EUROPEAN ATOMIC ENERGY COMMUNITY

BRUSSELS, March 1965

OFFICIAL SPOKESMAN

EMBARGO :

BACKGROUND INFORMATION

EURATOM INDUSTRIAL POLICY PROPOSALS AND LONG TERM FORECASTS

INTRODUCTION

Article 40 of the Euratom Treaty requires the Commission to publish periodically "programmes indicating, in particular, the production targets for nuclear energy and the various types of investment required for their attainment". The Commission has prepared a "programme indicatif" for the Community nuclear power industry. This programme provides the basic data for the Commission's "Elements for a Community industrial policy" for nuclear energy. Both the "programme indicatif" and the industrial policy suggestions will be discussed at a number of meetings during the next two months, in particular at a conference of experts from the Community's nuclear industry to be held at Venice in April. Consultation with the Economic and Social Committee will follow. The Commission will thereupon publish its final findings and recommendations.

The two documents are:

The "programme indicatif", covering mainly the decade 1970-1979, but with projections to the year 2000, sets out the likely growth of electricity consumption, the rôle which could be played by nuclear power in satisfying this demand, and the implications for the different branches of the nuclear industry in terms both of production and investment costs. Providing an order of grandeur for the future of the industry, it gives some idea of the scale of the challenge for the nuclear industry. Both the objectives and the investment volume are taken to be the 'indispensible minimum'.

The "Elements for an industrial policy" consist of a survey of the structural and organisational problems arising from nuclear energy's entry into the industrial stage, along with suggestions for action in the industrial field.

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I. THE "PROGRAMME INDICATIF"

The first assumption of the programme is that electricity consumption will rise as follows during the period 1965-2000:

1960-65	1965-70	1970-80	1980-2000
(average annual increase during each period in %)			
7.5	7.0	6.5	6.0

The estimates for annual electricity consumption that follow are (KWh 285 milliard in 1960);

(milliard KWh)

1965	409	1980	1,080
1970	574	1990	1,930
1975	789	2000	3,450

The rôle of nuclear energy in satisfying this demand is based, for the immediate future, on known projects and on programmes already announced. Over the longer term, it is estimated that between 1980 and 2000 two thirds of new power station capacity will be nuclear. This, however, is regarded as a minimal hypothesis; in view of the technical maturity likely to have been achieved by nuclear power and its economic advantage over conventional plants, for which fuel costs are expected to rise, it could well be that all new capacity installed after 1980 or 1990 will be nuclear. This would give a capacity of at least 500,000 MWe in 2000, to furnish around two-thirds of electricity, and a third of total energy, needs.

According to the hypothesis adopted one half of the Community's installed capacity in 2000 will be nuclear; slightly more than half the total electricity produced and around one quarter of the energy consumed would come from nuclear sources. The following table sets out the nuclear power production 'objectives' for the period 1970-2000:

	Total installed power on 1 January ('000 MWe)	Load factor (hours/year)	Annual production (mrd KWh)
1970	3.7	6,000	22
1975	12.0		72
1980	40.0		240
1990	140.0	5,500	770
2000	370.0	5,000	1,850

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Some observations on the above

- Energy imports, which have been rising from 5% pre-war to 27% in 1960, around 50% in 1965 (of which 80% from Arab countries in the Middle East and North Africa) should rise to between slightly over half and a little under two thirds in 1975, in spite of the (still modest) recourse to nuclear power. Even with the implementation of this "programme", however, imports will still furnish nearly 50% of energy requirements in 2000. Thus this growth in the recourse to nuclear power is indispensable if too great a dependence on external sources is to be avoided,

- furthermore, even if a large part of the fissile materials are imported, nuclear energy will nevertheless contribute to the security of supply owing to the much lower cost of nuclear, as opposed to classical, fuel sources, the cheaper and more favourable conditions of transport etc.

- furthermore, assuming a stable price of $ 13.50 per ton c.e.(1) for the fossil fuels used in most conventional power plants i.e. coal, fuel-oil and natural gas, during the period, and assuming that the nuclear power plants to be installed will produce 17,000 mrd KWh before 2000 and 34,000 mrd KWh after (i.e. altogether 140 times Community electricity production in 1964) it is estimated that savings in the cost of electricity production will be $ 93 mrd or 36% (in absolute values) and $ 23 mrd (or 30%) in real values.

The reactors to be installed

Four sets of hypotheses are put forward on the types of plant to be installed. These are purely tentative in that the evolution of reactor development and installation will certainly be much more complex. The set of assumptions selected foresee that nuclear power stations will be equipped with 'proved' reactors (i.e. equal proportions graphite-moderated, gas-cooled and water-cooled) until 1975, that they will be complemented by the installation of advanced converters from 1975 and fast breeders from 1980. The installation of 'proved' reactors will cease when they form one half of total capacity, in about 1990. By 2000 fast breeders will represent one half of the total, advanced converters and 'proved' reactors by then taking respectively only 30 and 20% of the total.

