINTH

General Report

on the

Activities of the Community

(March 1965 - February 1966)

APRIL 1966

SUMMARY

VOLUME I

VOLUME II

DRAFT INTRODUCTION TO 9th GENERAL REPORT

In issuing its eighth general report in May 1965, the Commission referred to the confident spirit in which it submitted that account of the activities pursued during 1964 to the European Parliament. This confidence sprang largely from the success of the six Member States, after long and arduous efforts to reconcile their understandably different viewpoints, in reaching agreement on the adaptation of Euratom's second five-year programme.

A few weeks later, however, the European Community was in the throes of a crisis which, originating in a specific EEC problem, was soon to affect the operating of the EAEC — although this body was not directly involved — not only by breaking off the Council's deliberations on the various major questions of future policy that were pending at that time, but also through the failure to take a decision on the draft research and investment budget for the financial year 1966. The results of the meeting at Luxembourg on 30 January 1966 further testify to the will of the six Member States to carry on with the tasks begun, in spite of the divergences that inevitably stem from their practical situations.

I

As nuclear energy gradually takes its place in the economy, industrial problems bulk ever larger. The Commission, aware of this vital development, has for some years stressed the need to arrive at a comprehensive view of all the problems that have now to be faced in the nuclear field. It started by clarifying the various data relating to the passage of nuclear energy to the industrial stage, and is at present working out the conclusions to be drawn therefrom.

The objective conditions needed to prepare the "First target programme" already obtain. It will be recalled that, under Article 40 of the Treaty, the Commission must periodically publish programmes indicating in particular the production targets for nuclear energy and the various types of investment required for their attainment. The purpose of these programmes, likewise specified in the Treaty, is to stimulate the initiative of persons and undertakings and to facilitate the coordinated development of investment by them

in this field. In April 1965 the Commission examined a preliminary draft target programme with the industrial circles concerned, and then with Community labour union representatives.

On the basis of the comments thus obtained, the Commission prepared a draft programme and submitted it, as stipulated, to the Economic and Social Committee, which gave a favourable opinion on 24 February 1966. Meanwhile, having heard the views of the Scientific and Technical Committee, the Commission took into account the observations formulated. This opens a new phase in the Community's work in this field. The economic and industrial questions can take their rightful and essential place as soon as technical development allows the nuclear industry to get under way.

As a guide for investments, for which landmarks are required in such novel fields, the target programme must cover a sufficiently long period. That is why, although the target programme proper applies to the years 1970-1980, its estimates range beyond that period, because of the need to take long-term decisions as well. Before 1980, these estimates offer a sufficient degree of probability to be regarded as feasible targets ; after 1980, they are beset by so many uncertainties that they can merely serve as an indication.

The guidance for investment policy given by the target programme bears not only on nuclear power stations but on other sectors of nuclear industry as well — for example, the mining and processing of ores, isotope separation, fuel-element manufacturing and the reprocessing of irradiated fuels. The target programme deals only with the application of nuclear energy to electricity generation. At the present time, other uses are only just beginning to yield economic figures reliable enough to allow of even short and medium term forecasts.

As regards the criteria adopted to determine the nuclear electricity output targets, the Commission has of course looked at the power problem as a whole, i.e. in terms of basic data common to the three present bodies of the European Community. Thus the targets in question were mapped out in line with the quantitative supply requirements, a reasonable expansion of the conventional energy sources and a certain rate of industrial investment. In applying this method, the Commission adopted the principle of gradual substitution of energy sources as set out in the common energy policy.

In its attemps to find the best way of attaining the targets laid down, the Commission made a selection from the various likely hypotheses on the rate of technical progress, with a view to cutting the cost of electric power of nuclear origin and reducing the scale of the uranium supply problem.

As was pointed out in the introduction to the eighth general report, the preliminary studies for the first target programme showed that such a pro-

gramme would lose a great deal of its point unless an appropriate industrial development policy were adopted.

Every effort must therefore be made to avoid hiving off the nuclear industries within the confines of their home markets ; they should be enabled, on the contrary, to benefit fully from the broad Community market. This applies not only to the manufacturing industry but also and equally to the electricity producers who, by reason of the marked trend towards large unit outputs, will be called upon to step up grid capacities and reinforce the international link-ups.

This raises a large number of problems wich the Commission is studying at present, with a view to producing a document on the elements of a common industrial policy — after consultation with the circles concerned — for submission to the Council.

This document will also contain a section on supply policy, which aims at ensuring regular and equitable supplies of fissile materials as advocated by the Treaty ; this object to be achieved by coordinated efforts to prospect for new uranium deposits, by financial participation in the mining of deposits in all non-member countries, an by the concluding of long-term supply contracts.

Among the fundamental conditions required to set up a nuclear policy based on the target programme, one imperative is the availability, at the right moment, of a labour force and executive staff of the best possible calibre and quantity for the task. Coordinated social and technical training policies should, therefore, be established in the Community with the dual aim of achieving the objectives of the target programme without social disruption and developing the highly-skilled labour bound up with the advanced technical nature of nuclear work.

The Commission, alive to these problems, had its first contact with trade union representatives at the Stresa symposium in May 1965. On the basis of the observations formulated on that occasion, it set up a dossier which will form the subject of a conference on social questions to be held at Munich on 24 and 25 May 1966.

II

With regard to research, the year 1965 was notable for the adaptation of the second five-year programme, made necessary, inter alia, by the progress of economic and technical conditions. The ceiling for this second five-year programme had been set in 1962 at 425 million EMA u.a., plus an amount of about 24.5 million EMA u.a. carried over from the first five-year

programme, which brought the total up to 449.5 million EMA u.a. By a decision of the Council, this total was boosted by a further 5,578 EMA u.a. This increase, which of itself was not enough to offset the price and wage increases that had occurred since 1962, was accompanied by a certain reshuffling of items under the five-year programme, that is, a transfer of appropriations from one head to another. In this way it was possible to bring the Community's financial resources to bear more suitably on a certain number of high-priority items for wich the increase — some 31 million EMA u.a. — was greater than the overall figure indicated. These items comprise the Joint Research Centre, the ORGEL project and the Community's work in the fast reactor field. This concentrating of programmes, the slight raising of the ceiling and the acceptance of the principle of a reserve (albeit allocated) must be regarded as steps in the right direction which, of course, could only be made at the cost of sacrifices in other fields, however valuable the latter might legitimately appear to be in some eyes.

This year saw the completion of the critical experiment ECO, the continued construction under normal conditions of the reactor ESSOR and the operation of the exponential experiment EXPO, as well as the pursuit of studies calculated to provide the Ispra Centre with a range of activities not exclusively connected with the important ORGEL project.

At Petten, work went ahead with the construction programme. The HFR reactor was operated satisfactorily and the establishment consolidated its position under the various association contracts dealing with advanced gas reactors.

At the Central Nuclear Measurements Bureau at Geel, the big linear accelerator is now installed and will come into regular service in 1966. The Van de Graaff accelerator has been operating regularly. The establishment's technical authority and its international rôle were most satisfactorily reinforced in 1965.

At the Karlsruhe Centre, the laboratory is now finished except for the very hot cells and will gradually be brought into service, its first task being the fabrication of fuel-elements for the Mazurca reactor, built under the contract of association with CEA in the fast reactor field.

The association contracts, which account for some 35 % of the second five-year programme appropriations, are one of the means available to the Commission for carrying out its activities under the programme.

In this way considerable progress has been recorded ; the Harmonie source reactor was commissioned at Cadarache under the fast-reactor association with the CEA, whilst the setting up of the other installations scheduled under our association arrangements has been actively pursued at Cadarache and Karlsruhe. Satisfactory cooperation has been established between the "Gesellschaft für Kernforschung" at Karlsruhe and Belgo-Dutch partners under two new

association contracts concluded by Euratom after the adaptation of the second five-year programme ; while an adjustment of the activities planned under the association with CNEN was in preparation.

As to the high-temperature gas reactors, we can report the gradual power run-up of reactor experiment DRAGON, and the active implementation of the association programme with the "Kernforschungsanlage Jülich des Landes Nordrhein Westfalen".

With regard to thermonuclear fusion, which is far from being a matter of short-term industrial concern, Euratom's coordinating powers are being wielded effectively and without encountering any fundamental difficulties.

Without going into further details here, we may mention that 581 research contracts, varying in importance from thousands to millions of EMA u.a., are now being carried out.

Scientific activity in the Community has given rise to 655 technical reports and 875 applications for patent.

The Commission is particularly aware of the responsibility it bears toward the unified Community which will arise from the imminent merger, to prepare the groundwork for the Community's research activities — henceforth inseparable from any general and deliberate economic policy, with particular reference to the policies pursued with regard to energy and industrial cooperation. It has testified to this awareness by its collective action and also by the part played from the very outset by its members in the inter-executive bodies which foreshadow the manner in which the future Community will pursue its tasks.

Economic strength at the present time is largely contingent on the quality of research and the efficiency of the industrial machine. If the European Community becomes — as it can and as we hope it will — a very great economic power in the world of tomorrow, it will prove itself in these two spheres. Then the work briefly summarized here, and representing such efforts, will acquire its full value. The same perspective that sometimes reveals the ephemeral nature of institutions also enables the abiding worth of tasks accomplished to be justly appreciated.

With financial limitations imposed by the capacities of its Member States, working within novel and untried structures often complicated by the problems inherent in research and in the attainment of common goals, the members of the Commission have carried out their task in good faith and with unsparing effort. It is without anxiety that they prepare to hand over the results of their endeavour to those who, in a wider framework, will have the responsibility of carrying on the work.

CHAPTER I

THE DEVELOPMENT OF NUCLEAR INDUSTRY

I. Developments in the nuclear energy industry in 1965

1. In industry, the trend towards using nuclear energy to meet rising electricity requirements was reaffirmed in 1965, both within and outside the Community. Reactors commissioned up to the end of the period 1965-70 will be producing electricity at competitive prices or nearly so. Nuclear energy development thus assumes an industrial character which calls for consideration of the long-term prospects of this form of energy and its future influence on the Community's economy.

Evidence of the trend is to be seen in the expansion of civilian nuclear programmes, both public and private, in countries differing widely from both the industrial and economic angle. Interest in nuclear energy is manifested alike in industrially and economically powerful countries possessed of ample sources of energy, in industrialized areas poor in energy supplies and in developing countries like India.

The reasons lie first and foremost in the improvements in power plant design itself (e.g. standardization of circuits and equipment, increased efficiency) which have made possible a very substantial reduction in the installed kW cost and price of current generated.

It is an accepted fact that the ratio of specific cost to unit capacity falls more steeply for nuclear power plants than for identical conventional generating plants. Accordingly the interest shown in high unit capacities in previous years was confirmed in 1965 without diminishing, however, the importance in certain circumstances of developing medium-sized reactors.

As regards installed unit capacity, firm orders for reactors in the western world in 1965 include seven for a capacity of 600 to 870 MWe and one (St. Laurent-des-Eaux 2, France) of 480 MWe.

Furthermore, in the Community, declarations of intent made public during the year confirm the preference for high unit capacities for the future, since invitations to tender to be issued in 1966 will almost all be for 600 MWe reactors.

Installation of reactors on this scale implies on the one hand a further build-up of the Community grids and on the other the continued development of the emerging mutual assistance system to combat the consequences of down-time in such big units.

2. Here are some facts about the growing part played by nuclear industry in the world during 1965 :

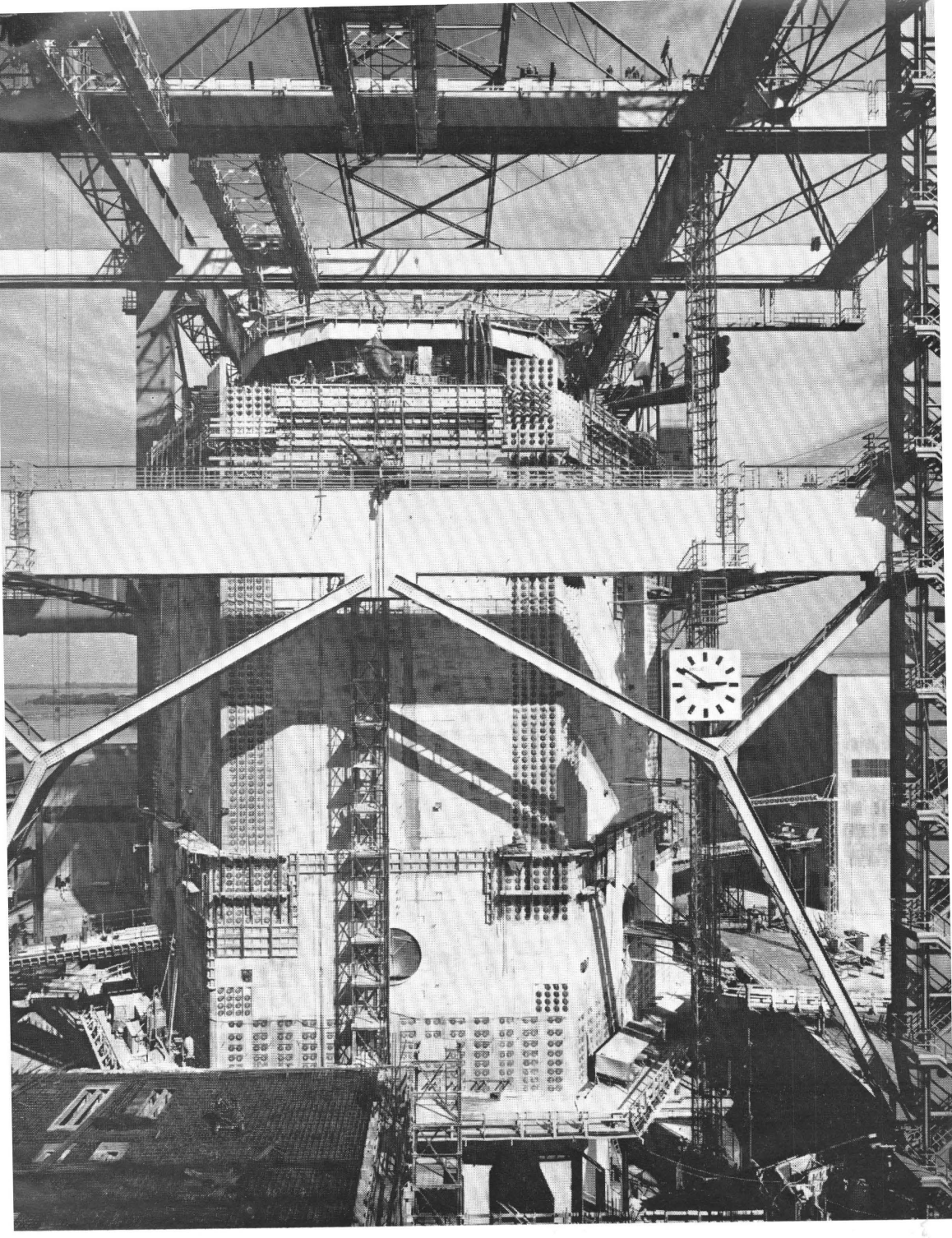
The breakdown of orders for nuclear power plants is as shown below :

Plant	Type	Capacity MWe
St. Laurent-des-Eaux 2, France	Graphite-gas	480
Kahl, Germany	BWR/nuclear superheat	25
Oskarshamn, Sweden	BWR	400
Beznau, Switzerland	PWR	350
Santa Maria de Garona, Spain	BWR	440
Dungeness B, UK	AGR	2 × 600
Dresden 2, USA	BWR	714
Colorado, USA	HTGR	330
Brookwood, USA	PWR	450
Millstone Point, USA	BWR	600
Boston, USA	BWR	600
Turkey Point, USA	PWR	760
Indian Point 2, USA	PWR	870
Tsugura, Japan	BWR	325
Quebec, Canada	Candu (*)	250
Rajasthan, India	Candu	200
Kalpakkam, India	Candu	2 × 200

(*) Coolant : boiling light water

Aggregate installed capacity of these 17 plants amounts to approximately 8400 MWe approaching 1,750 million dollars in value.

3. Apart from firm orders placed in 1965, there were a number of declarations of intent during the same year. These included, in the Community, the RWE's invitation to tender for a joint German/Swiss 600 MWe project, the announcements of EDF (Bugey power plant, 480 MWe) of ENEL (600 MWe), of the North German producers (600 MWe) and of the Belgian



ST LAURENT DES EAUX (France) — CONSTRUCTION OF PRESTRESSED CONCRETE REACTOR PRESSURE VESSEL

(See other side of page for caption)

The EDF 4 power plant now under construction at St Laurent des Eaux on the Loire, is based on the natural uranium-graphite-gas concept. Designed for a capacity of 480 MWe, the plant is scheduled for commissioning in 1968.

electricity producers (2 × 600 MWe), and the Franco-German project for a 600 MWe plant. Thus the 1100 MWe scheduled at the end of 1964 was more than tripled at the end of 1965.

Firm orders placed within the Community in 1965 relate to the St. Laurent-des-Eaux 2, France, and the Kahl, Germany, plants (see table above).

Nuclear power plants under construction in 1965 in Community countries, totalling a generating capacity of 2036 MW, were as follows :

— Gundremmingen (Germany), KRB.
Boiling water. 237 MWe. Commissioning date 1966.

— Lingen (Germany), KWL.
Boiling water, fossil fuel superheating system. 240 MWe. (total). Commissioning date 1968.

— Obrigheim (Germany), KWO.
Pressurized water. 283 MWe. Commissioning date 1968.

— Chinon EDF 3 (France), EDF.
Graphite-gas. 480 MWe. Commissioning date 1966.

— St. Laurent-des-Eaux EDF 4 (France), EDF.
Graphite-gas. 480 MWe. Commissioning date 1968.

— Chooz (Franco-Belgian), SENA.
Pressurized water. 266 MWe. Commissioning date 1966.

— Doodewaard (Netherlands), GKN.
Boiling water. 50 MWe. Commissioning date 1968.

The following were commissioned in 1965 : Chinon EDF 2 reactor (France), graphite-gas string, 200 MWe, and the 50 MWe heavy-water multi-purpose research reactor at Karlsruhe (Germany) (see para. 4 below).

Net generating capacity of the nuclear power plants and prototypes in operation within the Community in 1965 came to 1037 MW, representing a net electricity output of 4,300 million kWh, which accounted for 1.1 % of the total net output (conventional and nuclear). These figures compare with net nuclear electricity production for 1964 of 2,980 million kWh or 0.8 % of total net output. Since nuclear plants began to be used for power generation in the Community, 9,090 million kWh have been sent out.

4. Alongside the activities dealing with proven-type reactors and improvements to them such as nuclear superheating, endeavours have been continued in the Community in respect of advanced converters and fast reactors. Here Community industry has been building up its rôle considerably.

In this domain we have the Community-initiated ORGEL project which has reached a stage where the construction of an industrial-scale prototype is

possible, and EURATOM's association with the DRAGON and AVR high-temperature gas reactor projects. The latter, a 15 MWe installation, is due for commissioning in 1966.

To complete this list, reference may be made to the EL 4 reactor (Brennilis, France - heavy water CO_2 - 75 MWe - commissioning date 1966) ; the KKN prototype (Niederaichbach, Germany - heavy water CO_2 - 100 MWe - commissioning date 1968) ; the MZFR (multi-purpose research) reactor (Karlsruhe, Germany - heavy water - 50 MWe - first criticality October 1965) ; and the BR 3 Vulcain (Mol, Belgium - spectral shift - 10 MWe - now being converted).

In the fast reactor field, national research and development programmes in association with Euratom continue throughout the Community and more particularly in France and Germany. These programmes cover a number of experimental reactors being constructed by industry in the Community.

5. The table in para. 2 might suggest that industry outside the Community has forged ahead of Community industry.

In fact, electricity producers in the USA and the UK generally got their nuclear power plant construction programmes going a year or two before those in the Community, but the latter have to some extent benefited from the extra time to build more advanced power plants. This time-lag was again seen in 1965. The year was mainly occupied with issuing invitations to tender and with examining the bids received. Results have been most encouraging : they have shown that in the Community and even outside it, European industry is well able to compete with non-Community industry. It has devoted very important resources to the study and perfecting of high-powered projects. Industrialists have taken it as their duty to seek out economic solutions, with the possibility of having all components manufactured within the Community, and have displayed much energy in meeting international competition. Thus French industry which for a long while had been supplying nuclear plants in the national programme was able to submit tenders for complete installations, in France and elsewhere, incorporating the guarantees required by operators.

German industry, which was already capable of supplying complete plants like Lingen and Obrigheim, has pushed ahead and been able to offer higher-capacity installations, likewise with all equipment supplied. In the other Community countries industrial concerns are similarly ready to respond to the invitations to tender mentioned above.

The supply of reactor parts during 1965 proceeded satisfactorily and enabled industry to get used to manufacturing components which are tending to become increasingly commonplace.

While reactor parts in general can be supplied by Community industry, there are still two sectors that have not been able to develop normally, for lack of a market, namely fabrication of fuel elements and of control rods and drive mechanisms. Unfortunately, too, the fuel element industry in the Community is somewhat scattered.

A more general problem deserving of attention relates to the creation of the basic conditions for equipping the Community's nuclear industry with a structure that measures up to the expanding market. Some progress can be recorded during 1965 in the move to prevent compartmentation into national industries. Links between manufacturers in the Community have become close enough for joint proposals to be submitted. But it is a continuing concern of Euratom to stress the need for big firms to bring about a degree of concentration of nuclear business in the Community and for small or medium-sized firms to specialize or to achieve a high degree of technical proficiency.

II. Industrial aspects of the fuel cycle

6. Among factors which have helped to underline the importance of the industrial aspects of the fuel cycle are :

— the advent of competitiveness of energy produced by power plants and the emergence of economic and industrial problems destined to loom ever large alongside the technical problems which beset nuclear energy in the early stages ;

— the possibilities opened up by the system of private ownership of fuel in the United States and availability of toll enrichment services.

The importance of the fuel cycle and the need to canvass the overall prospects have impelled the Commission to devote the utmost attention to the study of certain general problems, while pressing on with activities launched in previous years.

1. *Nuclear fuel management*

7. Development in nuclear energy must involve an increase in the extent and the variety of the Community's nuclear fuel requirements.

The many processes involved will confront every reactor operator or supplier of a complete fuel cycle service with a series of problems such as fissile material procurement, management etc.

Euratom during the year under review had studies carried out on the most complex fuel cycle, namely the slightly enriched uranium cycle.

The object was to investigate methods of coordinating individual fuel cycles in order to arrive at an overall pattern of fuel management, optimum use of discharged elements and fabrication wastes, and increased commercial bargaining power for the users concerned.

These theoretical studies brought out the benefits of applying a system of coordinated management having the following features :

— Utilization of fissile material in the possession of the Community is continuously optimized to avoid any unnecessary transport, conversion or delay. The fresh fuel derived from toll enrichment is used in the first place as direct supply for highly enriched fuel reactors and in the second place for mixing with discharged fuel and manufacturing wastes, so meeting the demand for less enriched fuel. This cuts out the need to send fuels back to the diffusion plant.

— A saving of around 10 %, as compared with individual cycles, of the amount which is capable of being reduced by coordinated management, which would mean a substantial gain for the Community as a whole.

Fuel cycle management for natural uranium reactors, too, could of course be rationalized, with coordination of concentrated supplies first of all and of irradiated fuel reprocessing and management of the plutonium produced later on.

Substantial problems are involved on the practical side and there are a number of possible formulae for setting up a coordinated management body ; but irrespective of the form chosen, scope and continuity are essential if the benefits of coordinated management are to be reaped — which means that for a fairly long time it would have to be carried out at Community level.

The introduction of such a system of coordinated management would be of considerable help in mapping out the elements of industrial policy.

2. *Procurement*

8. The problems of nuclear fuel supplies in the context of a common energy policy are dealt with elsewhere in this Report.

Confining ourselves here to features bound up with the fuel cycle, we find that procurement policy is closely linked with the measures to be taken on the coordinated management of fissile material.

Recent supply contract negotiations brought out the importance of such problems as those concerning specifications, the grouping of chemical operations, price, delivery dates etc. involved in the purchase of large quantities of natural uranium, their conversion into uranium hexafluoride and the re-use of surplus material.

Steps should be taken immediately to turn to account the experience gained already, which affords some idea of what will happen when toll enrichment is employed on a wider scale.

3. *Fuel element fabrication*

9. The manufacture of a fuel element draws on a combination of processes and specialized knowledge ranging from the thermal and nuclear core calculations to the technical skills required for fabrication. Fuel element performance is a determining factor in the operator's decision to go ahead with the construction of a nuclear power plant.