It is assumed that power reactors will be installed along the following general lines:

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(1) c.e. coal equivalent

	"PROVED" Graphite-gas	"PROVED" Water	ADVANCED CONVERTERS	FAST BREEDERS	TOTAL
By end of period	M W e				
1970 (1)	2,000	1,500	200	-	3,700
1970-74	5,500	5,000	1,500	-	12,000
1975-79	17,000	17,000	5,000	1,000	40,000
1980-84	25,000	25,000	19,000	6,000	75,000
1985-89	35,000	35,000	51,000	19,000	140,000
1990-94	35,000	35,000	98,000	60,000	228,000
1995-99	35,000	35,000	115,000	185,000	370,000

Thus by 1970 graphite-gas and water reactors would have 56 and 40% of the market respectively; in 1980 they would each have 42 ½ %, with advanced converters taking 12 ½ % and fast breeders 2 ½ %; by 1990 the share of advanced converters and fast breeders would have risen to 36% and 14% respectively; and by 2000 fast breeders would take 50% of the total.

This programme is selected since it conforms with the present industrial situation, with the state of R & D in the Community and with a harmonious evolution of techniques. According to it the total investment will be lowest, it requires the smallest quantities of fissile materials, whether enriched uranium or plutonium, and it is based on the progressive introduction of fast breeders, thus making the most rational use of the Community's limited resources, as well as those of the Western World as a whole

Among the factors of uncertainty which could modify these forecasts are:

- the two types of 'proved' reactors might not develop in parallel; this would have little impact on any of the succeeding forecasts other than that concerning enriched uranium consumption
- enriched uranium needs could be reduced by the use of plutonium as fuel for water reactors from 1975
- the introduction of the thorium/U233 cycle is not taken into account owing to insufficient technical and economic data. Its use could help to solve supply problems; it is most likely to be first employed for high temperature reactors.

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(1) representing about 20 power stations in service, under construction or planned.

Outlook for reactor types to be installed

The Report makes a number of observations on the reactors to be installed under the "programme" selected. Among them are:

"proved" reactors

A decisive advantage cannot reasonably be attributed to one type or the other. The two "filières" have reached in the Community roughly the same point of industrial development, the economic prospects are similar, as is their consumption of fissile materials. It is therefore expedient to admit that the parity between the two types will be maintained approximately until the end of the period under consideration and this independently of the various hypotheses about the technico-economic success of more advanced types of reactors. Furthermore "at least for the first years of the programme, and having regards for the present equilibrium, it is certainly wise not to concentrate exclusively on one technique. Indeed, nuclear industry in the Community is equally interested in both". While the investment in enriched uranium reactors may be lower, gas reactors offer a greater autonomy of supply and permit the exploitation of techniques which from the beginning have been developed in the Community. Lastly, the choice of reactor could be affected by such political considerations as the need for independence from a monopolistic supply situation.

Advanced converters

Among the numerous types of advanced converters, heavy water moderated and high temperature gas reactors appear most worthy of consideration for the Community. Both types hold promise technically and economically and for both the use of thorium may be envisaged. Their excellent neutron economy should permit a lower specific consumption and a higher "in situ" use of the fissile materials produced, thus making for an optimal utilisation of the natural resources of uranium and thorium. In addition to these advantages which apply to both types: heavy water reactors alone can function using natural uranium as fuel, their requirements being minimal; high temperature gas reactors hold great promise in the field of thermodynamic yield and breeding.

While the relative advantages of the two types appear roughly equal, it is impossible to estimate the shares the two will take in the "programme". But as more technical and economic data is available for heavy water reactors than for high temperature reactors, the former may be arbitrarily considered as representative of advanced converters.

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- fast breeder reactors

It is assumed that fast breeders will have been perfected towards 1980. A key factor regarding the pace at which they are introduced will be the availability of plutonium. The greatest uncertainty, however, lies in the rate of technological development, in particular when fast breeders will have become 'proved' industrially and economically advantageous. It is assumed that the risk of delays in their development will be avoided by an intense and concerted effort.

Some implications for the nuclear industry

Materials

It is estimated that this programme will require 43,000 tons of natural uranium during the period 1970-79 and 109,000 tons during the following decade, and altogether 281,000 tons by 2000. Enriched uranium needs are put at 5,000 tons during 1970-79, 12,000 tons 1980-89 and 12,000 tons during 1990-99. As known Community reserves of uranium suffice for only half the expected consumption to end-1979, prospection must be intensified. Community enterprises would also need to develop access to resources in third countries.
As regards enriched uranium, isotopic separation capacity in the western world appears to be sufficient for the period to 1980, but a Community action might thereafter become necessary in this field.

As regards plutonium, forecasts are limited to production in 'proved' and advanced converter reactors: during 1970-79 34 tons during 1980-89 177 tons and by 2000 altogether 557 tons. The quantities produced and required by breeders are difficult to estimate.

Estimates are, however, made of retreatment capacity for the recovery of plutonium: by the end of 1979 2,000 tons/year of natural uranium elements and 400 tons/year of enriched uranium elements. By the end of 1989, capacity will be 6,500 tons/year of natural uranium elements (including the fuel for the blankets of fast breeders) and 850 tons/year of enriched uranium elements (including the core of fast breeders).

Investment volume

The volume of investment required for nuclear power stations during the 1970s, the 1980s and the 1990s is put at $ 7, 17 and 37 milliard respectively, i.e. a total of about $ 60,000 million.

The 17,000 milliard KWh produced during 1970-1999 would cost $ 90 milliard to generate, the average cost per KWh unit being about

5 mills. This figure includes costs both of the installations and of the fuel.

The installation of nuclear power plant

In addition to the circa 4,000 MWe of proved reactor capacity in service, under constuction or planned for end-1969, a dozen such plants of 500-1,000 MWe capacity, would be brought into service during 1970-74 (7,000 MWe total) and 25 during 1975-79 (23,000 MWe). Two or three advanced converters of 200 or 300 MWe would come into service during 1970-74, one of which would be a prototype industrial Orgel reactor to come into service, if a decision were taken early enough, at the beginning of the period. Between 1975 and 1979, six further 500-1,000 MWe advanced converters could come into service.

A prototype fast breeder reactor (100 MWe) would have to be brought into service towards 1972 along with two full-scale power plants (500 MWe or more) towards 1979 for these reactors to achieve their 'maturity' by the end of the decade.

Fuel element manufacture

By 1980 a total natural uranium fuel element capacity of 4,000 tons/year will be needed; for highly enriched uranium elements around 1,000 tons/year.

Irradiated fuel reprocessing

By end-1979 irradiated fuel to be reprocessed would have risen annually to 1,720 tons/year (uranium contained) for natural uranium elements (graphite-gas reactors), 230 tons for natural uranium elements (intermediate reactors) and 350 tons for lightly enriched uranium elements. In addition to Eurochemic (lightly enriched uranium) and Cap de la Hague (natural uranium elements), a new plant for lightly enriched uranium elements with a capacity of over 400 tons/year will need to enter into service once water reactor capacity has exceeded 4,000MWe, i.e. towards 1974.

Between 1980 and 1989 retreatment capacity would need to rise from 2,000 to 6,000 tons/year for natural uranium elements. Three 2,000 ton plants might have to be built during the period for the natural uranium elements and a 400 tons/year plant for enriched uranium elements will be built towards 1989. The fast breeder blanket and core elements will have to be reprocessed by the natural uranium and enriched uranium reprocessing plants respectively.

II. ELEMENTS FOR AN INDUSTRIAL POLICY

The second section of the Report deals with the types of problems likely to accompany the rapid expansion of the nuclear industry foreseen in the first section of the Report. There follows a series of suggestions for Community action to overcome these problems.

Rising electricity needs and the rapid lowering of nuclear electricity costs do not alone provide a guarantee that the nuclear industry will develop automatically at the pace required. The Report deals with the conditions that must be fulfilled for a satisfactory development.

A. Market

The first condition is the existence of a market among electricity producers for nuclear equipment. The essential factors are the desired dimensions, the operating conditions, in particular the load factor, the technical security and the behaviour and supply of fuel. The Euratom Commission considers it an established fact that a 500 MWe power station is a favourable size and that a load factor of 6,000 hours/year is a reasonable working assumption. However, it recognises that there are three categories of factor liable to put a break on the recourse to nuclear power. These are:

- novelty: to eliminate the difficulties resulting from adoption of the new technique , both the national and Community authorities must strive to give the widest possible dissemination of the experience obtained, to make the best possible forecasts of the rôle of nuclear energy, to foresee guarantees to complement or substitute those of plant suppliers, and to attend to the training of the necessary personnel
- the large dimensions of nuclear plant: suitable measures could be the strengthening of the co-ordination of investments and of the administration of electricity networks, along with the preparation by the member states of indicative programmes of investments.
- the supplementary initial investment required by nuclear as opposed to conventional power stations: here the Commission has various suggestions, such as loans (Art. 172 of the Treaty), bank financing or the hypothesis of the setting up of a joint action fund under the European Investment Bank.