The fabrication stage cannot be considered apart from the rest of the fuel cycle or the design of the plant ; hence the fabrication industry has to establish close structural links with other industries and organizations or else to set up a far-reaching and well-balanced organization of its own.

From the commercial angle :

— the provision of guarantees entails charges in excess of normal limits ;
— the investment for fuel element fabrication during the reactor life is one-and-a-half times that for the nuclear part of the power plant.

The long-term prospects are promising, but demand is spread over a period, whereas economic management of the industry, if it is to be competitive, calls for a high output and heavy concentration of the means of production.

Since about half the market is accounted for by first core elements, the manufacturers need to be in on the design stage of nuclear power plants in order to secure as big an outlet as possible.

In a narrow field of manoeuvre, and with a market in the process of formation, European industry (apart from French industry) has often had to manufacture fuel elements according to non-Community specifications. Having gained the essential technical know-how, certain manufacturers have resolutely gone on to acquire the resources and organizational set-up needed to make reactor cores themselves. In the case of the Lingen and Obrigheim plants, for instance, the reactor core designing has been taken over by European concerns.

Thus the basic industrial problems of the fabrication industry can be divided into three groups :

— Problems as to the structure of the industry. Centralization measures and specialization agreements are desirable to enable Community industries to supply technically and economically acceptable fuel elements and to guarantee their irradiation stability.
— Problems as to reactor cores and refuelling. Manufacturing concerns should endeavour to increase their technical competence in the matter and make

full use of experience to be drawn from plants already in service. It is to the operators' interest likewise to keep close track of their reactor cycle and to fix the most favourable fuel cyclings.

— Problems as to guaranteed burn-ups. Puchasers demand guarantees from their suppliers when buying nuclear fuel. But coverage for this low-probability risk involves fabricators in an outlay nearer to their turn-over than to their profit figures. Euratom has endeavoured, in close liaison with the industrial circles concerned, to explore various avenues which might lead to solutions. A number of exploratory studies have been carried out using technical and economic models with computer simulation. The ideas emerging from these studies are at present under closer investigation by a group of manufacturers actively engaged in laying the foundations for a genuine solution.

4. *Reprocessing of irradiated fuel*

10. Active reprocessing of irradiated fuel from power reactors in the Community will begin with the commissioning of the Cap de la Hague and Eurochemic plants. The Eurex facilities will be deployed chiefly in industrial research and will scarcely affect the load factor of other installations in the field of power reactor fuels.

The Community's first reprocessing facilities have entailed very heavy specific investments and cost a lot to run. They are needed either to obtain basic technical knowledge or to meet programme demands. But a real reprocessing industry cannot be created in the Community and sustain the keen competition from outside the Community unless these plants can be set up and operated under normal conditions of financing.

That means :

— that the industrial problem of reprocessing must be resolved at Community level,

— that existing facilities within the Community must be operated and exploited in a coordinated manner to yield maximum experience.

If this is done it should be possible to build a European-scale plant, probably towards the end of the seventies.

5. *Waste disposal*

11. The final stage in the fuel cycle is the disposal of the radioactive waste obtained either during actual operation of the reactor or from reprocessing of irradiated elements.

With the rise in installed nuclear capacity there will be an accumulation of highly radioactive waste which in time will present a health and safety problem.

Two ways of dealing with this problem are at present under study.

One consists in treating the waste to render it insoluble, thus permitting of permanent disposal or storage without risk to the population.

The other concerns applications of the long-lived isotopes produced during fission, since certain isotopes can be employed as intense radiation sources in various fields.

As things stand at present, reprocessing and storage along these lines seem unlikely to afford a basis for profitable industrial activity, especially by scattered individual undertakings.

It may therefore be considered best for the Community to organize the storage of radioactive waste at the outset, perhaps with provision for national authorities to take over.

6. *Transport of radioactive material*

12. As the business of transporting radioactive material develops the need becomes apparent for (a) rules which guarantee the safety of the population and (b) the application of such rules translated into viable industrial and economic practice.

Where national regulations are concerned, Euratom is collaborating with the Council sub-committee on "Transport of radioactive material" consisting of representatives of the Member States and the Commission, set up in 1962 to :

a) coordinate the position of governments on the complex of legal and administrative problems arising from the transport of radioactive material, in particular as regards approval of packaging and containers as being appropriate and of the means of transport to be used ;

b) examine along with the Commission the technical and economic aspects of these problems but not the measures to be taken for applying the basic standards, the study of which is proceeding according to the rules and procedures laid down by the Treaty.

Thus Euratom is endeavouring to promote specific studies to facilitate implementation of all the relevant regulations, starting with the categories of material most frequently accepted for carriage. A number of specific instances are presently under study, viz. transport of radioisotopes, fissile material - particularly UF_6, irradiated fuel and radioactive waste. Special effort is also being directed to the design of a testing station to solve

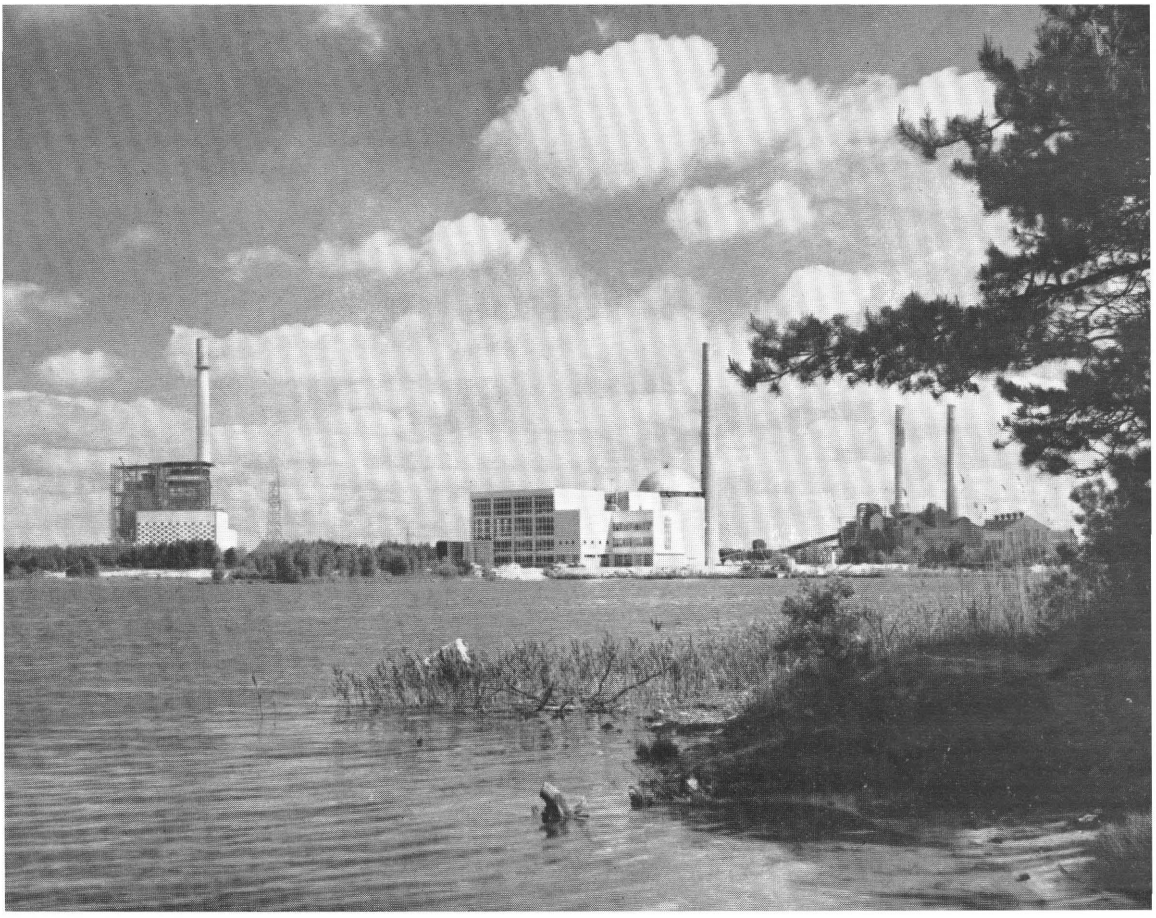
problems which arise for the competent authorities and the constructors from the system of approval of transport containers in line with the specifications laid down in the regulations.

Hence Euratom follows with close interest the work carried out on a world-wide basis by the International Atomic Energy Agency in Vienna, resulting in the formulation of international regulations, a revised edition of which was published in 1965.

Work currently in hand relates to the precise formulation of provisions on containers for and carriage of intense radioactive sources, a description which encompasses irradiated fuel elements.

Similarly, Euratom is alive to the work of specialized bodies, both national and international, dealing with particular forms of transport, such as the Central Office for international Railway Transport in Berne, which are introducing improvements in their own regulations in the light of the revised IAEA text.

It will be seen from this chapter that the fuel cycle is a branch of nuclear industry having its own distinct features. The Commission has, alongside some research results, indicated certain directives and, above all, set out the problems encountered in this field. It will endeavour to match them with solutions and concrete action, in particular when an industrial policy for the Community is mapped out.



MOL (Belgium) — THE EXPERIMENTAL POWER REACTOR BR 3

(See other side of page for caption)

The BR3 reactor at Mol has been used, mainly in the course of 1965, in connection with core studies for the Vulcain reactor.

CHAPTER II

DEVELOPMENTS IN NUCLEAR TECHNOLOGY AND THE JOINT RESEARCH PROGRAMME

I. Revised research and investment programme

13. The dominant event in 1965 was the revision of the second five-year programme, necessitated by changes in the economic and technical situation since 1962.

As the Council of Ministers' decision could not be taken until May 1965, a provisional budget was adopted for the financial year 1965, followed by supplementary budget in September 1965.

This naturally created problems with regard to the running of the Joint Research Centre establishments, which found it very difficult to make the best use of the heavily slashed equipment appropriations.

The amended programme showed an increase of 5,578 million EMA u.a., the credits being re-assigned among the various items and a reduction in the number of pests authorized by the end of the programme from 3,200 to 3,150.

Of this new ceiling figure of 455,000 million u.a. a sum of 3,078 million u.a. was set aside as a reserve earmarked for a limited number of projects. The move to constitute this fund must be regarded as an important decision of principle.

Revision of the programme has made possible a greater concentration of financial resources on a number of priority projects, in respect of which the increase — of about 31 million u.a. — was relatively bigger than at first sight appears from the overall figure. These priority activities include the Joint Research Centre, the ORGEL project, and Euratom's work in the fast reactor field. However, the slight increase in the allocations for the Joint Research Centre establishments is largely absorbed as regards some of them, the Central Nuclear Measurements Bureau in particular, by the redistribution of expenditure for the European Schools which charges the Centre with a proportion of costs well in excess of the percentage of children of Euratom staff employed at the CNMB.

While the increase in the amount allocated to Ispra is substantial, it merely offsets the rise in costs since 1962. This, combined with the shortage of staff, hindered Euratom's direct research activities in 1965.

The ORGEL project and fast reactors came off best under the new budget. That means that the ORGEL position is maintained. As regards fast reactors, the decision to raise the number of associations from three to five makes rationalization necessary to deal with the financial difficulties that have arisen since the programme was revised.

The principal chapters affected by the cutbacks in the programme are those covering proven-type reactors, processing of radioactive waste, radioisotopes, and the reprocessing of irradiated fuels. Moreover, the revised five-year programme entailed a big reduction in the appropriations for biology and training. In the latter field the cut of 30 % applied to the last two years of the programme involves a reduction of nearly 50 % in the already inadequate appropriations.

II. Implementation of the research programme

A. RESOURCES AND FACILITIES

There was no basic change in 1965 in the facilities available for carrying out the programme, provided by the Joint Nuclear Research Centre establishments, associations and research contracts.

1. *The Joint Research Centre establishments*

14. All four establishments are now operative, the Karlsruhe institute and the Petten establishment both having entered upon their respective activities.

The essential features for 1965 are summarized in the table below.

Staff movements remained normal, although the number of Grade A personnel applying for unpaid leave on private grounds must be regarded as rather high and the rigidity of the Service Regulations does not make administration of scientific and technical staff easy.

15. At Ispra the year under the review saw a number of buildings completed and occupied, viz. that of the medical service, the ORGEL offices, the social centre, the technology hall and laboratories, and the medium-activity laboratory. Building of the active chemistry laboratory continues.

Maintenance of existing buildings had to be kept to a strict minimum, in view of the budgetary allocations.

The ECO reactor, construction of which was completed under Euratom auspices, went critical on 11 December 1965 and has since been operating smoothly. Construction of ESSOR is proceeding, with the difficulties normal in an undertaking of this magnitude.

The IBM 7090 computer, which has been fully employed, will be taken back in 1966 by IBM who will lease to the Commission a 360-60 outfit in exchange. Thus Brussels, Luxembourg and Ispra will in 1966 all have machines of the same series, which will facilitate private-line communications between Geel, Brussels and Ispra to the utmost.

Some large loops were completed and others already constructed kept in operation.

The ISPRA 1 reactor was again used mainly as neutron source for external assemblies. The DIRCE loop was introduced but could only be used with non-nuclear heating. A handling error on this loop during a down-time period caused serious contamination of the heavy water by organic fluid as a result of which the reactor was shut down for nearly three months. This technical incident provided the opportunity for checking that the local safety board functions perfectly in liaison with the reactor control unit.

The competence and conscientiousness of the staff are evidenced by the ingenuity and keenness displayed in getting the reactor back into working order, and the energy devoted to completing and commissioning ECO.

Also to be regarded as noteworthy successes at Ispra in 1965 are the commissioning of and data obtained from the EXPO exponential experiment.

Through close collaboration between the Ispra Centre and two European undertakings it proved possible to complete the design studies and reports for the SORA fast-neutron pulsed source reactor project. With USAEC authority to employ the highly enriched U-235 which Euratom was unable to acquire, the Oak Ridge National Laboratory, using parts fabricated at Ispra, assembled a critical mock-up of the SORA core and mobile components.

These experiments, which will be continued in 1966, have already testified to the reliability of the calculations performed at Ispra on the neutronics of this complex figuration.

Among physics researches to be noted are the continued neutron spectroscopy studies and the very promising work on the preparation and employment of radiation detectors using lithium-doped germanium. Aside from research directly related to metals and ceramics needed at ORGEL, research on solid metals or salts under radiation went ahead.

Establishment	Staff recruited		*Finance (in millions of u.a.)*					
			Appropriations utilized in 1965 (commitments)					Revenue in 1965
	at 31. Dec. 1964	at 31. Dec. 1965	Staff and administration (Budget heading I, II, less tax)	Technical operation (Budget Chapter 30 & 32)	Real property investments and maintenance (Budget Chapter 31)	Contract work (Budget Chapter 53 a)	Assigned credits (1)	
Ispra	1424	1553	12.973	2.305	1.387	0.462	2.832	0.057
Karlsruhe	127	163	1.517	2.456	0.650	2.434	—	—
CNMB	144	157	1.592	0.733	0.221	0.046	—	0.008
Petten	120	146	1.316	2.778	1.395	0.039	—	0.529
	1815	2019	17.398	8.272	3.653	2.981	2.832	0.594

(1) These are credits stemming from projects under the second programme other than those relating to Joint Research Centre establishments.

Nuclear fuel chemistry yielded some interesting initial results on flow schemes for electric refining of metallic fuels and the treatment of ceramics by fused NaOH and fused chloride baths.

Certain problems relating to light metals in the molten and boiling state were tackled by a method and with results of value to the fast reactor associations.

The large pressurized-water loop proved a useful source of data on high-pressure boiling (up to 240 atm.). Since this loop cannot be fully used under Euratom's own programme for the time being, the plan is to put it at the disposal of industry ; this would already have been done if the Commission had had the personnel to provide a minimum of technical support for outside teams.

ORGEL has the first call on the technology department. It also assisted the direct conversion unit and successfully pursued its instrumention studies (fast-acting pressure gauges ; high-temperature strain gauges).

Research on direct conversion centred chiefly on thermionic devices with capillary circulation of liquid alkaline metals heat-pipes. This is probably the first "non-classified" embodiment of an idea patented in the United States five years ago. Less intensive study is being devoted to thermionic converters. The Ispra direct conversion unit, with its generally recognized high standard but extremely limited resources, will lead a precarious existence until a European space programme with Euratom participation has been laid down. The Commission has been pointing this out since the second five-year programme was drawn up, in the awareness that the present situation cannot go on much longer without nullifying the progress achieved and dashing the hopes raised.

The European Scientific Data Processing Centre (CETIS) succeeded in perfecting the analog-digital coupling, a feat which has been applauded by the leading cumputer centres both in America and in Europe. As well as carrying out various mathematical and programming studies, it substantially widened the support it affords to the various departments at Ispra and to the Community in general on questions of scientific and administrative applications. CETIS continued to assist the OECD nuclear code library established on its premises eighteen months ago and, within the very restricted limits authorized by the Council, maintained some activity in computerized documentation (in conjunction with the Information and Documentation Centre - CID). There was also an increased demand for automatic Russian-English translations.

16. At Petten the prefabricated buildings are installed and in occupation, and construction of the chemistry laboratory has started.

The HFR reactor, which the Reactor Centrum Nederland continues to operate under contract, was employed to a satisfactory degree, the main users being the RCN itself and the French Atomic Energy Commission. Despite difficulties, substantial improvements have been introduced in the irradiation devices both as to quality of construction and reliability in operation.

The Petten establishment has consolidated its role in connection with the DRAGON and THTR (thorium high temperature reactor) associations, the outstanding feature being the consent of the nuclear graphite manufacturers and users to the creation of a graphite testing and documentation centre at Petten. It is particularly encouraging to note that the U.K. Atomic Energy Authority has expressed interest in this laboratory and will supply it with British-produced material.

17. At the Central Nuclear Measurements Bureau (CNMB) at Geel the Van de Graaff accelerator has been in regular operation. The big linear accelerator is finished and provisional acceptance fixed. It will come into regular service in 1966, as will the time-of-flight measurement facilities bases, some of which will be used by teams belonging to national agencies. In current discussions on the subject, account is being taken of the Council's instructions that no services are to be provided gratis.

The CNMB neutron measurements programme itself is proceeding in accordance with the recommendations of the European American Nuclear Data Committee (EANDC).

Its other work (source calibration, target and detector preparation, analysis of isotopic composition, etc.) continues normally.

Links with external bodies have been strengthened, both as regards laboratories in the Community and other institutions (EANDC, IADEA, International Bureau of Weights and Measures, symposium arranged by the CNMB on isotope measurement of irradiated nuclear fuels, etc.).

The technical authority and the international liaison function of the CNMB can be said to have been very satisfactorily consolidated in 1965.

18. The laboratory at the European Transuranium Institute, Karlsruhe, is now finished except for the "very hot" cells, and has been gradually brought into service. It received 2 kg of plutonium for its own use and 100 kg to fabricate the fuel for MASURCA (1). This latter is technically mature, and is proceeding in spite of the general difficulties which persist in the fast reactor field since the revision of the second five-year programme. Studies for the establishment itself are well in hand, especially those relating to high temperature chemistry of heavy elements.

(1) Critical assembly constructed under the "fast reactor" association with the French Atomic Energy Commission (CEA).

The chemical processing of irradiated americium was successfully completed, as a result of which most valuable data have been acquired together with samples of transplutonium elements calculated to assist the various researches begun under contract. Unfortunately the funds left over from the first five-year programme are giving out and the transplutonium programme will have to be wound up. A contract signed with the University of Amsterdam will make it possible to relinquish, with minimum disadvantage to research and to individuals, an interesting and fruitful area of scientific activity which has unquestionably enhanced Euratom's reputation.

2. *Contracts of Association*

19. The associations, which account for some 35 % of the appropriations under the second five-year plan, have from the outset afforded the Commission a technically and administratively effective means of entering on equal terms into researches launched at national level so as to coordinate related researches for the whole Community. We shall return to this matter later, point by point. Let it suffice here to say that revision of the second five-year programme has not helped Euratom's position. It was natural of course, to try to standardize the terms of Euratom's participation but it had to be done in difficult circumstances. The proposals in every case necessarily involved cuts in the Commission's participation or stretching its contribution until 1968. Staff shortages and the difficulties of recruitment prevent Euratom from playing its full part technically. The fact that in one association-project with the Kernforschungsanstalt, Jülich, relating to thermonuclear fusion a research worker from Euratom was recently made head of research, gratifying as it may be, only underlines the difference between actual and potential achievement.

3. *Contracts*

20. The notices published in the Journal Officiel of the Communities inviting proposals for research to be carried out under Euratom control yielded the following results :

At 1 March 1966 proposals received numbered 793, about 50 more than at the same date in the previous year. There has been no marked change in the breakdown according to subject and country of origin since the last report. On 300 proposals decisions were taken to negotiate and/or conclude a contract, 308 were rejected and 185 are under consideration.

In 1965, 90 new research contracts were signed, for a total of 10.036 million u.a. As regards association contracts, the five existing ones in the field of

thermonuclear fusion were renewed and four fresh contracts were signed. Two of the latter, concluded with Belgian and Netherlands partners, relate to fast reactor research.

Ceiling figures for Euratom's share of total expenditure under these two contracts are 1.1 and 1.4 million u.a. respectively.

The other two were concluded under the "Biology" programme with the Gesellschaft für Strahlenforschung and the University of Leyden, the ceiling for Euratom's share being 0.472 and 0.269 million u.a. respectively.

B. MAJOR OBJECTIVES

1. *ORGEL and heavy water reactors*

21. Heavy water reactors planned or under construction in the Comunity include two national projects (EL 4 and KKN) with pressurized CO_2 as coolant. Euratom is also engaged, in association with the Italian Atomic Energy Committee (CNEN), in research on fog-cooling or boiling-water-cooling (CIRENE), the work being entrusted to the Centro Informazioni Studi ed Esperienze (CISE) which, under a Euratom contract, had initiated these studies well before the CNEN came in.

The ORGEL project at Ispra encompasses this work, which comprises :

— the construction and operation of reactors and large-scale experimental facilities ;

— the conduct of research both by departments at Ispra and by contract ;

— development studies on this design concept.

A progress report on the project was presented to all Community agencies concerned (public and private undertakings) at a Symposium, the proceedings of which — including discussion — are now available. (1)

At this stage, and having regard to the AEC programme which is pushing ahead with preparations for building high-output heavy water reactors, the conclusion of a Euratom/AEC agreement (suggested in 1964 by the AEC) and a decision on a European prototype (administration-level studies for which began in 1965 but are as yet far from complete) are matters of urgency.

The ECO reactor is now in operation and construction of ESSOR continues on a tight schedule so that it can be expected to go critical early in 1967. Apart from construction, the vital problems are those of safety procedure (relations with the Italian authorities) and getting together an operating team.

(1) Proceedings of the Orgel Symposium — Meeting held at the JRC Ispra, October 1965.

The development studies have demonstrated that a natural uranium carbide-fuelled ORGEL plant would be competitive but that slight enrichment would make it possible to exploit the properties of that fuel to the full (high density, high thermal conductivity) without the necessity for chemical re-processing of unloaded fuel. This foreshadows the development of a high specific power variant.

It has been shown that a medium-power prototype of the order of 100 MWe would be fairly representative of future generating plants of this type.

Of the many lines of research at Ispra or under contract, we shall mention only the most important and those which open up unexpected prospects for the design of advanced variants of the ORGEL type.

There was very good agreement between the theoretical and experimental data obtained on the neutronics of uranium carbide / heavy water / organic fluid lattices. Several instruments used at Ispra and elsewhere in Europe and in Canada have enabled valuable comparisons to be made of the calibrations effected at the various points.

Significant progress was recorded on the physical chemistry of radiopyrolysis of the coolant and on an original clean-up method. Loop tests in the SILOE reactor at Grenoble confirmed the possibility of keeping the coolant in good condition in-pile at the maximum temperatures contemplated for industrial-scale ORGEL reactors.

Further ground has been covered in the study of materials appropriate for use in advanced variants (molten-metal-impregnated graphite, zirconium and magnesium alloys).

Experiments and research on SAP (sintered aluminium powder) and uranium carbide are going ahead satisfactorily ; the price of carbide is falling, and an American firm has placed a big order for SAP tubes and ingots with a European firm.

Lastly, very encouraging results are being obtained in the quality and resistance control of spare parts and mechanical assemblies (pumps, valves, channels, etc.).

Studies relating to the heavy-water-moderated light-water-cooled variant (CIRENE) were focussed principally on the respective merits of uranium metal and uranium oxide. As recommended by the Commission, research is henceforward to be confined to the latter fuel.

2. *High-temperature gas reactors*

22. A general description of this reactor series was given in the Seventh General Report. In this field, Euratom is taking part in the DRAGON project in liaison with the European Nuclear Energy Agency, and an associa-

tion with Brown Boveri/Krupp and the North Rhine Westphalia Nuclear Research Centre at Jülich for the development of a pebble-bed reactor using thorium.

DRAGON programme

23. After going critical in August 1964, the reactor experiment was run up to power undergoing the normal sequence of power trials as laid down in the programme. The reactor operated at 10 MW for several months, incorporating special elements in its first charge, the behaviour of which was so good as to enable preparations to be made for the run-up to 20 MW, planned to start in April 1966.

Total radioactivity of the primary circuit is extremely slight, owing to the very low rate of release of fission products by the fuel elements and the faultless functioning of the helium purification system.

The primary circuit proved perfectly leaktight, so that extrapolation to a full-scale reactor can be undertaken with confidence.

Development studies on this prototype are centred on the "feed-and-breed" method using two types of fuel, in which the "feed" fuel can be replenished while the reactor is on-stream. The investment costs will not be known until 1966.

The research programme has been cut back considerably and will end in a few years, work on the DRAGON project being concentrated on engineering problems and reactor operation. Very special attention has been directed to certain problems which have to be solved before a power reactor can be guaranteed to function on an industrial scale, e.g. high-dose irradiation behaviour of the graphite and the coated particles.

THTR programme

24. This association is three-pronged :

— A research and development programme to be carried out to cover :

development of a fuel element fabricated in the Community with performance characteristics equal to or better than those of the American fuel developed for the first core of the AVR (Arbeits-Gemeinschaft-Versuchs-Reaktor) ;

study of various pebble circulation configurations depending on the number and positioning of control rods and the number of pebble unloading ports ;

development of a selector device allowing of quick decision as to the destination of the irradiated pebble after unloading and burn-up measurement ;

study of certain reactor components (blowers, heat exchangers, etc.).

— Design studies on a power prototype and a secondary steam circuit ; dimensions of this prototype will need to be such as to permit of extrapolation of the components to an industrial-scale reactor without any fundamental modification.

The reference capacity of the prototype has been set at 300 MWe. The consolidated reactor design concept has been retained ; downward circulation of helium at 40 atm has been adopted, which means arranging the heat exchangers round the reactor to permit replacement if necessary.

General design studies will continue throughout 1966 and should culminate in a detailed preliminary draft design in 1967.

— Participation in operating the AVR reactor, construction of which is nearing completion at Jülich. The association will be responsible for selecting reserve fuel and experimental fuel elements to be inserted in the AVR.

3. *Fast neutron reactors*

25. Two new association agreements were concluded in 1965 with partners in Belgium (Belgian State - Belgonucléaire - CEN) and the Netherlands (TNO - RCN), thus extending Euratom's activity to all Community countries engaged in this field.

The definite advances achieved in research were accompanied by organizational and financial problems in 1965.

Fast reactors are vital to the Euratom research programme. The revised second five-year programme raised the appropriation under this head by 9.5 million u.a., to 82.5 million (but still less than the Commission had asked for). At the same time, the Commission received notice of further price increases after the Council's decision. This combination of circumstances confronts the Commission with financial problems which are now under examination with the partners concerned with a view to negotiating a solution based on a tightening up of programmes plus certain facilities to be afforded by our principal partners to ease the budgetary difficulties (e.g., the German authorities have advanced a sum of 3 million u.a. to the Commission, corresponding to Euratom's share of the additional plutonium cost (which in 1962 it had been hoped might be leased) within the framework of the Euratom/Gesellschaft für Kernforschung association.

While the original dispersal of effort through the existence of two projects has not been remedied, a substantial degree of coordination has been brought about ; nevertheless, difficulties persist as regards the transition to the industrial stage. Thus the construction of a prototype remains a national

concern for the time being, since the current five-year programme makes no provision for Euratom to participate in a project of this kind.

On the initiative of the Scientific and Technical Committee, an *ad hoc* committee consisting of the Commission's association partners, the electricity producers and the reactor manufacturers has been set up to discuss all problems connected with fast reactor development.

So far, the joint action represented by the system of associations and by the agreement with the USAEC (under which large quantities of plutonium have been acquired) which this scheme made possible has not, however, given rise to the creation of a common policy.

In fact there are major differences in the structure of industry in the several Member States of the Community. In some, the construction of a prototype is a matter for the State, working through national corporations. In others the initiative lies with private industry, with or without support from public money.

It will therefore be for the Community to find a formula for settling the problem of the prototype in a way that will reconcile the differing views.

Joint enterprise status, as envisaged by the Treaty, might provide an answer, since it facilitates the settlement of problems relating to information acquired such as might arise from the participation of private firms.

The problems facing the Commission are the more urgent in the case of fast reactors in that the CEA and CNEN association agreements are drawing to an end. The need to negotiate extensions, at least until the end of 1967, will be superimposed on that of ironing out present difficulties and negotiations concerning the more distant future.

Having disposed of that point, we shall confine ourselves to mentioning the outstanding technical results for 1965.

The HARMONIE source reactor went into commission at Cadarache, while the STARK and SUAK assemblies continued in regular use in Karlsruhe.

Construction of the RAPSODIE reactor, the MASURCA critical assembly and SNEAK (Schnelle Null-Energie Anordnung, Karlsruhe) is proceeding smoothly, as is the fabrication of fuel elements for these reactors.

The big sodium loops at Cadarache and Grand-Quevilly are operating normally.

In the United States, the very fast pace of construction scheduled for the SEFOR reactor (with Euratom participation via its GfK associate) is being maintained.

The associations with CEA and GfK have very actively pursued their reactor development studies, including those relating to the safety of reactors of around 1,000 MWe. The overall results were reported at the Argonne National

Laboratory symposium, thus enabling a comparison to be made with similar studies in the United States and in Britain (insofar, as they have been made public). The notable position of the Community in this field and the respect accorded to its achievement were confirmed.

Cooperation has been excellent between the GfK association and the new associations with Belgian and Netherlands partners.

It has not yet been possible to define the terms of the cooperation looked for between the Euratom/CEA association and the Euratom/CNEN association.

Cooperation is gradually developing with the AEC, as also with the UKAEA in the reactor physics sphere only.

4. *Proven-type reactors*

26. Development studies on the gas-graphite/natural uranium reactor string continued and some were completed. Thus studies for a new system of charging these reactors showed that the biggest difficulties appear to have been overcome and that the new process can be taken as sufficiently advanced to move on to the practical phase.

The programme of fuel can fabrication from a single extruded blank yielded excellent results. Fuel casings with markedly better thermal and aerodynamic properties than clads employed hitherto can be made by this process.

Apart from research projects already in hand, no other research is at present planned in the field of proven-type gas-graphite/natural uranium reactors. Euratom's endeavours will be directed towards extracting maximum advantage from the investments made, the know-how acquired and the data so far obtained under existing research and development contracts.

27. As regards the light-water series, the Commission likewise operates through contract arrangements, principally under the Euratom/US Agreement, save as regards certain small-scale studies carried out at Ispra on assigned credits carried over from previous years.

Initially the contracts placed by Euratom in Europe were used to create or maintain facilities in industry or in national centres within the Community which had been left without work or even deprived of their raison d'être by the early difficulties encountered in getting the nuclear industry off the ground. The contracts awarded by the AEC in the United States on behalf of the Community, on the other hand, furnished Euratom with data and technical contacts which made possible a speedy start on light-water reactor technology.

At the moment the USAEC is withdrawing from the water-reactor field, believing that its development is now a matter for industry alone. Euratom's activity is still focussed on a few major development studies and on the experimental use of the first operative power plants insofar as that is possible. These have in fact in several instances been equipped with special instrumentation or can serve for the testing of certain materials.

The main subjects covered are listed below :

a) Plutonium recycling in thermal neutron reactors, the studies ranging from neutronics to plutonium-bearing ceramic fuel fabrication and dry chemical reprocessing of the same after use.

b) Further studies on materials, in particular pressure vessel steels and cladding materials (corrosion, improved alloys).

c) Improving characteristics of boiling-water reactors. The success of twisted-tape fuel elements and studies on prestressed concrete vessels open up prospects for a European variant of these reactors the study of which is bringing certain European and American concerns into increasingly close collaboration.

d) Processing and storage of radioactive waste.

5. *Materials testing reactors*

28. The BR 2 and HFR reactors at Mol and Petten respectively have been in regular service. Both of them, the latter in particular, were duly loaded with irradiation experiments, for the most part having no direct connection with Euratom's programme.

Experience in 1965 bears out the following points, which are significant for the future :

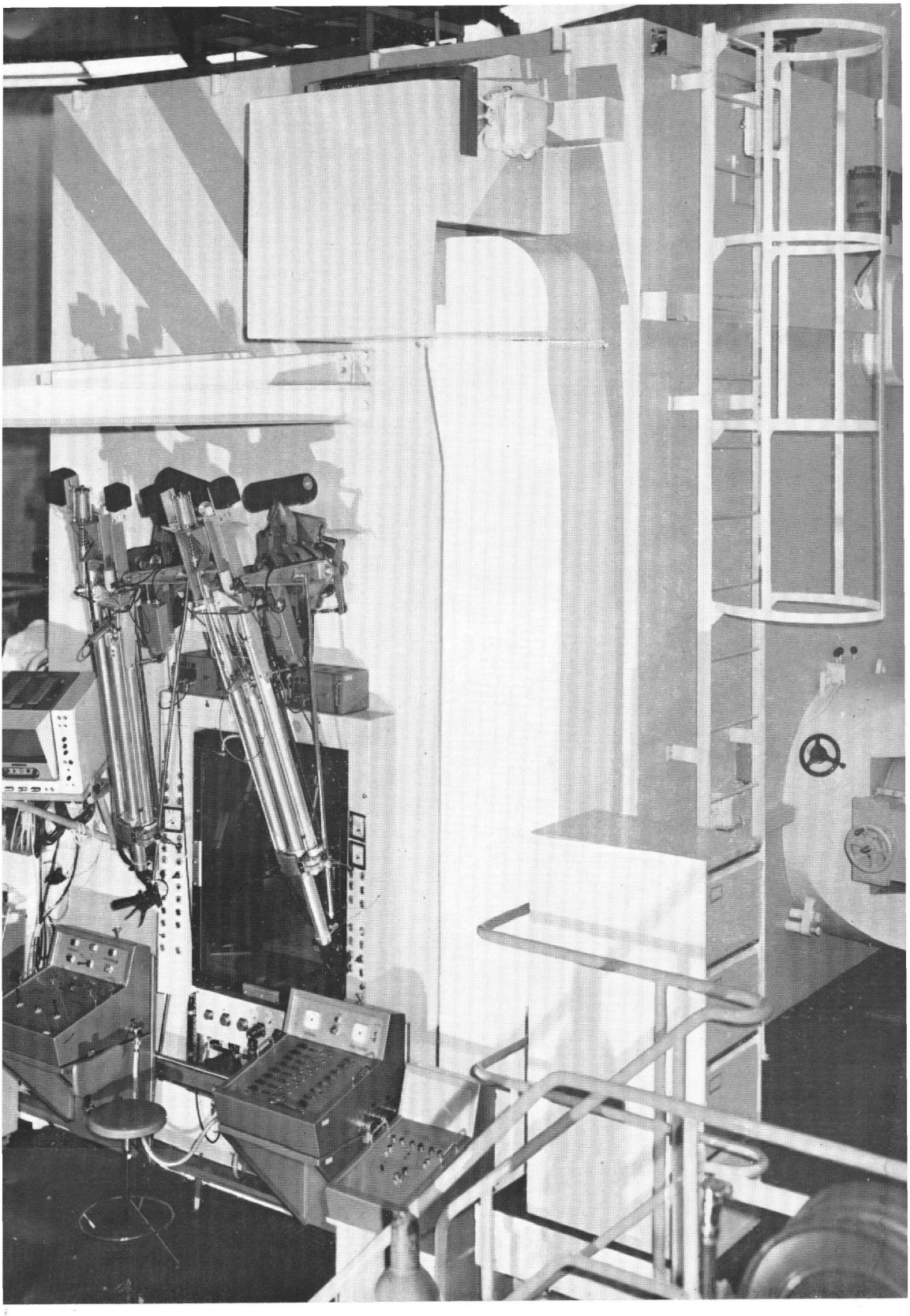
a) These reactors cannot be operated to break even financially simply by selling neutron irradiation facilities at prices acceptable to customers.

b) The position is aggravated by the inability of Euratom and its CEN associate at BR 2 to finance big in-pile loops which might result in more customers.

c) Big customers are only interested in irradiation in the strict sense and carry out most of the preparatory work and post-irradiation examinations themselves. The indispensable accessories are thus chronically underemployed, since the reactor operator has no rational programme of his own ; this adds to the deficit.

d) The same customers are gradually acquiring their own specialized reactors.

That being so, while these reactors continue to operate close attention must be paid to any change in the general trend.



PETTEN (Netherlands) — HFR DISMANTLING CELL

(See other side of page for caption)

This cell, which has just been brought into service, is housed within the reactor containment. It is employed for the post-irradiation handling of experiments inserted in the reactor. Various remote-control techniques, particularly for the under-water dismantling of capsules containing the sodium-potassium eutectic, have been devised and used with success.

6. *Thermonuclear reactions*

29. In this sphere, as yet remote from any industrial prospects, Euratom's work of coordination proceeds effectively without encountering any fundamental difficulties.

Shortage of staff restricts the Commission's influence and too often leads to a feeling among personnel on assignments of being a minority in the units to which they are attached and so failing to play the part they would wish to have.

For the first time over, a Euratom official was appointed to direct the whole of the technical work carried out under an association contract.

From the administrative standpoint, the most important item in 1965 was the renewal of five association contracts which had expired at end 1964 and been provisionally extended until 30 June, 1965. The five contracts were renewed, after lengthy and difficult negotiations in some cases, for a period of three years from 1 January, 1965, namely with CEA (French Atomic Energy Commission, Fontenay-aux-Roses and Saclay laboratories), CNEN (Italian Atomic Energy Committee, Laboratori Gas Ionizzati di Frascati), IPP (Institut für Plasmaphysik, Garching bei München), KFA (Kernforschungsanlage, Jülich, Institut für Plasmaphysik) and the FOM foundation (Fundamenteel Onderzoek der Materie, Jutphaas, Amsterdam and Arnhem laboratories). Final negotiations were held up until the revised second five-year programme was settled. In accordance with Council directives, the trend in the new contracts is to standardize Euratom's financial participation, which in fact represents a substantial rise in total Community expenditure in this field (approximately 20 million u.a. annually, of which approximately 7 million a year provided by the Commission against 22 million a year in the United States (USAEC activities) and 11 million a year in Great Britain).

These association programmes follow the same line of research as under the previous contracts, save as regards modifications suggested by results already obtained.

A number of major international conferences were held in 1965, viz., "Ionized gas phenomena" (Belgrade, August, 1965) ; "Plasma physics and controlled thermonuclear fusion" (Culham, September, 1965) ; and "Megagauss fields" (Frascati, September, 1965).

The "Interassociations" liaison group discussed the results at its meeting at Fontenay-aux-Roses, in relation to the work and programme of the associated laboratories. These conferences, in particular the second one, had the twofold effect of to some extent high lighting the current situation and testifying to the ever-increasing scientific contribution of our laboratories both quali-

tatively and quantitatively. The leeway due to a late start on the part of most laboratories in the Community as compared with others has thus been made up.

Outstanding among experimental data obtained in the Community in 1965 are :

— the very high temperatures reached at Garching by means ot thetapinch in high-purity plasma ;

— the setting up, by the same group, of torus configurations in which the plasma does not display an abnormal degree of diffusion, a result which, if it were repeated at Garching and reproduced elsewhere, would constitute a refreshing exception to the disappointments generally encountered on these important configurations ;

— corroboration at Fontenay-aux-Roses, at least under certain conditions, of the stability of magnetic well configurations, even at appreciable plasma densities ;

— in ion injection experiments, the absence of instabilities observed on magnetic mirror devices at Fontenay-aux-Roses and the increased confinement time in the "cusp" configuration at Jutphaas ;

— plasma formation by means of the hot-ice experiment at Frascati, and, also at Frascati, the production of reproducible magnetic fields of several megagauss which have been subjected to exhaustive studies ;

— production at Jülich, by progressive wave acceleration, of high-energy plasma bursts ;

— dense plasma acceleration and accumulation at Saclay with very efficient HF energy transfer to the plasma.

However, it must be borne in mind that the results achieved, whether in Community laboratories or in the rest of the world, are simply milestones along a long and difficult road.

It is encouraging to find that in all working groups the planning of future developments under the programme is the subject of increasingly careful study as regards both the choice of targets and the design and construction of the experimental devices.

Collaboration between theorists and experimenters is becoming ever closer and more effective.

7. *Biology*

30. Consolidation rather than further progress was the keynote in this sphere during 1965.

Revision of the second five-year programme entailed a big cut in the "Biology" appropriation, the more severe in that it occurred when most of the projects were already under way and so in fact reduced funds still available by a third.

As regards the association contracts, while development had to be slowed down in keeping with the new budgetary stringency, pursuit of the major objectives was nevertheless maintained.

On the other hand the budget restrictions entailed abandonment or non-renewal of more than half the research contracts, so that numerous studies of several years' standing have had to be relinquished. Research teams have been broken up and scientific staff discharged. Scientific and financial capital, in some instances very substantial, has been wasted. The weight of these decisions has fallen most heavily on the universities.

However, Euratom has a moral success to its credit, which enhances its prestige beyond the Community's frontiers, in the official confirmation of Mr. R. K. Appleyard, director of its biology department, in his appointment as Executive Secretary of EMBO (European Nuclear Biology Organization).

The sectors covered by the biology programme were the same as in the previous year, namely :

— diagnosis and treatment of radiation lesions ;
— genetic hazards and radiations ;
— somatic hazards and radiations ;
— research into genetic and somatic hazards ;
— movement of radioactive isotopes in man and in animals ;
— movement of radioactive isotopes in the environment ;
— dosimetry, methods and instruments ;
— applications of nuclear techniques in agriculture ;
— applications of nuclear techniques in medicine ;
— interdisciplinary training of radiobiologists and miscellaneous support programmes.

Within the biology programme, however, Euratom has endeavoured to channel the work so that agronomic and medical applications of nuclear energy derive maximum advantage from researches on irradiation hazards.

The biology department of Euratom also assists the Development Fund run under the aegis of the EEC Commission in connection with the application of nuclear techniques in some of the Associated African and Malagasy States.

8. *Labelled molecules and radioisotopes*

30a. Euratom's programme in the labelled molecules field was continued by way of the labelled molecules bank and research under contract.

The programme, it will be remembered, aims at making available to users products that are scarce or unobtainable on the market, at promoting research

into the synthesis of new compounds for which a demand exists, at improving relations between producers and users with a view to balancing output against requirements, at disseminating information on the products available and developing the exchange of information on the synthesis and employment of labelled molecules.

The labelled molecules bank delivered preparations, nowhere else obtainable, for special biological research in the Community countries and the United States, so that it is largely thanks to the bank that this research could be undertaken at all.

Euratom concluded contracts with university bodies or industrial concerns in the Community for the preparation of new substances by conventional processes or for perfecting new general methods of synthesis, or again, for improving the techniques employed so as to yield higher quality at lower cost. Side by side with this activity went the organization of meetings of scientific experts and of exchanges of information with agencies in non-Community countries.

As to radioisotopes, Euratom's activity embraced the production of new radioisotopes, the recovery of fission products and the development of new applications. This action was slowed down owing to the big cutback in credits in connection with the revision of the second five-year programme.

Discoveries made through research contracts on fission product recovery (in particular on the development of new inorganic ion exchangers) led to the formulation of a system for separating out the various radioisotopes at once simpler, more efficient and cheaper than the separation methods elaborated in the United States.

Work relating to the production of new radioisotopes and the development of new applications was concentrated on specific objects, for instance tritium targets of new design, an original method of producing Cl 36, and a method of analysis based on photoactivation.

9. *Training and Instruction*

31. The reduction in the "Training" appropriation from three million u.a. to two under the revamped second five-year programme has meant slashing the Commission's work in this field, already less extensive than under the first (1958-1963) programme. First to suffer have been the training courses and grants which contribute to the training of research workers and nuclear energy specialists in the Community. The average period of student-training courses has been cut to enable a reasonable proportion of applications already lodged at the time of the Council decision to be accepted. After running

for years, this side of Euratom's work was becoming so well known in the relevant quarters that the number of applications has risen 348 in 1964 to 460 in 1965, in spite of the Commission's care to abstain from any further publicity. Applications accepted in 1965 numbered 271 (59 %) as against 156 in 1964. Buth the average duration of courses was cut to 3 months, which the host centres consider inadequate, especially as Euratom trainees are sent outside their own country and therefore need some time to adjust to new living and working conditions. The number of training courses will accordingly have to be reduced in 1966.

The Commission cut down the award of thesis grants and specialization grants for young graduates, though adhering to the established principles. Thirty-one new grants were awarded to candidates who had applied in 1965 and 18 to 1964 applicants. The subjects and location of these awards are listed in the Appendix. In addition, during 1965 the Commission extended 34 grants awarded in 1964, most of them thesis grants.

Lastly, Euratom gave hospitality at its Joint Research Centre establishments to 23 research workers or qualified engineers from other research centres or industrial undertakings interested in the Commission's scientific and technical work. Sixteen of them were nationals of countries outside the Community.

Against this the Commission was obliged to make heavy cuts in or suspend altogether the assistance it was giving to certain advanced research establishments (e.g., the Institut des Hautes Etudes Scientifiques, Paris) and to small avant-garde symposia. The consequent loss of prestige seems out of all proportion to the savings made, especially when it is remembered that the people we stopped helping had in most cases to turn to the great American foundations for assistance.

10. *Results*

32. To a limited, though far from negligible, extent, the publications, patents and revenues of the establishments witness to the effectiveness of the research effort.

Hence it is worth noting that in 1965 Euratom and its contracting or associated partners issued and published 655 Euratom reports and 462 articles in periodicals in connection with the implementation of the Community's research programme, filed 875 patent applications (80 of them being first applications in the name of Euratom) and we granted 214 invention patents. The greater part of this published material derives from the activities described above, including the output of the various associations. Total

revenue amounted to 610,000 u.a., chiefly from services rendered (irradiations at Petten, electronic computer work at Ispra, services of the CNMB), while 1,600 u.a. derives from licence fees.

11. *The European University*

33. Negotiations on the question of a European University continued in 1965 within the framework of the intergovernmental conference set up by the Italian Government in implementation of the decision of the Bonn Conference of Heads of State on 18 July, 1961. The results of the negotiations may be summed up as follows :

— The working party under the chairmanship of Mr. P. Pescatore, Secretary General of the Luxembourg Ministry of Foreign Affairs, reported on 31 March, 1965 on the draft convention concerning a European University. The legal instrument necessary to give effect to this project is thus ready.

— The working party under the chairmanship of Mr. Sattler, Ministerial-director at the Foreign Affairs Ministry of the Federal Republic of Germany, has completed its work and agreed on a definite programme for the initial years of the European University's activity. On the basis of the working party's proposals, first budget estimates have been drawn up.

The Euratom Commission reaffirms the interest it has always shown, in agreement with the European Parliament, in the matter of a University of Europe, in the belief that the realization of this project would contribute to the advancement of European culture and the progress of European society as a whole.

CHAPTER III PROMOTION OF INDUSTRIAL ACTIVITY

I. Nuclear power plants and marine propulsion

1. *Programme of the US/Euratom Agreement*

34. Three nuclear power plants have been built under the power reactor programme of the US/Euratom Cooperation Agreement, at Garigliano, Chooz and Gundremmingen.

The Garigliano boiling water reactor (150 MWe) operated at a high load factor until the shut-down date scheduled for replacement of the stainless steel fuel assembly units with Zircaloy-2 units, as well as for maintenance work that revealed several defects which, while of no exceptional gravity, nevertheless held up recommissioning of the plant for several months.

The phenomena observed mainly concern cracking phenomena in certain materials. This is not unique, and similar problems have come to light in other nuclear power plants that have been running for several years. It demonstrates the absolute necessity of establishing inspection schedules for checking the various parts of power reactors and studying the service behaviour of the materials employed.

Owing to these delays, it has not yet been possible to carry out the research programme as planned on the Garigliano power plant ; however, all the necessary equipment is in place and the planned measurement series using four instrumented fuel assemblies will be carried out immediately after the plant is started up again. Installation of the data logger assembly constructed under the research contract with ENEL went very well and its performance has afforded full confirmation of the value of this equipment in the optimization of operational criteria for nuclear power plants.

Construction of the Chooz and Gundremmingen plants, by the Société d'Energie nucléaire franco-belge des Ardennes (Sena) and the Kernkraftwerk RWE-Bayernwerk GmbH (KRB) respectively, is almost completed. Acceptance testing of the various parts of these plants is in progress and fuelling will probably be effected next autumn. Barring accidents, these installations should be running at full power at the beginning of 1967.

Finally, SENA's proposal to step up capacity from 210 to 266 MWe has been approved by the Commission.

2. *Power reactor participation programme*

35. The participation programme is being carried out under the first five-year programme. Its object is to encourage construction and industrial-scale operation, by Community undertakings, of nuclear power plants in the territory of the six Member States, and to assist Community industry to reap the advantage of experience and data obtained in the field of power plant design, construction and operation.

To this end the Commission signed participation contracts relating to five nuclear power plants, to a total of 32 million u.a. Together these contracts cover the following fields : start-up charges resulting from a shortfall in energy production, fuel element fabrication, and fabrication of nuclear and para-nuclear components.

In return for its participation Euratom receives a considerable volume of very valuable technical information which it makes available to all parties furnishing evidence of legitimate interest.

Of the above-mentioned 32 million u.a., 26,600,000 relate to fabrication of fuel elements and of nuclear and paranuclear components. Euratom's participation in this respect is effected, insofar as the items are Community-made, through manufacturers in the Community.

The remaining 5,400,00 u.a. cover charges arising for the contractor through a shortfall in energy output during the start-up period.

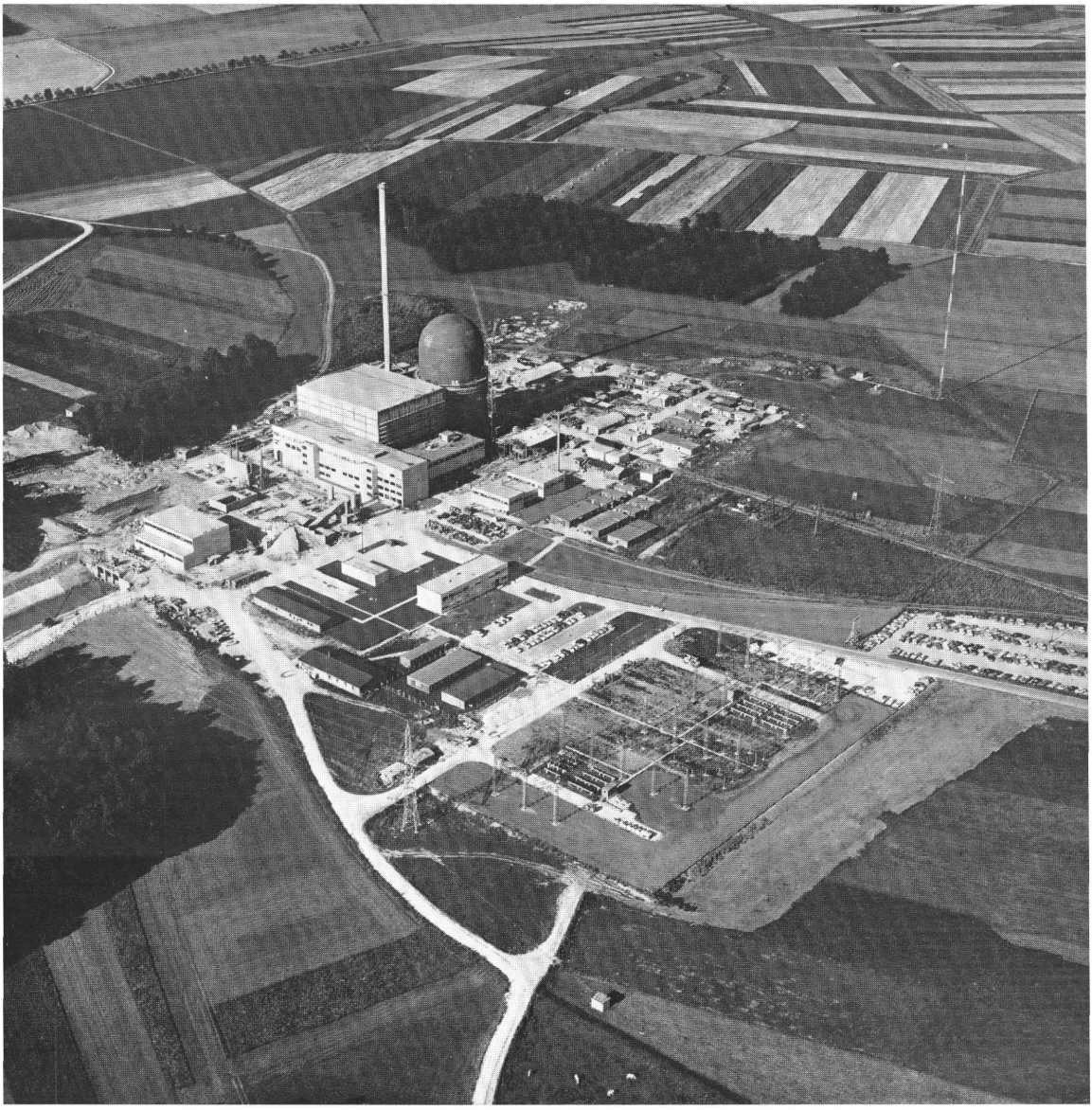
By virtue of its participation, the Commission has already refunded an aggregate of 6 million u.a. to various contractors, of which 4 million u.a. for fabrication of reactor parts in the Community, 1,760,000 u.a. for start-up losses and 220,000 u.a. for fuel element fabrication in the Community.

Access to the information concerning the power plants in which Euratom participates is provided through various channels : documentation furnished by the contractors, secondment of staff of Euratom or of certain Community agencies and undertakings to work with contractors, training courses for students from educational institutions in the Community.

The information is disseminated by means of technical seminars, notices, printed publications and microfilms. There are also facilities for consulting the documentation assembled at Euratom headquarters.

36. The five power plants in which Euratom participates are :

— Garigliano : Boiling water, 150 MWe net - Entente Nazionale per l'Energia Elettrica (ENEL)



GUNDREMMINGEN (Germany) — BIRD'S-EYE VIEW OF KRB PLANT

(See other side of page for caption)

The civil engineering work and plant erection are now practically completed. First criticality is scheduled for mid-1966 and industrial commissioning for the end of the year.

The KRB's Gundremmingen plant, equipped with a boiling water reactor operating at 237 MWe, forms part of the Euratom participation programme.

— Latina : Graphite-gas, 200 MWe net - Ente Nazionale per l'Energia Elettrica (ENEL)

— Chooz : Pressurized water, 226 MWe net - Société d'Energie nucléaire franco-belge des Ardennes (SENA)

— Gundremmingen : Boiling water, 237 MWe net - Kernkraftwerk Rheinisch-Westfälisches Elektrizitätswerk-Bayernwerk (KRB)

— Doodewaard : Boiling water, 50 MWe net - N.V. Gemeenschappelijke Kernenergiecentrale Nederland (GKN)

The following was the position regarding these five plants at end 1965 :

The Garigliano plant, as mentioned above, ran for about nine months and delivered some 902 million kWh to the grid. Since end September 1965 the plant has been shut down for annual maintenance, replacement of stainless steel with Zircaloy channels and execution of a research contract concluded with Euratom.

The Latina plant was in normal operation throughout 1965 save for a 34-day shut-down for annual overhaul towards the middle of the year. Net output of electric current was 1,441,000,000 kWh approximately. A research contract concluded by Euratom is in progress. New fuel deliveries were made in October and December. Towards the end of the year a first batch of irridiated elements was despatched to the reprocessing plant at Windscale.

At Chooz the major part of the assembly and cable-laying work is nearing completion, as are the component tests which directly follow as each assembly is completed. The first general trial, i.e. the hydrostatic testing of the primary circuit, took place at the beginning of December 1965. First deliveries of fuel elements, control rods and follower-blades were effected in early November and December. Full-scale commissioning is scheduled for the end of 1966.

The assemblies and cabling and the component testing for the Gundremmingen plant are largely terminated. The turbo-generator group ran during much of December on steam from the stand-by boilers, thus enabling a series of tests and adjustments to be effected. The plant is expected to be in full production by the end of 1966.

Mainly civil engineering work was carried out at the Doodewaard power plant site during 1965. Factory production of equipment is proceeding according to plan. Orders already placed by GKN include those for the reactor vessel and internals and the control rode drive system.

Assembly work is due to start around mid-1966 and the vessel should be installed towards the end of the year. Detailed design studies continue and commissioning is planned for early in 1968.

3. *Joint enterprises*

37. Chapter V of the Euratom Treaty provides for joint enterprise status to be granted to "undertakings of fundamental importance to the development of nuclear industry". In recent years the Council of Ministers has conferred this status of a legal person under European law on three undertakings. These are the Société d'Energie nucléaire franco-belge des Ardennes (SENA) at Chooz, the Rheinisch-Westfälisches Elektrizitätswerk-Bayernwerk GmbH (KRB) nuclear power plant at Gundremmingen and the KWL nuclear power plant at Lingen. At the Commission's request, the Council of Ministers made these companies subject to the company law of the country where they have their headquarters insofar as their Articles of Association lay down no special provisions on the subject. The Council of Ministers furthermore accorded these companies the advantages set forth in Annex III to the Euratom Treaty. This enables the first nuclear power plants, even though still in the nature of experiments, to be operated similarly to conventional installations.

Under Article 50 of the Treaty, alterations to the Articles of Association of joint enterprises cannot take effect until they have been approved by the Council on a proposal of the Commission. During the year under review, several such modifications were approved by the Council, mainly relating to capital increases in connection with the financing of nuclear installations.

The only undertakings to have applied for and been granted joint enterprise status so far are nuclear power plants, all of which are now building.

The present position of the SENA (Chooz) and KRB (Gundremmingen) joint enterprises with which the Commission has signed contracts under the participation programme is reported above in paragraph 36.

As regards the Lingen plant, this is equipped with a boiling water fossil-fuel-superheat reactor having a total net generating capacity of 240 MW.

Construction began in 1964 and is progressing according to schedule. The containment shell is almost finished ; the evaporators, superheater and reactor vessel at present being constructed at the works will be installed between mid-1966 and mid-1967.

Turbine assembly will start around the beginning of 1967 and the civil engineering work has progressed steadily. Commissioning of the power plant is planned for September 1968.

Early in 1965 the Kernkraftwerk Obrigheim GmbH applied for joint enterprise status in accordance with Chapter V of the Euratom Treaty and for certain of the advantages set forth in Annex III to the Treaty. The latter are similar to the advantages accorded to the Gundremmingen and Lingen joint

enterprises. After consulting the Member States, the Commission on 3 November 1965 passed the KWO application on to the Council for a decision, accompanied by a report on the projected nuclear power plant and its own opinion in favour.

In the Commission's opinion the nuclear power plant at Obrigheim is an undertaking of cardinal importance for the development and progress of nuclear industry in the Community, in view of its stimulus to the expansion of capacity and the know-how gained in construction.

The KWO nuclear power plant is located in the district of Mosbach, Land Baden-Württemberg. The concern was founded by thirteen electricity undertakings in Baden-Württemberg which joined forces for the purpose of its construction.

It is equipped with a pressurized water reactor, with a planned net generating capacity of 283 MW. Building began in March 1965. Civil engineering work is proceeding normally. Construction of the containment shell will be completed towards the end of 1966 and fabrication for the reactor vessel about March-April 1967. Installation of the evaporators will begin around the middle of 1967 and a start is expected to be made on turbine assembly in the autumn of that year. Commissioning of the power plant should take place around the end of 1968.

The Lingen and Obrigheim plants will be the first light water power plants to be constructed in the Community virtually without outside help, the designs and specifications having been handled almost exclusively by Community industry as also the supply of equipment. Some proportion of the fuel elements — of Community design — may possibly be imported from non-Community sources.

Joint enterprises are required to make available to the Euratom Commission information acquired in the course of design, construction and operation of their nuclear power plants, thus enabling Community industry to benefit by their experience.

Similar methods apply regarding Euratom's acquisition and dissemination of this information as for the participation programmes, for instance in the matter of the supply of documentation by the undertaking and the secondment of Euratom staff and other personnel.

4. *Nuclear ship propulsion*

38. New prospects for viable nuclear ship propulsion are opened up by the entry into service of the first specially-designed fast container vessels.

There is a noticeable trend in favour of using this new type of cargo ship, which calls for high engine power and is thus particularly suitable for nuclear propulsion with its inherent advantages. At present, however, ore carriers and oil tankers are the only types in the development of which Euratom is participating because they make it possible to acquire a certain amount of data at minimum risk and expenditure.

Through the contract with the Gesellschaft für Schiffbau und Schiffahrt mbH providing for Euratom participation in the construction of the nuclear research ship "Otto Hahn", data so far obtained have been communicated to the Community governments and manufacturers concerned via seconded engineers and by means of reports on the occasion of meetings and visits. An overall picture of what has been done as regards the main ship-building work assembly of safety shield aboard and current fabrication of components for the nuclear installation was given to suppliers at a first symposium, which is to be followed with further meetings. Supply of reactor parts such as a portion of the core, primary circuit pumps, auxiliary circuits and part of the ventilation system, has been entrusted to non-German firms in the Community. The Deutsche Babcock & Wilcox Dampfkesselwerke AG/Interatom (Internationale Atomreaktor GmbH) group has brought the French Indatom company and the Reactor Centrum Nederland in on the engineering. The ship will be classified not only in the German Lloyd list but also that of the Veritas Bureau.

Development of ships' reactors of an advanced type, which is being pursued under two association contracts with the Italian Fiat and Ansaldo concerns and with Reactor Centrum Nederland, is nearing the stage where building of prototypes will be practicable.

The valuable results of the above-mentioned contractors' work, notably in the fields of compact ship reactor design, optimization of radiation-shielding, greater mechanical strength of nuclear components and improved naval architecture, repay the efforts made with Euratom help.

II. Legal and institutional infrastructure

1. *Application of Articles 41 to 44 of the Treaty*

39. In respect of all projects involving investments in excess of the limits set by the Council's Regulation No. 4 defining the investment projects to be communicated to the Commission, specialist working parties have been formed to study and discuss the projects with the undertakings concerned and prepare the ground for the Commission to deliver its opinion.

2. *Third-party liability and insurance*

40. To make it easier for nuclear enterprises to conclude insurance policies against nuclear hazards, Euratom continues to work towards the establishment and harmonisation of a legal frame-work appropriate to nuclear requirements, the development of nuclear insurance and the elaboration of terms of insurance compatible with the general interest.

It has been concerned in particular to speed up ratification of the Paris Convention of 29 July 1960 on the third-party liability in the atomic energy field and of the supplementary Brussels Convention of 31 January 1963.

The Commission hopes that these Conventions will come into force during 1966 and that this will favourably affect development of nuclear industry at the same time greatly facilitating the international transport of nuclear material.

On 28 October 1965 the Commission addressed an eight-point recommendation to the Member States, calling for standard formulation of rules issued by the countries of the European Community for giving effect to the Conventions.

In issuing this recommendation, the Commission sought to promote fuller development of the European nuclear market, which would be unattainable if Member States were to exercise their freedom under the conventions to adopt differing regulations. The Commission's adoption of the recommendation followed a series of meetings to consult with national experts and insurers. Standardization proved to be impossible on some points for the time being. In particular, the Commission notes with regret that no standard figure could be arrived at regarding an operator's maximum liability within the meaning of the Paris Convention or the inclusion of the means of transport within the meaning of the conventions on liability. The Commission will go on trying to bring the position of the Member States into harmony on these and a few other points.

Euratom held a symposium in Berlin on 8 and 9 July, 1965, with nuclear risk insurers, electricity producers and representatives of the Community's nuclear industry present, at which all sides explained their needs and problems in the matter of insurance against nuclear hazards. Mutual agreement was reached on a number of questions, while on others still in suspense a solution was brought nearer.

At this symposium, approval was given in principle to the Euratom draft framework policy covering operators' third-party liability in respect of fixed nuclear installations on which the Commission has been working since the summer of 1964 together with the insurers, electricity producers and manufacturers in the nuclear industry.

3. *Nuclear plant safety*

41. Construction and operation of nuclear installation are everywhere subject to permits and administrative regulations designed to ensure the safety of those installations. The criteria used to determine whether or not an installation can be considered safe are manifestly of direct concern to the manufacturers. From the Community standpoint, it is obviously desirable to bring these criteria into line as far as possible in order to prevent distortion of competition and to simplify procedures and working methods. Such harmonization could, indeed, make it possible to standardize certain specifications as to construction and operation, which is manifestly in the industry's interest.

Each of the Member States has, in accordance with its own legal system, introduced administrative procedures for the issue of licences to build and operate nuclear installations. The procedures differ from country to country but have a common feature, namely, the government and local authorities concerned base their decisions on the advice of technical bodies competent in the matter of safety and inspection of materials and components.

Community institutions may not normally intervene in matters of national administrative procedure. Euratom is required to carry out certain technical studies for nuclear power plant safety assessment on the basis of contractual provisions such for example as certain basic contracts concluded with a number of operating companies or under joint enterprise agreements. On several occasions the governments of some Member States or private firms have explicitly sought Euratom's opinion as to the safety of individual projects. In other cases, for instance in respect of projects such as nuclear marine propulsion, in which several Member States are concerned, Euratom has taken the initiative in promoting Community-wide technical safety studies.

All these purely technical studies are conducted in strict observance of the administrative prerogatives of the national authorities competent for the issuing of permits under the laws of each Member State, but in close collaboration with the relevant technical bodies in each State.

In carrying out these safety studies, which also include computer checks, Euratom systematically uses experts from the Community or from other countries in addition to its own specialist staff, thus ensuring a thorough interchange of experience on the part of technical agencies specializing in safety matters.

The pooling of knowhow by these various agencies and the continuing exchanges of views among operators and constructors will make it possible gradually to harmonize the safety assessment techniques employed by the competent national authorities. Moreover these evaluation studies in themselves exert a marked unifying influence.

While the above-noted activities are the most advanced just now, the time may be considered ripe to supplement this gradual alignment :

— by trying systematically to simplify procedures and working methods, e.g., by standardizing the form of safety reports and evaluation criteria ;

— by standardizing certain specifications as to construction and operation ;

— by pursuing an experimental programme at Community level in support of and related to the theoretical studies referred to above.

4. *Activities of the Bureau Eurisotop*

42. The Bureau Eurisotop continued its work of coordination aimed at promoting the wider use of radioisotopes in industry as an up-to-date instrument for the solution of numerous technical problems. To that end the Bureau has so far signed 80 contracts for the development or perfecting of methods and apparatus relating to radiometry, radiochemistry, activation analysis, radioactive tracers and the use of intense radiation sources.

By directing its development programme to sectors receiving insufficient study, it has sought to supplement national research programmes while bringing about coordination of effort in this sphere. The promotional and informational activities launched in the textile industry in 1964 is an example of Community action in which 40 nuclear experts, 24 textile engineers and some 335 textile firms have drawn up a balance-sheet of the potentialities which isotopes and radiations offer.

In another field, the Bureau Eurisotop undertakes research and surveys for the Community as a whole on administrative, sociological or organizational problems liable to affect the promotion of nuclear techniques. These comparative studies will throw light on points of difference for which appropriate solutions should be sought.

In addition to wide circulation of numerous booklets and leaflets, the Bureau has been associated or has participated in the organization of several symposia and conferences, outstanding among them being the "International symposium on activation analysis".

5. *Commercial policy*

43. Under a Council decision dated 2 April, 1962, Common Customs Tariff duties on nuclear reactors, their components and spare parts (CCT No. ex 84.59 B) were suspended as follows :

84.59 B	*CCT Duties*	*Suspension*	
		Rate	*Expiring*
	%	%	
I. Reactors	10	7	31.12.65
II. Components and spare parts :			
a) Natural uranium fuel elements, non-irradiated	10	2	31.12.64
		5	31.12.65
b) Enriched uranium fuel elements, non irradiated	10	0	31.12.66
c) Other	10	7	31.12.65

It follows from this decision that the suspension of duties under three sub-items ran out on 31 December, 1965.

During the discussions on the list of exceptions for the Kennedy Round, the Council at its meeting on 15 November, 1964 had already agreed in principle to suspension of duties under sub-section ex 84.59 B.

44. The joint sub-committee of government experts on the Common customs Tariff having examined in October, 1965 the full list of suspensions due to expire, the Commission reconsidered the question to determine if new factors, whether economic or technical, might in the meantime have arisen to justify any departure from the agreement of 15 November, 1964. Following investigations on the subject, the Euratom Commission requested the EEC Commission to refer the matter to the Council of Ministers for a formal decision in accordance with Article 28 of the EEC Treaty, so that the relevant suspensions could continue to be applied without interruption until 31 December, 1966. The Council's decision was reached by written procedure and entered into force on 1 January, 1966.

From 1 January, 1966 until 31 December, 1966, Common Customs Tariff duties for the products in question are suspended to the level shown below :

CCT No.	*Description of goods*	*Duty* %
84.59	B. Nuclear reactors :	
	I. Reactors	7
	II. Components and spares :	
	a) Natural uranium fuel elements, non-irradiated	5
	b) Other	7

6. *Industrial documentation and card-index systems*

45. On the basis of information assembled on manufacturers of material for nuclear use, a first European nuclear buyers' guide was issued in January 1966, constituting a first attempt at listing European firms with a nuclear material fabrication capability ; the Commission hopes to improve it later on by adding such further details as it is able to collect.

Studies launched on the relations between European concerns and outside countries and on the nuclear work of European firms should make it possible to form an exact idea of "the degree of dispersal or concentration" of nuclear or paranuclear concerns and the extent of nuclear energy work in European enterprises.

A third edition of the list of nuclear installations in the Community was published early in 1965 and the fourth is scheduled to appear at the beginning of 1967.

On the basis of documentation and card-indices maintained by the Commission, much information has been supplied on European nuclear production, installations and undertakings in the Community as well as economic data concerning the nuclear sector.

7. *Dissemination of information and industrial property*

46. On 1 August, 1963 the Commission submitted a statement to the Council setting out its policy on the dissemination of non-patended information deriving from Community research.

Such information is published only where there is no risk of depriving Community industries of exclusive use, or at least priority of use. Unpublished data are circulated confidentially in the form of "communications" to Member States and to firms and individuals who establish their legitimate interest in receiving them for research or manufacturing purposes. So far 260 applicants have been accepted on the mailing list for these "communications", which is 60 more than in 1965 and demonstrates the growing interest in these documents.

There has been no slackening in the expansion of the portfolio of patents and licences. Some dozens of patented inventions are currently employed in the implementation of the research programme and some have proved their value in continuous use for two or three years.

Until such time as prototypes have been built, it is difficult to grant licences on the most important patents such as those to protect ORGEL-type

reactor features, for instance. On the other hand, new licences were granted in 1965 in respect of inventions which can be exploited independently of reactor construction. Licences have now been granted in respect of seventeen inventions, five of them by Euratom contractors for patents filed in their name. Patended inventions, of course, are not always exploited under licence ; Euratom contractors holding patents deriving from researches entrusted to them often exploit such patents themselves.

The non-exclusive licence rule written into the Rome Treaty (Article 12) is one reason why the granting of licences is expanding so slowly. Another is that manufacturers frequently fail to exploit the information circulated by the Commission and hesitate to adopt processes which they have not developed themselves and are not yet marketed. Community patents are, of course, published in the periodical "Euratom Information" and in "La propriété industrielle nucléaire" (Nuclear Industrial Property), and also by national Patent Offices. But there seems to be an urgent need for a more active canvassing of the possibilities available and Euratom is trying to arrange this, particularly as regards inventions already being exploited in its own establishments, which are more convincing to the potential licencee in demonstration than in any printed patent specification.

The industrial property clauses have given rise to no difficulties in negotiations and no change has been necessary, whether as regards non-patentable information, knowhow or patended inventions stemming from research and association contracts, and Euratom's approach for dealing with this thorny problem is so far proving sound. But only time will tell. The true effects will be known only when a real market under normal competitive conditions exists for nuclear industry and the Commission has to arbitrate, with the interests of the Community in mind, in disputes between its patent-holding contractors and their competitors seeking licences.

47. The Information and Documentation Centre CID) pursued its two-fold task of affording research workers prompt and full access to scientific and technical information published anywhere in the world, and of collecting and disseminating the results of the Community's research programme.

The Commission has set its sights on meeting the documentation needs not only of its own but of all research workers in the Community. Realizing the impossibility of fully exploiting the huge mass of date on nuclear energy by conventional "manual" methods, it instructed the CID to develop a computer-based semi-automatic documentation system.

In 1965, with the active cooperation of the USAEC, the CID went on storing data in the electronic "memory" ; its efforts will be increasingly directed from now on, however, to elaboration of the productive phase of the system,

which will consist in supplying "answers" to specific requests for information and is scheduled for 1966.

Nevertheless the CID continued to meet current documentation demands from Euratom research workers and contractors by conventional retrieval methods. It likewise pursued its endeavours to fill the gaps in the international nuclear documentation system. Thus while continuing to publish the "Transatom Bulletin" which gives information on nuclear documents translated from Slavonic or Oriental languages, the Commission founded jointly with the Kernforschungsanlage, Jülich, a new centre for the acquisition and translation of Eastern-bloc nuclear literature not hitherto translated. In addition, liaison has been established with 268 documentation centres in the Community specializing in questions peripheral to nuclear energy, to which the CID can quickly turn for the solution of specific problems.

The CID is also responsible for publishing two periodicals, viz., "Euratom Information", which gives the broad outlines of the research programme, abstracts of published results and the subject of contracts signed and patents granted, and the "Euratom Bulletin" which caters for a wide public interested in questions relating to the peaceful uses of nuclear energy in Europe.

8. *Safeguards and controls*

48. Two main factors affected activity in the sphere of safeguards and controls during 1965. These were :

— the increase in stocks of materials subject to Euratom control, and

— the political background against which international transfer of nuclear material and equipment was effected.

As regards stocks under Euratom control, the main increase, both quantitative and qualitative, was in materials subject to guarantees as to peaceful use underwritten by Euratom in its cooperation agreements with non-Community supplier countries.

First, the start-up of fuel fabrication for the fast-neutron programme called for big supplies of plutonium and highly enriched uranium.

Then the gradual commissioning of enriched uranium power reactors demanded imports of this material on an increasing scale.

Plutonium produced in these reactors is governed by the same guarantees as to pacific use as the imported uranium of the core elements, and as the number of power reactors rises this plutonium output will grow accordingly. In 1965 such irradiated fuel was discharged for the first time and sent for reprocessing.

With control of the use of plutonium and highly enriched uranium assuming increasing international importance, the principal producer/exporters of nuclear material have been calling more insistently for the application of an effective system of controls on foreign sales.

Alongside this, the tendency among the said producers has been to transfer the control they themselves exercise to a worldwide organization or to bodies having equivalent control powers. This trend still further emphasises the importance of the system of safeguards and controls operated by Euratom and recognized as being effective by the partners to its cooperation agreements, i.e. the three leading producer countries — the United States, Great Britain and Canada.

The system is thus to an increasing extent a prerequisite of regular, adequate nuclear material supplies. Its effectiveness derives from the powers vested in the Commission by the Treaty which upon ratification became part of the municipal law of the several States.

Those powers enabled the Commission to create a system with certain features not found in other multilateral control systems, e.g. direct application to all nuclear materials and installations, automatic application without prior consent of the Member State and irrespective of the source of supply. Added to this is the Community's property rights over special fissile materials although allowing the holders the greatest possible freedom in their use.

The Member States of the Community considered these arrangements necessary as representing the only means of bringing about effective control. In accepting them, they also accepted certain limitations on their sovereignty which go beyond anything that the most ardent advocates of non-proliferation so far appear ready to accept.

Implementation of the cooperation agreements concluded between the Community and non-member countries continued by way of exchanges of views, specifically with the United States and Canada. Not only do these contacts afford suppliers an opportunity of verifying that an effective system of safeguards and controls is maintained in the Community ; they also help to further the development of control techniques through the pooling of experience.

Excellent contacts have been established at technical level between the Commission and the International Atomic Energy Agency, which have allowed the fruits of Euratom's experience over more than seven years to be made available to the Vienna Agency.

In 1965 nearly double the number of inspections were carried out as compared with the previous year. Regard being had to the resolution adopted by the European Parliament on 23 September 1964, the Commission provided the

relevant department with additional means to discharge these growing duties while at the same time pursuing the development of new techniques of measurement and analysis.

9. *Relations with industrial federations, employers' associations and labour unions*

49. During the past year, relations with industrial federations, manufacturers' and employers' organizations and labour unions were concerned with proposals relating to the Euratom target programme. Exchanges of views were held which enabled due account to be taken of opinion in industrial and other circles involved.

Thus the symposium held in Venice from 12 to 14 April 1965 with representatives of the reactor building industry and the electricity suppliers as well as experts representing the Member Governments helped to confirm the basic hypotheses and criteria adopted by the Commission regarding the target programme and the long-range pattern of nuclear energy development. In accordance with the Treaty provisions, the target programme has been submitted to the Economic and Social Committee.

In a wider context, Euratom's participation in the second congress of the European Atomic Forum (Foratom) in September 1965 provided an opportunity for comparing the Community's prospects with those of the 15 European members of Foratom. Preparations for the congress had been made by the authoritative experts of the participating countries and discussion was based on themes developed in reports prepared prior to the meeting. In view of the foregoing, Euratom did not hold symposia with representatives of employers' organizations in 1965 and confined itself to maintaining the contacts established in previous years.

In the matter of relations with labour organizations, consultation of workers' representatives also took place at the symposium held in Stresa on 18 and 19 May 1965. These contacts preceding the final drafting of the target programme facilitated the debate in the Economic and Social Committee to which the target programme has been submitted for an opinion.

Side by side with these exchanges, the process of keeping workers informed of the social effects of nuclear developments continued, by way of Euratom's own endeavours and in liaison with specialist institutes for economic studies. The Commission instructed its personnel to prepare a series of studies with a view to holding a conference on these social issues in 1966, dealing with :

— evaluation of staffing needs for nuclear development and increasing the size of power plants,

— nuclear energy and regional policy,

— freedom of access to skilled nuclear jobs,

— security of employment.

Independent institutions specializing in economic studies have been entrusted with enquiries into other social aspects of nuclear energy in its industrial phase. Two of them relate to the structure of the nuclear economy in the Federal Republic of Germany and in Italy and seek to determine the industrial and social consequences of the advent of nuclear energy. A third will endeavour to determine the effect of methods and processes developed for nuclear research purposes on various branches of conventional industry. A study contract has been signed with a view to working out the optimum staff structure for a nuclear power plant, staff selection criteria and training methods.

III. Supply

1. *Joint supply policy*

50. As mentioned in the Eighth General Report, the drawing up of the first target programme as provided for in Article 40 of the Treaty brought out the need for a joint long-term policy to cover the supply of all nuclear fuels, which policy is linked with industrial policy and must be integrated into energy policy. This need was confirmed by the acceleration of nuclear industry development observed during the year under review and by all the long-range development estimates, which foreshadow a very rapid growth in nuclear fuel needs.

Simultaneously with the attempt to estimate its exact requirements of the basic fuel, namely, natural uranium, Euratom has been engaged in studying methods of procurement in the medium and long term.

In accordance with a resolution of the European Parliament dated 23 September 1964, the Commission turned its attention first to Community territory, with a view to defining areas suitable for exploration.

A report on the studies carried out by an expert working party of geologists set up by the Consultative Committee of the Agency pursuant to a directive from the Commission, was submitted to the Commission and subsequently published. According to this report, a reasonable programme of prospecting and exploration should lead to the discovery within the Community, more particularly in Germany, France and Italy, of reserves equal to present known reserves, at a cost not exceeding 10 dollars, which would therefore be an economic proposition.

Reports reaching the Commission from Member States in respect of 1964 indicate that uranium prospecting in their territories remained just as uneven as in previous years. France alone has steadfastly pursued her campaign of mining exploration over the past twenty years, as part of her long-range procurement policy. The French report shows that at end 1964 national reserves discovered had risen from 28,000 to 30,000 tons.

The Commission accordingly intends inviting Member States and Community industry to proceed on the lines of the geologists' report with the requisite measures for discovering cheap supplies of uranium in Community territory.

Nevertheless it is evident that, compared with long-term needs, these resources can represent no more than a useful reserve to help safeguard the Community against international market hazards and will not rule out the necessity for very considerable imports, hence the continued investigation of the uranium supply potential of non-member countries during the past year.

A geological mission sent to the Argentine under the cooperation agreement with that country reported back to the Commission on the uranium mining outlook there and the prospects for collaboration in developing these resources for use by foreign industry.

In talks with Sweden in December 1965, Euratom's representatives learned of the endeavours being made to reduce the production costs of Swedish uranium from extensive but relatively low-content deposits (several hundred thousand tons).

From contacts at technical level with Spain and Portugal it emerged that they have similar geological characteristics to other uranium-producing countries in Europe and are actively exploring for uranium. They are trying to create a big uranium industry to supply their national nuclear programmes and also to be in a position to export, though the quantities available for export seem likely to be limited.

Some non-Community countries are again taking steps with a view to discovering fresh resources. In certain cases it is simply a matter of firms wanting to stake claims in regions believed to have potentialities but deferring actual field work until they think the time is ripe. As regards Community industries, the Commission finds that only in isolated cases is anything being done, whether in negotiating long-term contracts or — to a lesser degree — towards acquiring their own reserves.

The reason for the reticence displayed by mining undertakings towards the resumption of uranium prospecting lies in the absence of any real market for this fuel today.

Unless the producer concerns can be reassured and assisted, there is a danger that they will be unable to keep pace with the nuclear fuel consuming industries and that an undue rise in prices will result.

51. The new factor last year as regards enriched uranium supplies was the entry into force of American legislation instituting a system of private property in fissile materials and permitting the USAEC to undertake toll enrichment from 1 January 1969.

Meanwhile the USAEC has devised a transitional scheme whereby enriched uranium purchases can be paid for partly with natural uranium, the terms of these barter arrangements to be worked out separately in each case, to suit the mutual advantage of the parties.

Of the four reactors in respect of which the Supply Agency asked for barter arrangements, two are henceforward admitted to these benefits. However, certain pointers suggest that, regard being had to the attitude of the US Congress Joint Committee on Nuclear Energy, the USAEC will discontinue its policy of supplying enriched uranium to foreign customers under barter agreements, so that it is to be feared that no further reactors will be allowed to share these advantages.

The conditions for toll enrichment proposed by the USAEC in October 1965 have received the attention of the Commission and the Agency. Judging by these provisions, contracts concluded with non-American users may be expected to follow similar lines to those proposed by the USAEC for the American domestic market. The Agency therefore called a meeting on 8 November 1965 of Community users and representatives of the authorities concerned to consider — as is done in the United States — the uranium enrichment terms proposed by USAEC. It was thus able to inform the USAEC of the point of view of these users, who will represent its biggest market outside the United States.

The message stressed the importance which Community users attach to being associated with American users in the deliberations leading up to the USAEC's decisions regarding enriched uranium supply. It also voiced the hope that the contracts will as far as possible be on commercial lines.

Finally, the last Euratom report pointed out that an enquiry was needed into the question of Community action in the field of isotope separation. Such a survey has now been launched, the particular aim being to assess the future enriched uranium demand, which is at present uncertain.

52. As in the case of enriched uranium, plutonium supplies continued to be provided under the US/Euratom Agreement. Substantial amounts were also delivered under the Euratom/UK Cooperation Agreement.

Plutonium requirements will depend for some years yet on research programmes. The quantities needed will be nonetheless important, since the development of fast breeder reactors calls for the installation of several experimental plants and even of prototypes which could be described as industrial-scale plants.

On 17 June 1965 the Supply Agency signed a contract with the USAEC on behalf of Euratom's partners under the association agreement on the joint fast reactor research programme, for the purchase of 414 kg of plutonium. The contract, which was jointly negotiated by the Agency and its Euratom associates, is intended to ensure supplies for the MASURKA, SNEAK and possibly the CNEN installations. The greater part of the plutonium contracted for was delivered in 1965. The contract has absorbed practically the whole of the 500 kg which the USAEC was authorized in 1964 to make available to Euratom under the Euratom Cooperation Act. Bearing in mind estimated requirements and quantities of plutonium obtainable in the Community, the Commission, with an eye to ensuring uninterrupted supplies, has begun talks with the American authorities aimed at securing Congressional authorization for a substantially higher ceiling for USAEC plutonium supplies to Euratom. Negotiation of such a contract will be facilitated by Euratom's guarantee of peaceful use, resting on a safeguards system of proven effectiveness.

It is generally believed that only from 1975 onwards will appreciable amounts of Community-produced plutonium be available.

2. *Implementation of Article 76 of the Treaty*

55. Article 76 of the Treaty stipulates that the provisions of Chapter VI relating to supplies should either be confirmed or be revised as from 21 December 1964. The Commission suggested to the Council of Ministers that this chapter should be modified in keeping with changed economic circumstances and proposed :

— dispensing with the principle of equal access to resources in favour of the principle of non-discrimination between users, so as to avoid supplies going to improvident users at the expense of others who have made the necessary investments at the proper time ;

— further relaxation of the rules governing the conclusion of supply contracts, while retaining the Agency's role in the conclusion of contracts for so long as the market situation shall make this necessary ;

— on a number of important points, supplementing the provisions of Chapter VI which the Commission considers inadequate as they stand for the implementation of a common supply policy.

In June 1965 the European Parliament, after thorough discussion, delivered a concurring opinion on the Commission's proposals. However, owing to the exceptional situation which arose during the second half of 1965, the matter could not be taken up in the Council of Ministers.

LATINA (Italy) — GENERAL VIEW OF THE PLANT

(See other side of page for caption)

This 200 MWe graphite-gas plant was connected up to the grid for the first time in May 1963, since when it has been in industrial operation.

The Latina plant is included in the Euratom participation programme.

CHAPTER IV TARGET PROGRAMME

54. Ideas regarding the future of Europe's energy supplies have evolved considerably in recent years. Since the Treaty came into force, with its provision, in Article 40, that "the Commission shall periodically publish programmes indicating, in particular, the production targets for nuclear energy and the various types of investment required for their attainment", there have been many changes in the economic background against which energy requirements are forecast.

Thus the need arose for a target programme to be drawn up in this general context.

The atmosphere of shortage which formerly characterized the European energy outlook has given place to a climate of plenty due to the fact that electricity consumption is rising faster than overall energy demands.

Nevertheless the Community's own resources remain inadequate in terms of requirements and imports continue to occupy a big place in the energy balance of Member States.

In view of this situation, nuclear energy offers particularly favourable cost prospects, enabling it to play an important part in meeting these demands. There are still certain technological difficulties in the way of its development but solutions will be found in the medium term. The advent of fast breeders, for example, is expected in about 1980 and this technique will open up wide possibilities of expansion in the use of nuclear power.

Hence the target programme covers three periods :

— from 1970 to 1980, the period to which the target programme proper refers ;

— from 1980 to 1990, corresponding to the medium-term outlook ;

— from 1990 to 2000, covering the long-range prospects.

55. The target programme is thus an important factor in the Community's energy policy. The Protocol on energy problems agreed by the Governments of the Member States and adopted by the Council of Ministers of the ECSC on 21 April 1964 in fact lists the following objectives :

— cheap supplies,

— dependability of supplies,

— gradual replacement of older sources of energy by newer ones,

— stability of supplies both as to costs and quantities available,

— freedom of choice for the consumer,

— fair competition between the various energy sources in the Common Market,

— adherence to the Community's general economic policy.

Nuclear energy contributes greatly towards cheap supplies, since the cost of electricity generated by nuclear plants will become increasingly advantageous as compared with conventionally produced current and so bring down the overall cost of electricity production. Furthermore, nuclear energy will help to secure safety of supplies by restricting the need for imported fuel. (In 1975, primary energy requirements will probably be covered as to 45 % from non-Community countries).

Leaving aside the quantities available in the Community or liable to be discovered through more intensive exploration, uranium does not have to be imported from the same countries as the fossil fuel for which the Community depends most on outside sources, namely petroleum. Moreover, the main uranium supplying countries offer satisfactory guarantees of stabe supplies. Lastly, the nuclear fuel needed to produce a given amount of electric power now stands at a quarter or a fifth of the cost of the fossil fuel equivalent. This ratio will continue to widen as nuclear techniques are perfected and the effect will be to make the Community less dependent on outside sources in terms of foreign exchange even if nuclear fuels still have to be imported. Moreover, a policy based on nuclear energy to ensure dependability of supplies would be less costly and it would for example be much less expensive to build up reserves for nuclear power plants than for conventional thermal plants to give an equivalent output.

Again, it is to be noted that nuclear energy, at the expected pace of development, in no way compromises the principle of gradualness in the replacement of older sources of power so as to obviate economic and social tensions. It offers an assurance of stability of supplies, both quantitatively and cost-wise. Finally, in the expected development of nuclear energy there lies no danger of interference in the consumer's freedom of choice, of distortion of the competitive relationship between the various sources of energy or of running counter to the general principles of the Community's economic policy.

The aim is, in fact, to produce on ever more favourable terms economically, the increasing quantities of electricity, which, along with that derived from traditional power sources, will be indispensable to sustain the economic expansion of the European Community.

The target programme could usefully take account of all aspects of a coordinated social policy designed to promote the well-being of the workers. The programme could provide the means of pursuing such a policy by proposing the gradual expansion of the nuclear industry and making possible the necessary reconversion operations. With its emphasis on the technical side of the new activities peculiar to nuclear energy, the target programme embraces a whole series of measures to be taken in respect of vocational training.

I. Elaboration of the programme

56. Before production targets could be worked out or the investments necessary to their attainment calculated, nuclear energy had to become a paying proposition and exact forecasts of nuclear fuel supplies had to be available.

Nevertheless, as early as 1960 Euratom carried out certain studies on the basis of which it envisaged an installed nuclear generating capacity of 40,000 MWe in the Community by 1980.

Since then, the economic maturity of nuclear energy has been established and there has been a rapid fall in the costs of building and operating "proven-type" reactors. Meanwhile, the facts relating to long-range uranium supplies were becoming better known. The time had arrived for the Commission to proceed to the implementation of Article 40.

In April 1965 the Commission convened a meeting in Venice of experts from Member States and Community industries, to lay before them a first draft target programme drawn up by the appropriate departments. The meeting showed that a large measure of agreement existed within the Community regarding the targets proposed and the pattern of development put forward by the Commission.

The Commission then submitted the same draft to the Community's labour unions at a symposium held in Stresa from 17 to 19 May 1965.

57. How are nuclear electricity output targets to be arrived at ? The Commission considered that the programme should certainly be based on the potential expansion of nuclear energy but that it should also fit the context of the energy problem in general. An outstanding feature of this is the prospective sharp rise in energy demands in the years to come. Thus the demand for electric power is expected to increase two-fold by 1975, four-fold in twenty years' time and ten-fold by the end of the century.

Nuclear energy production targets have been calculated on estimates of

1) the requirements and quantitative supply possibilities,
2) the development of electricity deliveries from certain conventional energy sources,
3) the pace of expansion of industrial capacity.

In order to map out a programme by which the objectives set may be achieved, Euratom endeavoured to determine the pattern of investment which would give the lowest cost for energy generated by nuclear power plants and reduce nuclear fuel requirements to a minimum. Proceeding on these criteria, a choice was made between four theoretical models of nuclear power development, differing one from another as to the part assigned to the three broad categories of reactors — proven-type, advanced converters and fast breeders.

The programme model selected by the Commission draws in phase one on reactors of demonstrated profitability. It then plots the installation, in phase two, of advanced converters and in phase three of breeder reactors which, since they produce more fissile material than they consume, will favourably effect long-range uranium supplies.

The more plutonium produced in thermal reactors, the speedier will be the arrival of fast breeders. This is an argument for pushing on with advanced converters which produce more plutonium than do proven types. In this way very intensive utilization of uranium will gradually be achieved.

In the light of recent observations and new data, the Commission put the finishing touches to its draft programme in June 1965 and passed it to the Economic and Social Committee for an opinion on 29 June 1965. That Committee delivered a concurring opinion on 24 February 1966 and in its comments laid stress, *inter alia,* on the common policy which attainment of the programme targets and long-range plans will demand. The Commission next submitted the draft programme to the Scientific and Technical Committee after bringing it up to take account of new factors that had emerged during the second half of 1965, namely :

— further falls in the cost of constructing proven-type reactors ;
— certain advanced reactors have reached industrial maturity ;
— the trend is towards enriched uranium for various advanced reactor types in place of natural uranium ; enriched uranium thermal reactors could recycle substantial amounts of plutonium ; estimated specific plutonium requirements for fast reactors are progressively shrinking ;
— fast reactors can be expected to reach industrial maturity well before 1980.

These developments further demonstrate the circumspect nature of the target programme as regards the cost pattern for nuclear energy and uranium and plutonium supplies.

II. Programme objectives

58. Forecasts of electricity consumption were arrived at as follows.

For the period 1970-1975 they were based on the survey by the "Energie" Inter-Executive Group (1), a study which was itself founded on observation of certain economic parameters, (population growth rate, increase in gross national product and industrial output) since 1950 extrapolated to the period to 1975. From this economic expansion curve the probable curve of electricity consumption was plotted. However, when the target programme came to be drawn up, i.e. three years after the "Survey of long-term energy prospects" was published, electricity demand was found to have risen faster than had been expected. Very conservative amendments were therefore made, with the agreement of the working party concerned, in the figures advanced in that survey.

Beyond 1975, in the absence of survey data and in view of the unreliability of long-range forecasting methods, only provisional estimates purely in the nature of working hypotheses could be made.

The forecasters accordingly confined themselves to straight extrapolations, assuming a constant increase at the 1970-1975 rate until 1980 but a slight slackening between 1980 and 2000.

The Community's future electricity demands, of course, form the very basis of the target programme, and it is these estimates which determine the assessment of the means of production and the investments entailed. It was therefore essential to proceed with the utmost caution and scrupulously avoid overestimates. So the forecasts of electricity consumption were compared with those for other countries and checked for compatibility with overall energy demands by verifying whether the proportion of primary energy accounted for by electricity remained, within reasonable limits, constant throughout the period. The growth in electricity consumption in the Community and the requisite generating capacity were estimated as follows :

Year	*Consumption* *(10^9 kWh)*	*Capacity* *(10^3 net MWe)*
1960	272	65
1970	575	120
1980	1080	227
1990	1930	409
2000	3450	730

59. The part which nuclear energy might play in satisfying this growing demand has been assessed for the immediate future in the light of known

(1) Survey of long-term energy prospects of the European Community, Luxembourg, 1962.

national projects and programmes. Up to 1975 the figures approximate to those suggested in the survey of the Community's long-term energy prospects in 1962. They also bear out the 1960 estimates published in the Third General Report of 40,000 MWe of installed nuclear capacity in 1980.

For the period till the end of the century it has been estimated, as a working hypothesis, that nuclear power plants will account for a growing proportion of the increase in thermal power generated from "non-privileged" fuels (coal, fuel oil, natural gas, nuclear fuel) as follows :

1970 - 1980 : 40 %
1980 - 1990 : 60 %
1990 - 2000 : 80 %

This is certainly a minimum hypothesis in view of the technical maturity attained by nuclear power plants by that time and their increasing economic advantage over conventional plants.

Thus by the end of the century half of all electricity generating facilities will be nuclear, producing rather more than two-thirds of the Community's electricity output to cover approximately 30 % of its total energy consumption.

Minimum capacity and output targets would thus progress as under :

Year	Capacity at 1 January (MWe)	Annual output (thousand million kWh)
A. *Target programme*		
1970	4,000	28
1975	17,000	120
1980	40,000	280
B. *Long-range projection*		
1985	78,000	540
1990	135,000	920
1995	226,000	1,500
2000	370,000	2,400

60. In line with the trend, referred to above, observed when the target programme was being worked out, future electricity demand is most likely to exceed the forecast figure. Leaving aside the deliberately conservative nature of the estimates, the targets adopted must be regarded as minimal from two angles.

Firstly, given that nuclear plants will be competitive with conventional stations from 1970 onwards, electricity suppliers will very probably tend to exceed their initial targets, provided of course that conditions favourable to the expansion of nuclear industry are created.

Secondly, changes in the relative competitive position of Community energy sources and the danger of undue dependence on imports will probably make Member States, individually or in the context of a common energy policy, favour a bigger contribution from nuclear energy than that forecast.

III. Choice of a development model

A number of alternatives for attaining these objectives must be envisaged but a single model of nuclear technique development selected.

1. *Effect of earlier developments and present situation*

61. The earlier and current position of nuclear technology suggests a first general hypothesis as to the future structure of global nuclear power plant capacity according to type of reactor employed.

As things stand today and taking the Community as a whole, no overriding advantage can reasonably be attributed to one proven type of reactor as against the other.

Both types — natural uranium/gas-graphite and slightly enriched uranium/light water — are in fact at about the same stage of industrial development and afford identical prospects of viability as regards fissile material consumption. This conclusion is not based on Community experience alone, it is confirmed by plants built and operated all over the world. It can therefore be accepted in practice that these two reactor types will continue to run more or less level until the end of the period under consideration.

2. *The alternatives analysed*

62. Four models were set up for the period up to the year 2000.

Model I Total installed nuclear capacity to consist of power plants equipped with proven-type reactors (half graphite-gas and half light water).

Model II Alongside the proven-type reactors, advanced converters to be installed from 1975 on, in increasing proportions so as to account for half the total in the year 2000.

Model III Same as for Model II as regards proven-type reactors but supplemented by breeders from 1980 on.

Model IV This model is a combination of the two preceding ones : proven-type reactors to be supplemented in 1975 by advanced converters,

and then in 1980 by fast breeders as well. The increase in installed capacity of proven-type reactors falls off entirely when they account for about half the total, around 1990. On the other hand, installed capacity in advanced converters will rise until the year 2000. At that date fast breeders will account for 50 %, advanced converters about 30 % and proven-type reactors only 20 % of the total nuclear capacity.

A further hypothesis has to be accepted.

From the range of advanced converters, the choice should fall mainly on heavy water and high temperature gas reactors. These two systems hold out good prospects from the technical and economic angle and both promise very good utilization of natural uranium and thorium resources.

While the respective advantages of these two reactor types seem about evenly balanced, there is no valid argument for any specific breakdown within the overall advanced converter category contained in Models II and IV.

Heavy water reactors have been taken as working hypothesis, the calculations making due allowance for high temperature reactors.

3. *The model adopted : Model IV*

63. The trend in general is towards successive phases using first proven-type reactors, next heavy water and high temperature reactors and finally fast breeders.

Model IV is the one which cleaves to this line most closely and will therefore be adopted as target programme.

In the context of the research and development programme the corresponding activities will need to be continued so that fast breeders will be ready when they are wanted. An extensive programme of fast breeder construction will be called for, moreover, if this Model is to be preferable on economic grounds to the models confined to proven-type reactors or a combination of proven-type reactors and advanced converters.

Technical advantages of Model IV

64. Allowing for fast reactor development, Model IV presents the following advantages :

— smaller natural uranium requirements — about half as great as for Model I and 34 % less than for Model II ;

— smaller enriched uranium requirements — about one-third as great as for Model I and about 42 % less than for Model II, (the reduction would

be still greater with recycling of available plutonium in thermal reactors until such time as it can be used to better effect in fast reactors) ;

— better use of plutonium produced in proven-type reactors and advanced converters ;

— lower overall installation and operating cost and cheaper average price per kWh in consequence.

While we cannot rule out in advance some delay in fast reactor development which would in effect restrict the programme to proven-type reactors and advanced converters for a longer period, the risk is not very great and can be further reduced by forcing the pace in fast reactor technology.

The flexibility and adaptability of Model IV, with its provision for a relatively elastic intermediate phase, will be further enhanced by partial recourse during that middle phase to high temperature reactors which can be developed into thermal breeders, which would offer a possible alternative in the event of delay in fast breeder development.

Economic advantages of Model IV

65. In calculating the economic advantages of the target programme, the total cost of electricity generated from nuclear power plants in accordance with Models I and IV was compared with the cost of the same output from conventional thermal plants. It will be observed that for Models II and III, the comparison would yield results somewhere between the extremes represented by Models I and IV respectively.

The comparison covers only coal or fuel-oil fired conventional power plants, since the use of other energy sources for generating electricity is relatively limited and could not make good the deficit resulting from the absence of nuclear plants. For it has to be remembered that the expected output of 21,000 thousand million kWh by the end of the century and 44,000 thousand million kWh thereafter, or together some 65,000 thousand million kWh, is about 160 times the 1965 figure of electricity output in the Community.

At constant prices at 1965 level, the comparison yields these results :

If nuclear power plants were to be built, up to the end of the century, in the place of conventional (1) power plants, the saving which would result, for the same energy capacity, would, according to Model IV, in present worth terms (2) (at a rate of 4 %) amount to between 21.9 and 47.6 thousand million u.a., taking reference prices for fossil fuel at between 10 and 15 u.a./tce.

(1) This refers only to additional power plants which would have to be built instead of nuclear plants.

(2) Long-term actualization taking value of currency as constant.

The reference price of fossil fuels will in these circumstances amount to 5.7 u.a./tce to cancel out the saving resulting from nuclear energy on equalization of total expenditure.

As compared with electricity generated from conventional power plants, greater savings, for the same output, are obtained with Model IV than with the other three models.

Advantages of Model IV in regard to procurement

66. Model IV also demands less fissile material to install the required capacity and ensure optimum use of available resources.

The model recommended involves the lowest uranium consumption, still more so with plutonium recycling in thermal reactors as a possible variant, giving a saving of between 16,000 and 39,000 tons of natural uranium according to whether one adopts a pessimistic or an optimistic estimate of specific plutonium requirements for fast reactors.

It also involves lower enriched uranium demands and so helps to make the Community more independent.

IV. Analysis and progress of the target programme from 1965 to 1975

1. *Proven-type reactors*

67. Proven-type reactors will take pride of place in the nuclear field for the next ten years. On the 17,000 MWe of nuclear capacity expected to be commissioned by 1975, proven-types will account for 14,000 MWe. They will continue to play an important part in the following decade (1975-1985), since one-third of the 61,000 MWe nuclear capacity to be installed during that period (20,000 MWe) will be light water or gas-graphite systems. From 1985 onwards, however, the proportion of new capacity installed in the shape of proven-type reactors will tail off to vanishing point after 1990.

Contributory factors pointing to a reduction in the cost of nuclear power in the immediate future are :

— the move towards higher capacity installations,
— higher burn-ups,
— improved efficiency of other components (control rods, steam cycle, containment),
— standardization and manufacture in series.

Higher capacities

68. Installed capacity of nuclear power plants, the construction of which has been decided in the Community so far does not exceed 300 MWe for light water reactors and 500 MWe for the graphite-gas string. The most that is at present planned is for light water reactors of 500 to 600 MWe, as is evidenced by the latest Community projects (the German/Swiss project and the Belgian power plant projects in the Antwerp and Huy areas). From the costs angle it will clearly be of advantage to move on to unit capacities of at least 1000 MWe as soon as possible. Indeed, the most recent decisions for power plant construction in the United States relate to installations of more than 800 MWe (Dresden II and III and Indian Point), while in Great Britain the second nuclear programme to install 8000 MWe over the period 1970 to 1975, was launched with the decision to build the Dungeness B Advanced Gas Reactor with about 1200 MWe net capacity.

Higher burn-ups

69. Nuclear energy prices were calculated initially on burn-ups of

— 3,500 MWd/t for gas-graphite reactors

— 15,000 - 16,500 MWd/t for light water reactors

but higher burn-ups must now be assumed.

Fuel cladding for pressurized water reactors (PWR) has hitherto been of stainless steel. Burn-ups of 10,000 - 15,000 MWd/t can be obtained without difficulty, by variable enrichment in zones and limited application of chemical shim.

Burn-ups in the regoin of 30,000 MWd/t may reasonably be expected in a PWR with stainless steel clads, while surplus reactivity can be controlled by chemical shim which is now a well-tried method.

Whether with the same improvements, the irradiation stability of Zircaloy clads in a PWR is equally good has yet to be confirmed.

The susceptibility of stainless steel clads to intergranular corrosion in boiling water reactors (BWR) has resulted in General Electric using Zircaloy only. While this alloy possesses good properties from the neutronics angle it has limitations as regards mechanical strength and corrosion behaviour at high temperatures.

Burn-ups a high as in pressurized water reactors would seem more difficult to reach, as the chemical shim technique is not suitable for a BWR.

The optimum burn-up resulting from a compromise between the pursuit of high power densities and minimum fuel fabrication costs will be lower in a BWR than in a PWR.

In a BWR, a high power density means raising the burnout heat flux, and the resultant increase in fuel fabrication cost sets a limit to technical efficiency, which is not the case with a PWR.

Other improvements in efficiency

70. Proven-type nuclear power plants still afford prospects of improvement, especially in regard to neutron economy, thermal efficiency and compactness of assemblies, all of which will make possible cost reductions, *inter alia* through :

— reduction of the number of control rods needed ;

— complete elimination of the secondary steam cycle in the large BWR units, by adopting the single-cycle system in which the whole of the steam used in the turbine is directly extracted from the core without any intermediate heat exchanger ;

— inclusion in large BWR units of separators and steam drying equipment in the reactor vessel itself, so reducing the thickness of the containment needed ;

— the two processes mentioned above enable the volume of the steam-generating part to be reduced and facilitate the use of a pressure-suppression-type containment in place of a dome-type containment, thus affording substantial savings ;

— use of prestressed concrete vessels housing the reactor and the coolant and boiler circuits, which can be cheaply constructed by semi-skilled labour, partly with local materials, and which can be very durable.

Standardization and mass production

71. Except for the latest power plants being built by Electricité de France, some components for which are already in small-series production, nuclear power plants so far built in the Community are all "one-off" jobs. Considerable savings could be achieved by standardization of certain components (e.g. cooling loop of a light water reactor) and still greater ones by reproducing several copies of a standard design.

Cost per kWh of current from proven-type nuclear power plants commissioned after 1970 :

Costs can be estimated as follows for 1000 MWe power plants built after 1970 :

Installation cost	140 - 175 u.a./kWe
Fuel cycle cost	1.5 - 2 mills/kWh
Operation, maintenance and insurance	3.5 u.a./kWe/yr

These are very conservative estimates, since installed costs in the United States are already less than the lowest figure quoted above.

Thus costs will be as follows :

Cost per kWh from proven-type 1000 MWe nuclear power plants built after 1970 (in mills/kWh)			
Annual rate of fixed capital charges %	Annual utilization time		
	5000 h	*6000 h*	*7000 h*
8.1	4.8	4.4	4.1
10	5.4	4.9	4.5
13	6.4	5.7	5.2

2. *Advanced reactors*

72. As of now, proven-type reactors can compete, at base load, with conventional thermal plants, but their further progress is limited in that

— only part of the fission energy of the uranium 235 and plutonium produced is used (not more than 1 % of the fission energy of the uranium atoms placed in the reactor) ;

— higher temperatures and therefore thermodynamic efficiency are limited by technical factors.

Efforts are accordingly being made to develop more advanced reactor types, generally known as advanced converters.

Of the many advanced converter types now being developed, whether in the Community or in such countries as the United States, Canada and the United Kingdom, however, the only ones which seem appropriate for the Community at present are the heavy water and high temperature gas reactors. The prospects for these two types are both technically and economically promising and meet the objectives set out above.

In 1975, advanced converters will account for 3000 MWe — a modest amount still. Between then and 1995 the figure will rise to 93,000 MWe, or nearly half the 209,000 MWe nuclear capacity anticipated at that date.

It is difficult to foresee what part advanced converters will play in about the year 2000 and beyond but their capacity will almost certainly account for a lower percentage of the total figure.

As far as concerns heavy water reactors in the Community, those which merit special attention are organic-liquid-cooled (ORGEL) and CO_2 — cooled reactors (EL 4, KKN).

High temperature gas reactors are also destineted to play a significant part in the future.

Costs for organic-liquid-cooled reactors compare very favourably with those for a proven-type reactor of the same capacity. As demonstrated at the ORGEL

symposium arranged by Euratom in October 1965 at Ispra, for an output of the order of 500 MWe, with fixed charges of 10 % and an annual utilization time of 7000 hours, the ORGEL price is between 4.5 mills/kWh (natural uranium) and 3.8 mills/kWh (enriched uranium), whereas for a 600 MWe boiling water reactor the cost would be 4.75 mills/kWh with the same fixed charges and annual utilization time, according to the latest data available to the Commission.

Heavy water reactors using carbon dioxide as coolant are being developed in France (EL 4) and Germany (Kernkraftwerk Niederaichbach - KKN). The French project is concerned with developing a non-absorbent fuel cladding permitting the use of natural uranium. Beryllium is very promising, but in case it proves unsuitable, research is going on into zirconium-based alloys and stainless steel, which have greater neutron capture properties. This is what will probably be adopted for the KKN plant in Germany, which in many respects resembles the French EL 4 prototype. On present data the cost of electricity generated in 500 MWe reactors of this type, with fixed charges of 10 % per annum and an annual utilization time of 7000 hours, works out at 4.5 - 4.9 mills/kWh for reactor running on natural uranium and 4.4 - 4.8 mills/kWh for a reactor fuelled with the enriched variety.

All the above data taken together give the following parameters for costing advanced converters under the target programme :

	1975-1979 500 MWe	1980-1989
Installation cost (u.a./kWe)	180	170
Fuel cycle cost (mills/kWh)	1	0.9
Operation, maintenance and insurance (u.a./kWe/yr)	5	4.5

We thus arrive at the following figures :

Advanced converters Estimated cost in mills/kWh in the Community Annual utilization time 7000 h		
Annual instalment	*500 MWe*	*1000 MWe*
8.1 %	3.9	3.3
10	4.3	3.7
13	5.1	4.4

3. *Fast breeders*

73. It is now generally accepted that sooner or later nuclear energy development programmes will probably all go over to fast breeder reactors.

Latest information from the Community, the United States and the United Kingdom suggest that if anything this movement is gathering pace.

However that may be, this reactor type, after a relatively slow start (6000 MWe by 1965) is destined to cover more than half the total nuclear energy demand during the last fifteen years of the century, i.e. 179,000 out of 292,000 MWe nuclear capacity commissioned during that period.

The technical data which emerge from current research in the world in general and the Community in particular will be found in the section of the report relating to Euratom's activity in connection with fast breeders. The economic parameters at present to hand stem from reference design studies in France, the Federal Republic of Germany and the United States. While the first industrial-scale fast breeder reactors may be expected to operate on this basis the simultaneous or subsequent adoption of other solutions is not ruled out. Thus we find that the Federal Republic of Germany is also interested in steam-cooling for these reactors. The present German programme in fact provides for the simultaneous development of designs which should reach the stage of a first full-scale plant of at least 1000 MWe at the same time (1980 according to present plans).

These fast breeder studies yield the following data :

	1980-1985	1985-1990	1990-1999
Installation cost (u.a./kWe)	200	180	160
Fuel cycle cost (mills/kWh)	0.8	0.65	0.5
Operation, maintenance and insurance (u.a./kWe/yr)	4.0	3.5	3.0

From these data we arrive at costs from 1985 onwards, in Community conditions of financing, as below :

Costs for fast breeder reactors commissioned in the Community after 1985		
Annual utilization time 7000 h		
Annual rate of fixed capital charges	*1985-1989*	*1990-1995*
8.1 %	3.3	2.8
10 %	3.7	3.2
13 %	4.5	3.9

These costs, it will be seen, are appreciably lower than for advanced converters.

V. Supply

74. By using plutonium, the targets set for nuclear electricity generation in the programme and the trend envisaged for reactor construction and operating characteristics will entail the lowest possible level of uranium demand.

Cumulative requirements for the period of the programme can be put at 54,000 tons of natural uranium, and for the period 1950-2000 at around 332,000 tons. The rate of increase will be exceptionally high between 1970 and 1980 — at least four-fold in the ten years, rising from just over 2,000 tons to nearly 9,000. Over the two subsequent decades the curve will flatten out, to decline somewhat in the late nineteen-nineties.

If, as seems highly improbable, only proven-type reactors were commissioned until the end of the century, requirements would rise continuously to something like double the programme figure for the period 1970-2000.

The target programme puts the Community's enriched uranium requirements for the period 1970 - 1980 at 27,300 tons (expressed in tons of natural uranium), and for the period 1970 - 2000 at 106,000 tons.

Enriched uranium consumption will double between 1970 and 1975, after which date the rate of increase will decline until 1980. These estimates are far less reliable than those for natural uranium as the curve will vary greatly according to policies adopted, with particular reference to reactor types and fuel ; for instance, the advanced gas reactors on which the United Kingdom nuclear programme is based will be fuelled with enriched uranium. In the Community, recent research has demonstrated the economic advantages of an enriched uranium variant of ORGEL. If all heavy water advanced converters were to run on enriched fuel aggregate, Community needs for the period 1970 - 2000 would amount to 245,000 tons. Plutonium recycling, which is attracting increasing interest in the Community and in the United States, would have the opposite effect on enriched uranium needs.

Thus we see that requirements of plutonium and enriched uranium will be largely interdependent — the speedier the advance in the use of plutonium the faster will enriched uranium needs decline. Industrial-scale use of plutonium in fast breeders will not come about until the late seventies. The demand curve will be related not only to the growing number of reactors but also to their specific fuel requirements. Until the industrial-scale fast breeder arrives on the scene, the operators of thermal reactors seem increasingly likely to use them for recycling the plutonium which they produce. This will ensure continuous use of the plutonium while enabling the same quantity to be recovered as is recycled.

Lastly, the sooner fast reactors come to industrial maturity, the sooner will the uranium demand begin to decline.

The target programme puts plutonium output from thermal reactors in the Community until 1980 at 60 tons. The importance of utilizing this fuel can never be too strongly emphasised ; it will reduce the Community's dependence on outside energy sources and yield substantial savings in foreign exchange.

VI. Conclusions

75. As the foregoing remarks make clear, energy policy must itself be conceived in the wider context of overall economic policy. Here it is to be noted that the novel methods and sophisticated techniques deployed in nuclear processes constitute a ferment for industrial development and economic expansion. But conversely it is important and doubtless, indeed, indispensable, that conditions favourable to the expansion of nuclear industry should be present in the Community, and pre-eminent among such conditions will be the existence of a big market in which people, goods and capital can move freely.

Nor in considering the essential conditions for implementing nuclear policy on the basis of the target programme can the vital necessity for trained staff at all levels be overlooked.

Implementation of the target programme likewise postulates a research policy. For instance, it goes without saying that the perfecting of new techniques like those involved in the development of advanced converters and still more so of breeders can proceed at the pace envisaged only at the cost of intensive research. This will call for collaboration between the private sector and public authorities, especially where expensive research or testing facilities have to be created.

Looked at another way, one may say that, while costly research is needed if the target programme is to be brought to fruition, the existence of such a programme is necessary in order to sustain and give direction to nuclear research in keeping with the status of the Community's members as technically advanced nations.

In conclusion, certain broad lines need to be laid down for the implementation of a policy for industry.

In the electricity sector, grid capacities and international interconnections must be built up in order to carry the additional current generated by high-potential nuclear plants without disturbance to the network.

Thus it is of the greatest importance to remove the obstacles to the international exchange of electric power, by the alignment of taxation, direct or indirect, and scales of charges as well as by further coordination of the concession system.

Where nuclear fuel supply is concerned, the need is for a joint policy to reduce the Common Market's present dependence on imports and ensure regular

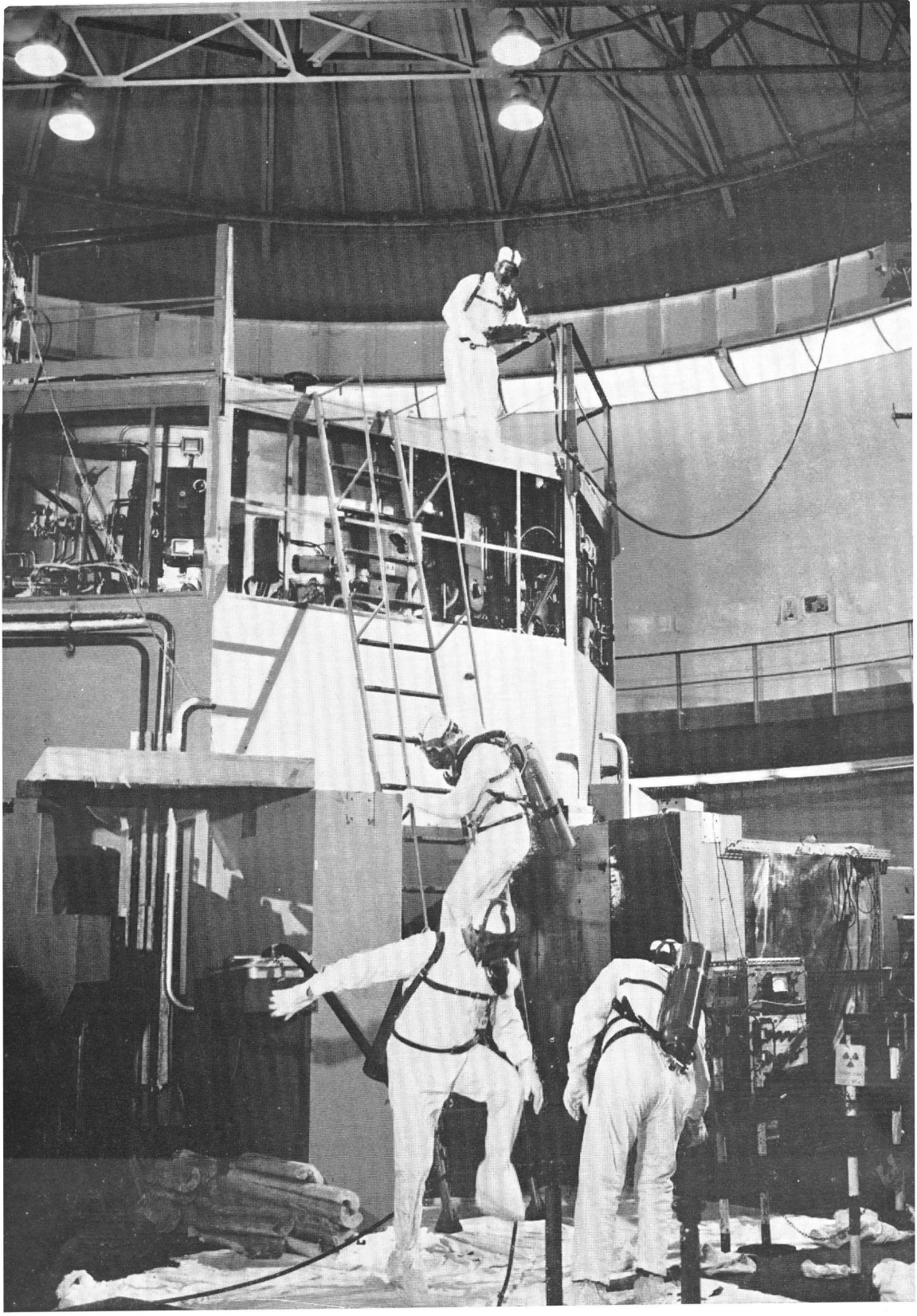
and equitable supplies as prescribed in the Treaty. Coordinated endeavours to discover new uranium deposits, financial participation in working deposits in non-Community countries, and the conclusion of long range delivery contracts are all appropriate means to that and. And it must be decided whether and what technical and economic parameters permit of the creation in the Community of isotope capacities, which may be under Community control.

As regards the reprocessing and transport of irradiated fuel and the disposal of radioactive waste, the location and capacity of reprocessing plants will need to be plotted well ahead and the system of transporting irradiated fuel elements and of radioactive waste disposal organized.

As to safeguards and insurance, the points to watch for are that the two international conventions on third-party liability must be put into effect, an effective system of insurance against nuclear hazards — material risks and third-party liability — must be devised, and policies covering third-party liability must be brought into line with a view to reinsurance.

In reactor construction, the dispersal that has hitherto characterized the industry must be dealt with. First of all, administrative measures are required to facilitate effective cooperation between vertically integrated and horizontally organized undertakings, which would be possible by means of specialization agreements as also by direct collaboration by way of joint enterprises, for example. Greater cooperation within the Community is especially necessary in the field of nuclear power plant construction. Formation of joint enterprises for proven-type nuclear power plants should be encouraged. For prototypes, the contracts should be placed with companies formed specifically for the purpose — with particular reference to experience in the Federal Republic of Germany — in which the various groups concerned (electricity suppliers, related industries, research institutes) would either have a financial holding or share the risks. In any event, the electricity suppliers and the manufacturers should have a stake in reactor development at the earliest possible stage. This means that not only have the technical parameters of a prototype to be determined but it has to establish whether the industrial-scale nuclear power plant to succeed it will at the time of commissioning generate electricity on terms which will, in comparison with other types then operative, justify the further development efforts needed.

While, therefore, decisions have to be taken in the coming years to give effect to a real policy for industry in the Community, the six countries must determine that policy with an eye to the broader horizons which the building of Europe opens up and proceed to adapt their potential to the European system as it gradually takes shape. The target programme will constitute a major step along this road.



ISPRA (Italy) — REFUELLING OF ISPRA I REACTOR

(See other side of page for caption)

The Ispra I reactor, installed by the Italian Atomic Energy Commission (CNEN) before becoming part of the Joint Research Centre, has been used to rig up a number of experimental devices : in particular, it was employed to carry out an extensive test series on organic materials planned under the Orgel programme.

CHAPTER V HEALTH AND SAFETY

I. Standardizing ; application of safeguards

1. *Implementation of Euratom directives*

76. On 2 February 1959 the Council of Ministers adopted the directives setting forth the Basic Standards for the protection of the health of workers and the general public against radiation hazards, which constituted the backbone of a body of legislation that has continued to extend its scope and to become steadily more effective through improved protective systems. Seven years after the publication of those directives, the health and safety of workers and the population at large can be regarded as effectively safeguarded by law in the Member States of the Community.

Numerous national laws were added to the existing body of legislation on the subject during 1965.

In Germany, certain provisions of Regulation I on protection against radiation hazards, relating chiefly to trade in radioactive substances, were amended by a regulation which came into force on 22 October 1965 ; pursuant to Article 33 of the Treaty, the Commission had delivered an opinion on the draft regulation on 21 May 1965.

In Belgium, three decrees relating to the establishment of industrial medical services and the safety of workers in mining and quarrying, on which the Commission's opinion had been sought, came into force ; furthermore the Commission delivered an opinion, by virtue of Article 33 of the Treaty, on a draft royal decree to regulate sealed radioactive sources and on two draft circulars concerning irradiation tables and interpretation of the term "controlled area".

France transmitted to the Commission two very important draft decrees, laying down general principles of protection against radiation and rules for the protection of workers respectively. The Commission also received from France a draft Order establishing the terms and conditions for recognition of bodies authorized to monitor radiation sources and a draft order on the transport of radioactive materials. These instruments are expected to come into effect shortly.

Italy sought the Commission's opinion on four draft decrees relating respectively to the degree of radioactivity at which the provisions of the decree of 13 February 1964 begin to apply, the classification of commercial undertakings, the procedure for the issue of a favourable opinion in respect of commercial undertakings and certain amendments to the "Nuclear Law" of 1962.

With the peaceful uses of nuclear energy expanding in the most varied fields, it is the Commission's responsibility to make sure that adequate standards of protection are applied in every instance.

The Commission has been careful, as in the past, not only to pay close attention to proposed national regulations at the drafting stage but, where appropriate, to point out to governments those sectors where gaps or inadequacies exist.

Thus it drew the attention of the Italian authorities to the desirability of finalizing without delay certain provisions the adoption of which is necessary in order that the important decree on protection which came into force in 1964 may be fully applied.

Similarly, it invited the Netherlands and Luxembourg Governments to adopt certain implementing provisions provided for in legal instruments in force in their countries, as soon as possible.

The Commission further investigated the problems raised by the application of national protective regulations in the four Joint Research Centre establishments. In this connection, proposals and working documents have been formulated to serve as a basis for negotiations with the Italian Government regarding procedures for applying Italian laws at the Ispra Centre.

2. *Revision of the Basic Standards*

77. Under the revision procedure prescribed in Articles 9 and 10 of the Basic Standards, the Commission on 18 December 1964 transmitted to the Council proposed directives to revise the Basic Standards.

The Council decided at its session on 25 and 26 January 1965 to consult the Assembly regarding this proposal. The European Parliament delivered an opinion approving the proposal on 13 May 1965. The resolution adopted by the Parliament on that occasion called for a further article to be added to the draft directive, specifying a period of one year within which States would be required to adopt the requisite provisions for giving effect to the directives.

Following a Council meeting held on 22 June 1965 to give the proposed directives a first hearing, the Commission was invited to prepare an amended version, which was transmitted to the Council on 22 November 1965.

3. *Background radioactivity monitoring*

78. During the period under review, special efforts were made to achieve greater comparability of measurement data on radioactive contamination of foodstuffs. The measurements are taken by the Member States and the data are communicated to the Commission under Article 36 of the Treaty. With the help of national experts, the Commission has formulated principles for the general monitoring of radioactive contamination of potatoes, other vegetables, meat products, eggs, beverages and fishery products. Such principles were laid down for bread and cereals in previous years. The technical reports compiled when formulating them will be published in 1966 and serve as guidelines for the national authorities concerned.

Euratom issued a report in 1965 on radioactive contamination of foodstuffs in Community countries in 1963. This survey contains data on strontium and cesium-137 contamination due to radioactive fall-out. In addition, it attempts to evaluate the internal irradiation dose caused by ingestion of strontium-90 in relation to total food intake, for each Member State and for the Community as a whole. The relevant concentrations have been found to equal only a minute proportion of the maximum permitted dose.

As in previous years, Euratom published an annual report on the data obtained from measurement of radioactivity in the atmosphere, in water and in fall-out in the Community countries. The 1964 figures show that contamination levels were low and comparable in December 1964 to those of 1960, i.e. before the resumption of nuclear testing.

The comparative survey of radioactive contamination in the diet of adolescents in Community countries, planned in the previous year, began on 1 October 1965, with twelve institutions in the Community taking part, after six months' preparatory work.

Under this programme the eight analysis and measurement laboratories have made a comparative study of measuring methods using samples of complete meals sent by Euratom for radioactivity measurement. The results demonstrate that measuring techniques employed in the several laboratories are in good agreement.

4. *Radioactive waste*

79. During the period covered by this report the Commission handed down opinions on six projects submitted to it in accordance with Article 37 of the Treaty. One was a project submitted by Germany in respect of the nuclear research centre at Jülich. Three were Belgian projects relating to the Scheldt effluent collector, the BR3 VULCAIN reactor and Eurochemic. The other projects

on which an opinion was delivered were a French one relating to the EDF 2 reactor and one submitted by Italy in respect of the Latina nuclear power plant.

At the present time general data on three radioactive waste disposal projects are under examination in accordance with Article 37 ; the first relates to the AVR plant at Jülich, the second to the Karlsruhe nuclear research centre and the third to the Enrico Fermi plant at Trino Vercellese. These project data are under study in the competent departments of Euratom, which will be in a position to deliver their opinions in each case during 1966.

5. *Health aspects of nuclear plant safety*

80. Euratom has collaborated in the safety studies relating to the KRB (Gundremmingen), SENA (Chooz) and GKN (Doodewaard) nuclear power plants and of the nuclear-propelled ship "Savannah".

It has also been engaged in the safety evaluation of the Eurochemic installation for processing highly enriched fissile materials.

6. *Nuclear hygiene and medicine*

81. The irradiation dose to which the population is exposed can be indirectly estimated by monitoring of background radioactivity. But direct measurement of radioactivity in the body or certain parts of the body is also possible and a study to that effect was initiated in the year under review.

Such direct measurements enable the hypotheses on which contamination levels in the human body are calculated to be checked and if need be corrected. Alignment of measuring procedures is likewise desirable in order to obtain comparable data which can be readily interpreted for the Community as a whole.

Radioactive contamination of water resources (lakes, rivers and so on) presents exceptionally complex problem as regards setting uniform standards or maximum levels. A prerequisite is the qualitative and quantitative determination of all factors liable to intervene between the controlled discharge of radioactive effluents and irradiation of the human body. On that basis it should be possible to prescribe a maximum permissible radioactivity level in a hydrological system.

Any discharge of radioactive effluents from nuclear installations is subject to legal restrictions but it was felt necessary to investigate how far those restrictions called for revision in the light of more detailed knowledge of the physical, chemical and biological processes involved.

Community countries have regulations governing trade in foodstuffs preserved by irradiation, and these generally embody provisions to safeguard public health. If observance of such provisions in this very special field is to be verifiable, practical methods of checking whether the foodstuffs are irradiated or not are essential. On the whole it may be said that really adequate methods have not yet been evolved, although studies have already been carried out in this field. There is considerable interest in their extension and Euratom has elaborated a research programme covering these questions. Meanwhile, studies performed on decontamination of milk and cereals under research contracts have demonstrated that decontamination is possible by various methods, although none of them is yet a practical, economic proposition.

With a view to the progressive alignment of working methods employed by physical monitoring and control services in nuclear installations, Euratom arranged a symposium for the heads of those services in the Community at Bad Nauheim in 1965. This was the occasion of a mutual exchange of information and comparison of experience in respect of on-the-spot physical monitoring and control. Meetings of this kind constitute an arena for individuals, departments and agencies whose business it is to ensure practical application of the basic standards in nuclear installations.

7. *Radiological assistance in the event of accidents*

82. Effective action in the event of nuclear accidents presupposes the solution first of a series of administrative and legal problems and then of specifically technical problems. Sustained, coordinated action is essential for analysis and rational study of all of them.

Euratom has the dual problem of the Joint Research Centre establishments and the protection of the health of workers and the general public in the European Community. As regards the JRC establishments, appropriate means and machinery have been provided to protect the workers and surrounding population, which take account of the provisions laid down by national legislation and apply uniform, rational methods on which other nuclear establishments in the Community could appropriately model their procedure.

By virtue of its general responsibility in the matter of protection of workers and the general public against ionizing radiation hazards, the Commission attaches great importance to the solving of the more general problem of mutual assistance in the event of accidents. Thus Euratom — as stated in reply to written question No. 71 in the name of Mr. Santero — has conducted research into administrative and practical aspects of procedure in the event of nuclear accidents and is initiating measures for the coordination of reciprocal aid

by Member States. The Commission is also in contact with the IAEA which is contemplating action with a view to international coordination in the same field.

8. *Social questions*

83. The Commission continued its enquiries, along with representatives of the ICFTU and ICCTU, into concrete problems relating to the protection of workers against ionizing radiation hazards, and pursued its efforts to find ways and means of promoting still greater and more fruitful collaboration between the labour unions and the relevant Euratom departments.

To that end, Euratom personnel paid a series of visits to the various national organizations and contacts are being maintained.

The information thus assembled was used at two meetings for ICFTU and ICCTU leaders held in Brussels on 26 March and 15 November 1965 respectively.

In each case some twenty trade union leaders attended and a start was made on the study of certain problems connected with the practical application of the Basic Standards.

In 1965, Euratom set about organizing a conference, to be held on 25 and 26 May 1966, on social problems related to its nuclear development programme. One of the major topics to be discussed at this conference will be the protection of workers against radiation hazards.

As in previous years the task of keeping labour circles abreast of developments was duly performed. A number of lectures or courses for trade unionists were held in Brussels, at which papers were presented *inter alia* on safeguards for the health of workers and the general public.

9. *Documentation and studies on regulatory instruments*

84. A meeting of experts was held on 29 and 30 April 1965 to consider matters relating to the regulation of irradiation and radioactive additives in foodstuffs, at which regulations currently in force in the Member States were examined.

A survey was undertaken of regulations adopted by international bodies and the Member States regarding notification of radioactive hazards and in particular the choice of symbols used to indicate radioactivity.

II. Research and Studies

1. *Rhine Basin radioactivity study*

85. This Euratom study, initiated in 1963 and carried out in collaboration with specialist laboratories in Germany, France, Luxembourg and the Netherlands, was completed in 1965. Its first phase consisted in river mud radioactivity measurements at 592 points in the Rhine and its main tributaries ; the second in analysis of the radioactivity in river water, suspended solids and mud from readings at 42 sampling points over a complete year ; and the third in studying the fixing capacity of muds by means of readings at 42 points.

The object of this third part of the programme was to devise the best possible process for breaking river muds down into their basic components in order to determine the fixing capacity of each component for radioisotopes used in industry or medicine.

In the fourth stage Euratom likewise carried out research, in conjunction with CEN Mol, on the amounts of radium present in the water, sand, organic and non-organic matter, clay and rivermud ; and in conjunction with the Casaccia nuclear study centre, very exact analyses of the strontium present in the water, sand and organic and inorganic matter of the Rhine basin.

The data obtained, the analytical methods developed, descriptions of the apparatus used and the procedures followed will be published by the Commission during 1966. The document, which will be the first to give such a complete and detailed account of radioactivity in a river basin may provide a pattern for similar studies and will be given wide circulation within the Community.

2. *Euratom/CEA association contract on levels of radioactive contamination of the food chain and the environment*

86. A method has been evolved by which it is possible, in given circumstances and regard being had to the various factors governing the transfer of contamination, to determine the diet of a critical population group and on that basis to calculate permissible levels of contamination for the several categories of food and the corresponding levels of contamination of the environment.

The method of calculating these levels involves numerous data drawn from a variety of fields ; the relevant researches went on in 1965 according to plan.

Substantial progress has been achieved and problems of contamination of the food chain can in future be approached rather more as one consolidated problem in keeping with the human and ecological characteristics of the Community.

Food intake data for specific population groups are obtained from nutrition surveys covering 9,000 families in eleven areas of the European Community. From a first analysis of the survey results the average intake per head of population in these eleven areas has been worked out. The report is in course of publication.

It now remains to determine by statistical methods the per capita intake for the various age-groups in each of the areas.

In the realm of human biology, research went forward in 1965 on the process of iodine incorporation in the body and the biological consequences of nutritional absorption. The data obtained are now being processed. Research into strontium incorporation was begun and a project worked out based on measurement of the strontium-90 skeleton guiders at various stages of growth.

Bibliographical studies have been carried out on determination of the factors governing the movement of radioactive contaminants in the food chain, in the circumstances applying to agricultural output in the several Community countries, and these point to the need for further experimental studies. The following projects were finalized in 1965 and a start was made in implementing some of them.

Overall studies of contamination in foodstuffs based on radioactive fall-out and soil pollution will be carried out at four separate stations in the Community.

The processes of direct contamination in various types of plants at various stages of growth and in relation to given conditions of precipitation and fall-out will be investigated in collaboration with the biology department at Ispra.

As regards strontium-90 — one of the chief contaminant radionuclides — research will be directed to mobility in arable soils and leaching loss and to absorption by plants of radionuclides present in the soil.

It is also planned to plot the relationship between direct contamination and strontium and cesium levels in grass and milk, on the basis of the grass crop of grazing land.

Lastly, a preliminary hydrological study was made, consisting in an inventory of specific contamination features in vegetable produce following irrigation with polluted water from rivers or lakes into which radioactive effluents have been discharged.

3. *Dosimetry*

87. Euratom continued through 1965 the comparative study of dosimetry by film badges initiated in 1964. Several hundred separate photographic dosimeters from the principal nuclear centres of the Community were irradiated at two specialized institutes.

Taken together, the series of experiments carried out in 1964 and 1965 meet the need for exact information as to the reliability of film dosimeters and comparison of the techniques and devices employed from one nuclear centre to another.

Side by side with these comparative calibration experiments Euratom launched a scientific dosimetry research programme to evaluate and lay down guidelines for the use of new types of dosimeters.

To that end, it has signed three research contracts with a special bearing on the development of thermoluminescent and photoluminescent dosimeters, zone dosimetry, and the study of intermediate neutron fields.

CHAPTER VI EXTERNAL RELATIONS

88. Cooperation between Euratom and its earliest partners — the United States, the United Kingdom and Canada— was again the chief feature of the Community's external relations during the year under review. The fresh possibilities which recently emerged for extending the scope of existing agreements with these countries bear witness to their dynamic nature ; examples are the idea of Euratom/UK cooperation in the fast reactor field and the American proposals for collaboration on the heavy-water organic-liquid reactor family. Simultaneously, the fields in which Euratom could establish closer relations with other non-Community countries have been defined. The long-standing good relations with many international organizations have been maintained and there has been a further rise in the number of non-member countries with diplomatic missions accredited to the Community.

I. Relations with non-member States

1. *Countries with which Euratom has concluded cooperation agreements*

89. In addition to the sectors already covered for a number of years now, cooperation between Euratom and the United States Atomic Energy Commission has developed satisfactorily in the fast reactor field, under the agreement signed on 25 May 1964. It will be remembered that this latter agreement covers a vast programme which by the end of 1967 will involve finance to the tune of some 230 million u.a. in Europe and roughly the same amount on the USAEC side.

In Europe, Euratom's network of contracts with the French CEA, the German GfK and the Italian CNEN was extended by the signature of two new association contracts, one with the TNO and RCN (Netherlands) and the other with the Belgian State and Belgo-nucléaire. With these contracts, all the Community's fast reactor programmes are coordinated under one Community programme, which itself ties in with the American programme. The Belgian and Netherlands partners are to be included in the Euratom/USAEC fast reactor agreement.

At the end of 1964 the USAEC had announced that it would be taking an active interest in heavy-water-moderated organic-liquid-cooled reactors and expressed the hope that Euratom/US cooperation might be extended to this sector ; that proposal for collaboration with Euratom in the ORGEL sector was confirmed to the Commission in 1965.

Even before that date contact at technical level had, at the request of the Member States, been maintained between the Euratom Commission and the USAEC so as to enable the former to keep abreast of American plans as they developed.

After a series of exchanges between the two Commissions to acquaint each other with what they had done and what they were planning in the matter of heavy-water organic-liquid reactors, the USAEC was in a position to put concrete proposals to Euratom which constitute very positive elements in a possible agreement for cooperation in this sector. These elements have been communicated to the Member States and discussed with them by the Commission. The latter has been requested by the Member States to press on with exploratory talks, now in progress with the USAEC, in order to work out details regarding the proposed collaboration.

The USAEC is interested in this type of reactor not simply on account of its potentialities in electricity production but also as an energy source to run large sea-water or brackish-water desalting plants.

This reactor type is USAEC's first choice for its vast desalination research and development programme drawn up jointly with the Department of the Interior, which is responsible for the non-nuclear parts of the programme. The possible scope of cooperation may be gathered from the fact that the budget for the nuclear part of the American programme alone amounts to some 220 million dollars over the ten years 1965-1975 ; it includes the construction of two heavy-water organic-liquid prototypes, the first to be commissioned in 1970 with a capacity of 300 MWe and the second — a 1000 MWe reactor — to come into service around 1974-1975.

90. Interesting developments also took place regarding cooperation with the United Kingdom and there were further fruitful exchanges on the economic problems of nuclear energy, health and safety, and radioisotope utilization. Similarly, in the field of research, mutual exchanges were extended to take in graphite research and communication of scientific information.

The Continuing Committee for Euratom/United Kingdom Cooperation, meeting in Brussels in July 1965, noted with satisfaction the results achieved. It also discussed possible cooperation between the two parties in the fast reactor research field and agreement in principle was reached regarding the exchange of scientific information on fast reactor physics.

91. Conversations took place during 1965 for the prolongation of the technical agreement between Euratom and Atomic Energy of Canada Limited (AECL) which had expired in October 1964 and the Agreement was renewed for one year with provision for automatic renewel and for amendment should this be rendered necessary by the contemplated Euratom/US collaboration in the same field, viz. the heavy-water-organic series (see above). The renewal agreement was in the form of an exchange of letters between the Commission and the AECL.

In this way the coordination of the research programmes of the two parties on heavy-water-moderated reactors previously instituted can continue uninterrupted. It affords Euratom access to the Whiteshell test pile, specially designed for studying the heavy-water-organic line of development, and to information on irradiation experiments inserted in this reactor.

2. *Other countries*

92. Technical relations with Sweden continued smoothly and were facilitated by the procedures jointly laid down in 1964 by the Commission and AB Atomenergi. Prospects for cooperation with Japan are still under consideration, the Japanese authorities having confirmed that they, too, are in favour of exchanges of information and of experts on basic research reactor physics and marine propulsion as well as on health and safety and biology.

The most recent proposals for cooperation to reach the Commission officially from a non-member country are from Israel.

They are a sequel to the working relations established in many fields since 1959 between Euratom departments and Israeli research workers and scientific bodies, so that the Commission was prepared to favour the idea of extending Euratom/Israel relations and giving them formal shape.

The short-range objectives of the Israel proposals concern reactor physics, nuclear chemistry and miscellaneous problems such as radioisotope utilization and health and safety. For the longer term, the Israel authorities propose cooperation on desalination problems, in particular the study and evaluation of the ORGEL project in connection with researches into the suitability of the various reactor types for dual-purpose operation (generation of power and desalination).

In the Commission's belief, this affords a basis for well-balanced scientific and technical cooperation, and it has placed the matter before the Council.

Mention must also be made of the good working relations maintained by the competent Euratom departments with those of OCAM (Organisation Commune Africaine et Malgache) through which Euratom keeps in touch

with the States of Africa and Madagascar. In addition, the Commission was represented at the second annual meeting of the Parliamentary Conference of the Association between the EEC and the Associated Africain and Malagasy States (Rome, 6-9 December 1965).

3. *Missions accredited to Euratom*

93. In 1965, Turkey accredited a mission to the Community, bringing the number of countries maintaining diplomatic relations with Euratom to twenty-five. Two more have initiated the procedure for accrediting a diplomatic mission to the Community.

II. Relations with international organizations

94. As in past years, Euratom participated in the work of the Organization for Economic Cooperation and Development (OECD), in particular in matters pertaining to the committees on energy and electricity and the scientific research and scientific and technical personnel committees, at whose meetings the Commission was represented. Euratom representatives likewise attended meetings of experts such as the working party on the behaviour of matter subjected to intense magnetic fields and sub-committees on scientific and technical information. The exchanging of documents in all these fields continued.

Euratom also participated in the second Ministerial Conference on science, held in Paris on 12 and 13 January 1966, when Mr. Paul de Groote, member of the Commission and Chairman of the Inter-Executive Group on Research, led a joint delegation from Euratom, the EEC Commission and the High Authority of the ECSC.

The outstanding event in Euratom/ENEA was the power run-up of the DRAGON reactor and the launching of the experimental programme in connection with its operation at full load.

However, the DRAGON Agreement, extended in 1962, is due to expire on 31 March 1967. The signatories are virtually unanimous in recognizing that, if full advantage is to be reaped from their investment so far, the reactor must continue to be operated beyond that date, and a further prolongation for nine months has in principle been decided. The expiry date is thus deferred until 31 December 1967. The additional cost to Euratom is set at 2 million u.a.

In the far more specialized field of radiation measuring standards, working relations have existed for several years between Euratom's Central Nuclear Measurements Bureau and the International Bureau of Weights and Measures.

To ensure the desired continuity, the Commission thought it best to define these relations in a formal agreement and an exchange of letters accordingly took place on 18 November 1965 between Euratom and the Director of the International Bureau. This provides for the continuance and strengthening of existing relations by means of mutual consultation and representation at working meetings on matters of common interest.

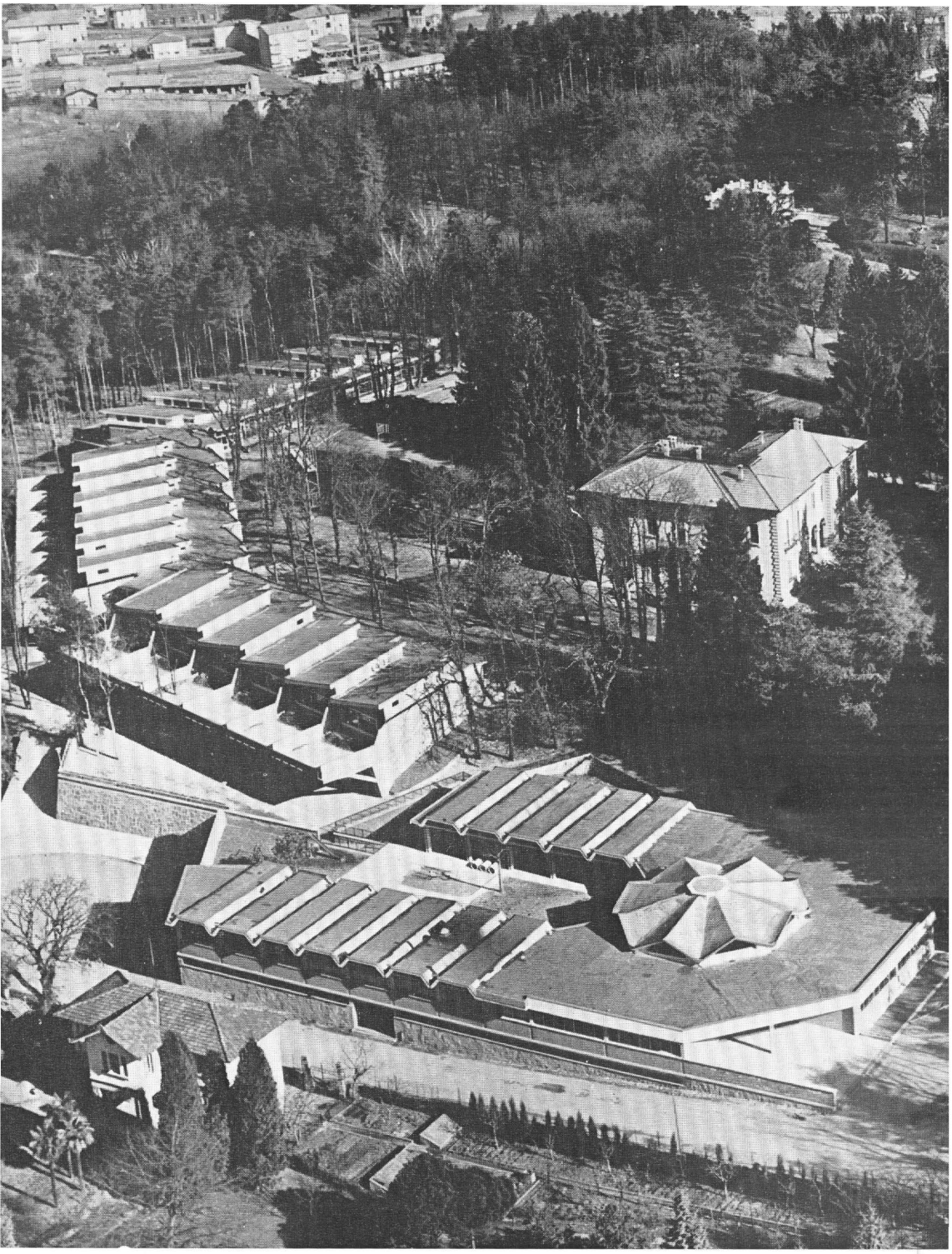
The Commission was represented as in previous years, at the invitation of the Board of Governors, by an observer at the General Conference of the International Atomic Energy Agency (IAEA) (Ninth Ordinary session, Tokio, 21-27 September 1965). Working relations between the competent departments of the Commission and of the Agency Secretariat continued to cover many fields.

In conclusion, Euratom's long-standing relations were maintained with the International Labour Organization (ILO), the World Health Organization (WHO), the United Nations Food and Agriculture Organization (FAO), the Inter-American Nuclear Energy Commission (IANEC) and the Council of Europe.

III. Other activities in the field of external relations and coordination of such activities

95. Pursuant to Articles 103 and 104 of the Treaty, the Commission was notified during the year under review of the following draft agreements :

— France/Japan (exchange of letters between the two governments) ;
— Federal Republic of Germany/Greece ;
— French Atomic Energy Commission (CEA)/GLAVATOM (USSR) ;
— Italian Atomic Energy Commission (CNEN)/Junta de Energia (Spain) ;
— Commissariat belge à l'Energie atomique/Polish authorities ;
— Commissariat belge à l'Energie atomique/UKAEA.



VARESE (Italy) — THE EUROPEAN SCHOOL — A PANORAMA

CHAPTER VII

THE INSTITUTIONS OF THE COMMUNITY AND INTER-EXECUTIVE COOPERATION

I. The European Parliament

96. During the period under review the European Parliament held seven plenary sessions as well as a joint session with the Consultative Assembly of the Council of Europe.

As its constituent session in March 1965, the Parliament re-elected Mr. Duvieusart as President.

It heard statements by the Euratom Commission on the remodelling of the five-year programme and the revision of Chapter VI of the Treaty, by the President of the High Authority on the ECSC policy report, and by the President of the Councils of the Community on the Councils' activities.

Also at that session, after discussing Mr. Edoardo Martino's report on political union, the Parliament voted a resolution urging the need for immediate progress towards European unity and the building of a federal democratic Europe.

In May the Parliament held a debate on the state of advancement of the research programme, at which the Commission explained the revision of the second five-year programme in broad outline and thanked the Parliament for all its help when the matter was being negotiated.

Resolutions adopted at the May session included :

— one on revision of the Basic Standards,

— one on the effect on health and safety problems of the merging of the Executives.

The agenda for that session also included a debate on the European Parliament's own resources and powers.

The President of the Commission presented the Eighth General Report of Euratom at the June session of the European Parliament.

At that session the Parliament adopted :

— a resolution approving the supplementary research and investment budget,

— a resolution broadly approving the Commission's proposal to the Council

to modify the provisions of Chapter VI of the Treaty while suggesting various amendments seeking to provide for parliamentary consultation or to define possible future action by the Council on questions of supply policy,

— a resolution recommending the Councils to give the EEC and Euratom Commission discharge in respect of the 1963 budgets,

— a resolution on the alignment of European systems of law.

In September the Parliament held the traditional joint meeting with members of the Consultative Assembly of the Council of Europe, taking as its theme commercial relations between the Community and State-trading countries.

The Parliament proceeded at the September session to the election of a new President — Mr. Leemans — to succeed Mr. Duvieusart on the termination of the latter's membership.

A feature of the October session was the discussion introduced by Mr. Toubeau, of Euratom's Eighth General Report. The debate was wound up by the adoption of a resolution which will be found in the Journal Officiel, No. 187, of 9 November 1965.

In October, too, the Parliament voted a resolution on the priority of Community law over the law of Member States.

An item on the agenda of the November session, in addition to EEC questions, was the policy debate on the Council of Ministers' statement of 26 October 1965.

The January 1966 session was the occasion of the Conference with the Councils and Commissions on the current situation of the European Communities.

During the same session the Council adopted a resolution on the supplementary operating and research budgets of the EAEC for the financial year 1965.

Association conference. The second annual meeting of the Parliamentary Conference of the Association between the EEC and the Associated African and Malagasy States took place in Rome from 6 to 9 December 1965. The Commission was represented by Mr. Margulies.

II. The Council of Ministers

94th Session (25 and 26 January 1965)

97. The Council met under the presidency of Mr. Edgard Pisani, Minister of Agriculture of the French Republic. It adopted the text, in the four Community languages, of the Regulation to amend salary scales of Joint Research Centre establishment staff employed in Belgium.

Also, it decided to consult the European Parliament on the proposed Council directive to revise the Basic Standards for protection of the health of workers and the general public against ionizing radiation hazards in accordance with Article 31, second paragraph, of the Treaty.

97th Session (1 and 2 March 1965)

The Council, meeting under the presidency of Mr. Michel Habib-Deloncle, Secretary of State at the French Ministry of Foreign Affairs, approved the Regulations embodying the conditions applicable to remuneration and social security of members of staff of the Joint Research Centre establishment employed in the Federal Republic of Germany, the Netherlands and Italy.

The Council unanimously gave the Commission discharge in respect of the budgets and supplementary budgets for the financial year 1962.

98th Session (16 March 1965)

The Council met under the presidency of Mr. Yvon Bourges, Secretary of State for scientific research and atomic and outer space questions in the French Republic.

At this session it held a far-reaching exchange of views on the question of recasting the Community's second five-year research and training programme.

100th Session (13 and 14 May 1965)

The Council met under the presidency of Mr. Maurice Couve de Murville, Minister for Foreign Affairs of the French Republic.

It endorsed the agreement reached by the Permanent Representatives on the question of recasting the second Euratom research and training programme in the light of developments both in economic and social conditions and in the scientific and technical field since the programme was drawn up in 1962.

101st Session (14 and 15 June 1965)

The Council met under the presidency of Mr. Maurice Couve de Murville. It approved a draft supplementary research and investment budget for 1965 — the sequel to the revision of the Community's second five-year programme endorsed in May — and passed the draft to the European Parliament for an opinion.

The Council went on to approve a second amendment to the articles of the Joint Enterprise "Kernkraftwerk Rheinisch-Westfälisches Elektrizitäts-Bayernwerk GmbH (KRB)".

102nd Session (28, 29 and 30 June 1965)

The Council met under the presidency of Mr. Maurice Couve de Murville. At this session it gave final approval to the Community's supplementary research and investment budget for the financial year 1965.

104th Session (25 and 26 October 1965)

The Council met under the presidency of Mr. Emilio Colombo, Treasury Minister of the Italian Republic. The French delegation did not take part in the meeting.

The Council proceeded to an exchange of views on a number of political problems stemming from the absence of French representatives from meetings of the Council and its committees and sub-committees since the beginning of July.

In the matter of the Community's draft budgets for 1966, the Council agreed to request the Committee of Permanent Representatives to continue its work to enable these drafts to be finalized, if necessary by recourse to written procedure.

105th Session (29 and 30 November 1965)

The Council, meeting under the presidency of Mr. Emilio Colombo and sitting in the absence of the French Delegation, examined the draft budgets of the Community for the financial year 1966 and requested the office of the President to set the written procedure in motion in order to obtain the opinion of the six governments on the said draft budgets.

Lastly, on 31 December 1965 the Council approved, by written procedure, two amendments to the articles of the Kernkraftwerk Lingen GmbH Joint Enterprise.

Other activities of the Council

98. The Council met on 2 February 1965 (95th Session) to continue the exchange of views on questions relating to the merger of institutions and increasing the powers of the European Parliament.

At the conclusion of this meeting the Council agreed to resume consideration of problems pending in March.

At its 96th Session (22, 23 and 24 February 1965) the Council appointed Mr. Hans O.R. Kramer to be a member of the Economic and Social Committee in succession to Mr. W. Beutler, resigned.

The Council at its 97th Session (1 and 2 March 1965) held its annual review of the remuneration of officials and other servants of the Community. It also discussed the restructuration of salary scales and the system of allowances.

Next, the Council continued its exchange of views on the merging of institutions and reached unanimous agreement on this question.

The Council then agreed to submit the agreement to the Representatives of the Governments of Member States with a view to convening an intergovernmental conference on the subject at an early date. That conference took place in Brussels on 8 April 1965 and endorsed the agreement reached by the Council.

Finally, the Council appointed Mr. R. Zijlstra to succeed Mr. P.A.J. Wijnmalen on his resignation from the Economic and Social Committee for the remainder of the latter's term of office.

Peripheral to the 99th Session of the Council (8 April 1965), a conference of the Representatives of the Governments of Member States proceeded to the appointment of a successor to Professor Enrico Medi on his resignation as Vice-President of the Commission. The conference nominated Professor Antonio Carrelli to be a member of the Commission for the unexpired period of Professor Medi's term, viz. until 9 January 1966.

After consulting the Commission, the Representatives subsequently decided to nominate Mr. Carrelli as Vice-President of the Commission for the period ending 9 January 1966.

At its 100th Session (13 and 14 May 1965) the Council signified its agreement to a procedure for liaison between staff of the Communities and the budgetary authority on matters of working conditions and remuneration.

The Council decided that when staff representatives asked for direct contact with the budgetary authority to explain their point of view on a specific question, they would be seen either by the Chairman of the Committee of Permanent Representatives or by the six Permanent Representatives, or — if the circumstances warranted — by the President of the Councils.

The Council then appointed Mr. Raoul Dentu and Mr. Michel Debatisse respectively in succession to Mr. Stiévenard and Mr. Oulid Aissa on their resignation as members of the Economic and Social Committee.

III. The Court of Justice of the European Communities

During the period covered by this report, eight actions to quash decisions on the part of the administration under the service regulations were brought before the Court by Euratom officials.

The Court pronounced judgement in eight other similar suits ; six were rejected as lacking in grounds or dealing with matters not falling entirely within the Court's jurisdiction ; in two cases the Court found for the plaintiffs as to the main part of their complaint.

IV. The Economic and Social Committee

100. At its 46th session on 25 and 26 May, the Economic and Social Committee heard a statement by the President of the Commission on the revised second five-year programme.

In accordance with the provisions of Article 40 of the Treaty, the Commission on 29 June 1965 requested the Committee's opinion on its first target programme for the development of nuclear energy. The Committee delivered its opinion in the matter at its session on 23 and 24 February 1966.

V. The Scientific and Technical Committee

101. Since the last annual report the Scientific and Technical Committee has met four times, on 7 April, 22 June and 15 October 1965 and 15 February 1966.

At its April 1965 meeting it elected Mr. Schnurr as its Chairman and Mr. Van Reenen as Vice-Chairman for the current year. They were succeeded at the beginning of 1966 by Mr. Baron and Mr. Cacciapuoti.

The first meeting in 1965, held at Karlsruhe on the occasion of the official opening of the European Transuranium Institute, was devoted to consideration of the scientific programme of that establishment and detailed inspection of its laboratories.

At its June meeting the Committee was informed of the difficulties encountered by Euratom in its endeavours to bring work on fast neutron reactors — current or planned — more closely into line. While realizing that the institution of Community action in this field is hedged about with very real problems such as the widely differing structure of industry in the several countries, the Committee recognized the urgent need for a really large-scale effort to sustain and improve cohesion between the Community's associates, to avoid the launching of fresh independent programmes and prevent duplication. It accordingly proposed the setting up of an *ad hoc* sub-committee of representatives of Euratom and its associates, the STC and the nuclear construction and electricity supply industries to make an overall critical examination of the measures required to achieve concerted action in the fast neutron field.

With the Commission's consent this sub-committee was formed on 15 October 1965.

Also at its meeting on 22 June 1965 the STC signified its unanimous support for the Commission's plan for an early start on the building of an ORGEL prototype in Europe and urged the need for appropriate financial participation in the undertaking on the part of the Community.

On 15 October 1965 the Committee expressed its opinion in favour of the draft research and investment budget submitted by the Commission for the financial year 1966 while regretting that the Council's decision on revision of the five-year programme did not allow of more vigorous action. It also came down firmly in support of prolonging the DRAGON agreement.

The Committee at its meeting on 15 February 1966 took note of the target programme for 1970-1980 and continued its discussions of problems confronting the Commission in connection with the ORGEL project, high temperature reactors and the possible creation of a guarantee fund to save nuclear fuel manufacturers in Europe. Consideration of these problems and of others posed by alignment in the matter of fast neutron developments will be continued at future sessions.

VI. Consultative Committee on Nuclear Research

102. The Consultative Committee on Nuclear Research met in Brussels on 9 September 1965.

It examined the technical documentation passed to it by the Commission, which the latter proposed to take as a basis for preparing the preliminary draft research and investment budget for 1966.

The French delegation was not present at this meeting.

VII. The Joint Services

1. *The Joint Press and Information Service*

103. As reported in the Eighth General Report, the EEC and Euratom Councils of Ministers held an exchange of views in July 1964 on the Communities' information policy and took note of a Joint Service memorandum on spearhead projects. With the opening of the new financial year at the beginning of 1965 and the increased budget for this item, a start was made in implementing these priority projects.

Today it is possible to assess the relative effectiveness of the various information media, both inside and outside the Community, with a fair degree of accuracy.

The main channel utilized was, as before, the written word, more especially by way of monthly reviews published in German, French, Italian, Dutch and English, and — since May 1965 — in Spanish for Latin America.

Circulation of these periodicals has been stepped up and moreover the two in French ("Communauté européenne") and English ("European Community") now include a special edition with a monthly supplement for readers in Africa and Madagascar. "Comunità Europea" (in Italian) is also circulated in Somalia and "Europese Gemeenschap" (in Dutch) in Surinam and the Indies.

In addition, the Joint Service issued the following publications in 1965 : some sixty booklets in the four official languages plus English, Greek, Spanish, Portuguese and Norwegian, totalling more than a million copies, two folders (360,000 copies) and 74,000 copies of wall maps, folding maps, guides to the European Communities, etc.

Four hundred and seventy copies of a bibliographical card index of works on European integration have been issued, containing 3,200 references now that it has been brought up to date, and 100 copies of a card index on review articles.

In Brussels, a reading room and picture library are open to the public at the Joint Service premises and are much used by teachers, students, journalists and so on. There are libraries, too, at the Bonn, Paris, Rome, London and Washington offices as also at the Athens and Dublin information centres.

One of the targets for the next few years is the establishment of similar reference libraries at universities and specialist institutes in the Community and elsewhere.

As regards audio-visual media, the temporary equipment in use for three years has gone, to make way for a modern film and sound recording studio directly linked to the European broadcasting network. The new studio was opened on 18 November 1965 and now affords reporters and radio and television correspondents in Brussels the facilities they proviously lacked.

Collaboration with the television networks of the six countries continued — though not without difficulties — with the programmes on ports of Europe, European theatre 1965 and steel in the world of today. Day-to-day cooperation with African stations is being developed through a special bureau.

A film on the Ispra Joint Research Centre establishment was made for account of Euratom and with its collaboration. The Joint Service also played a part in several film projects, e.g., those of the "Eurofilm junior" association

which produced the first in a series of children's films and of a consortium which is planning a filmed magazine "La voix de l'Europe" (the voice of Europe) for television screening in developing countries.

Participation in fairs and exhibitions continued, with particular emphasis on regional or school events in order to reach a wider or more youthful public. Thus the Joint Press and Information Service took part in the "Fiera del Levante" at Bari, the international communications exhibition at Genoa and the "Deutsche Industrieausstellung" in Berlin.

The Joint Service is also in charge of the preliminaries for a Community exhibit at the world exhibition at Montreal in 1967.

Apart from general information services for the public at large, special efforts continue to be directed to certain areas and groups.

Thus in the world of labour, some fifty information courses of two days or more were organized in Brussels or Luxembourg, in the main for international groups of labour union leaders. More than a hundred weekend or one-day European seminars were held in the six Community countries at the request and with the assistance of the international federations (International Confederation of Free Trade Unions and International Confederation of Christian Trade Unions), and numbers of courses or papers were included in the syllabuses of permanent trade union training centres. Some 250 lectures were given by a group of trade union lecturers and by Joint Service officials.

Three specialist periodicals are published in Brussels in five languages for labour union leaders, namely, a monthly bulletin of trade union and labour news, a calendar of meetings in the Community, and a reference list of articles in the specialist press. Apart from these, "Labor", a special bulletin for the United States, is issued by the Washington office.

Interest in European and Community problems is constantly mounting in educational and especially university quarters. European information centres now exist in many faculties of law, economics or political science and kindred institutions.

Numerous symposia were held with European integration as the topic and chairs were established in universities. More than 200 professors, lecturers and students working on theses were invited individually to visit the Community headquarters for a week at a time. Sixty-five entries were submitted for the Communities Prize, which the jury awarded to three very outstanding theses on the jurisdiction of the Court of Justice, the guarantee system for ECSC loans and the problem of countervailing duties in external trade respectively.

This expanding interest in university studies on European problems calls for close cooperation between the Joint Service and specially qualified private agencies. Thus the European Community Institute for University Studies is bringing up to date an index of research and study projects in progress (1). At the same time two specialist bodies have been set up — the "Arbeitskreis für Europakunde" in Germany and the "Europe Université" association in France. Similarly in Italy, such cooperation is the province of the "Società Italiana per le Organizzazioni Internazionale". In other countries direct cooperation is being developed between the universities and institutes of European studies.

Activities in connection with youth and adult education organizations have been stepped up, in liaison with the relevant government departments and certain non-governmental bodies in the Member States, to include for example a "Europe Day" in schools, a European teachers' association, a compaign for European education in civics etc. In Belgium, for instance, the Ministry of Education arranged three one-day seminars, in conjunction with the Communities, each attended by more than 300 teachers of ethics.

One of the chief events arranged in conjunction with the organizations themselves was the 25,000-strong European rural youth meeting at Sutttgart in May 1965.

2. *The Statistics Office of the European Communities*

104. In 1965 the Statistics Office of the European Communities kept up the regular flow of basic statistics to Community institutions. Statistical data were made available in the form of publications on sale to the public. The Statistics Office at present issues fourteen periodicals and a series of other publications.

The Conference of the Heads of Statistical Offices met twice during the year. The discussions centred mainly on the 1966 work programme, the Community background to economic accounting, the establishment of external trade statistics after customs barriers between the Member States have been abolished, the transport statistics programme and the implementation of the 1965 work programme.

In the matter of economic accounting, work on a Community system goes on, and progress has been recorded in certain specific sectors, e.g., processing and analysis of the survey data on social services expenditure and financing for the years 1962-63 is largely completed.

(1) Bulletin No. 1 was published in 1964 and No. 2 early in 1965 ; work is in hand on No. 3.

As regards energy statistics, the Office amassed basic data on liquid fuel and natural gas prospection and extraction which were published in Nos. 1-a and 3 of "Informations Statistiques". Concise figures and in particular energy balances were published regularly in the energy statistics bulletin ("Statistique énergétique") which was expanded in the course of the year.

The introduction of uniform nomenclature for manufactured goods constituted one of the chief aims of industrial statistics work during the year. As regards short-range pointers, a draft recommendation to the Council was drawn up for improved statistics on the economic climate. Work in hand for extending production indices to take in more sectors is nearing completion. The survey of industrial investment in the European Community countries is likewise completed except for Germany where the survey is to carried out at the end of the current year.

The family budget survey data have been analyzed for a number of countries and the results are being published in a special series of the social statistics bulletin ("Statistique sociale").

3. *The Joint Legal Service*

105. Liaison continued even more closely between the three branches of the Service, which deals with all matters of common interest. Consultations took place mainly on questions of an institutional nature and of interpretation and implementation of the Service Regulations as also on matters of legal procedure and litigation generally. In addition there were regular exchanges of information on legal questions of fundamental importance.

First and foremost the Legal Service proceeded with its duty of formulating and preparing the legal arguments for the official instruments provided for in Article 161 of the Treaty, including the Commission's proposals to the Council. It also participated, in close liaison with the relevant specialist departments, in the drafting of all contracts to be entered into between Euratom and other parties.

Counsel attached to the Legal Service again represented the Commission's interests and defended its decisions before the Court of Justice of the European Communities.

The Legal Service regularly took part in conferences of jurists, meetings of experts and so on for the exchange of information on basic questions of Community law and the problems raised by its application in Member States.

The following gatherings in which members of the Euratom branch of the Legal Service played an active part call for particular mention :

— Congress on problems of jurisprudence raised by the merger of the Communities (Liege, April 1965) ;
— Series of conferences on EAEC law, organized by members of the Legal Service (Sarrebrücken, May-June 1965) ;
— Third Symposium of the Fédération Internationale pour le Droit européen (FIDE), in particular on the topic of extra-contractual liability of Euratom (Paris, November, 1965).

In 1965 the Legal Service became a corporate member of the International Law Association and of the British Institute for International and Comparative Law, thus putting the long-standing close collaboration with those bodies on a formal footing.

VIII. Inter-Executive Cooperation on Energy

106. The Inter-executive group met on 3 June 1965 with Mr. Lapie, a member of the High Authority, in the chair, to examine the document drawn up by the EEC Commission on the Common Market policy on oil and natural gas.

The main thesis of the document was dependability of supplies and development of Community output, a common market in oil and programmes for natural gas.

Following an exchange of views in which the representatives of the three Commissions took part it was decided to submit the document, after further revision, to the Council of Ministers.

IX. Inter-Executive Cooperation on Research

107. In November 1963 the Euratom Commission proposed to the two other Executives that an inter-executive working group be set up to study problems of scientific and technical research in the Community.

At the meeting in Luxembourg on 15 February 1965 of the Cultural and Research Committee of the European Parliament, Mr Del Bo again put forward this proposal to which the EEC Commission for its part had announced agreement on 29 April 1965.

The new inter-executive group met for the first time on 14 October 1965 under the chairmanship of Mr. De Groote.

The group has set itself the task of reviewing experience in scientific and technical research within the three Communities and laying down guidelines

for the formulation of a joint or coordinated research policy. These could serve as a basis or shaping future action by the three Executives and ultimately by the single Executive. To that end the group is likewise keeping in touch with the work of the medium-term economic policy Committee's working party on scientific and technical research policy in order to assist the latter's studies and, if appropriate, put forward suggestions in accordance with procedures yet to be laid down.

Preparatory work for the inter-executive group's discussions is in the hands of an *ad hoc* committee which has so far met three times.

INDEX

(The figures refer to report paragraph numbers)
(Numbers preceded by the letters AD refer to Attached Documentation [Volume II])

A.

B.

C.

D.

E.

F.

G.

H.

I.

J.

K.

S.

T.

U.

V.

W.

PUBLICATIONS DEPARTMENT OF THE EUROPEAN COMMUNITIES
3876/5/1966/6

For the two volumes :

FB 150,—	**Ffr. 15,—**	**DM 12,—**	**Lit. 1.870,—**	**Fl. 11,—**