B. Competence

The development and maintenance of the necessary competence either through industry's proceeding with its own research efforts or through public research organisations increasing theirs.

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C. Concentration

The large degree of dispersion now reigning in the Community's nuclear industry calls for a drive for a degree of concentration, ranging from the formation of groupings of enterprises to outright mergers. The firms should have a sufficiently wide industrial, technical and financial spread to be able to cope with the hazards and even losses resulting from the adoption of a new technique. Moreover, on the technical plane there is a large degree of dispersion, while in contrast other countries have based their development on the basis of one reactor string. This dispersion would be eliminated by a drive research for more intense specialisation.

D. Administrative disparities

Differences between the administrative, legal and regulatory infrastructures of the member states which risk hindering development must be removed. In some fields (basic health norms and investment declarations) co-ordination has already been achieved. In certain other sectors, such as reactor security, public hygiene rules and the disposal of radioactive waste, there is scope for organisation on the Community plane, thus enabling them to be treated as aspects of a common policy.

Reactor development

The Report goes on to deal with the Community's rôle in reactor development. For "proved" reactor types, already at the industrial stage, the Commission emphasizes that existing "bureaux d'études" should be maintained in being and that fuel element manufacturing techniques should be developed. As regards the numerous advanced reactor types under development in the Community, the assistance of the public arm is necessary to organise and support more harmonised research, for the perfection of prototypes etc. The construction of prototype power reactors is therefore strongly emphasized. Some of the difficulties involved in building prototypes are mentioned along with some courses of action. A degree of co-operation between electricity producers and plant contractors is called for, the attendant risks for the electricity concerns should be minimalised by having access to all research results and appropriate guarantees against risks, exceeding the means of a single operator or constructor, involved in the irregular functioning of the plant, should be available. The initial operating loss should be covered, resort being made to one legal formula or another.

Supply

Finally, the Commission emphasizes the problem of supplies of nuclear fuels. These should be provided for on a regulated and equitable basis. This is a problem which exceeds the means of the nuclear fuel industry and of consumers in the initial phase. Therefore the intervention of the public arm appears necessary.

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Examples of Activities by the Community

The document is completed by a number of examples of actions which could be undertaken by the Community to counter the problems previously mentioned.

- Insurance: ratification of the Paris and Brussels conventions; harmonisation of legislations and formation of a Community-wide nuclear insurance market.

- System of consultations on national measures for promotion of the nuclear industry: a system of reciprocal consultation on the different national industrial policies, the methods and means employed, the investment and research programmes.

- Establishment of a mutual assistance system: special agreements for mutual assistance between electricity producers, possibly under the aegis of international organisations, in order, for instance, to distribute the fabrication of nuclear power producing units and to apply a system of guaranteed help in the event of their failure; the creation of a financial pool to cover the losses due to the failure of nuclear power stations.

- Realisation of prototype power reactors. In addition to fast breeder reactors a large number of intermediate reactors are being studied in the Community. Electricity producers should promote the construction of prototypes of a certain number of new reactor types. They should therefore form groupings in order to raise the financial means and to cover jointly any risks which might arise. This could be undertaken as a Joint Enterprise with attendant financial advantages etc. Loans could be granted, provided either from the Community's own resources, those of member states or from private loans, for which guarantees could eventually be made.

  At a later stage, the construction of a prototype fast reactor of around 100 MWe could be undertaken. A technical development programme could also be undertaken for such reactor equipment as liquid metal pumps, heat exchangers, fuel elements, etc.

- Establishment of a "Common fund for nuclear industrial development": although the development of industrial reactors of a certain degree of maturity could be financed by the Euratom research budget, a fund for nuclear industrial development could be a better solution. An essential characteristic of the fund would be the repayment of the credits granted. The administration of this fund would be a means of stimulating the activity of numerous interested firms and of ensuring that projects embarked on are on a sound footing. The first field of application could be graphite-gas or water reactors, the improvement of nuclear fuel performance, or the improvement of heat exchangers or reactor parts. Eventually, "projets de référence" for reactors in the 600 to 1,000 MWe range could be established.

- Establishment of a "European fund for the guarantee of nuclear fuel elements": a system for a mutual fund to guarantee the performance of nuclear fuel elements.

- Establishment of a Joint Enterprise for the industrial-scale reprocessing of fuel elements: the installation of the necessary irradiated fuel element reprocessing capacity under the most favourable economic and technical conditions. Until 1979 the main need will be a Community-scale plant for the reprocessing of lightly-enriched uranium elements. The Community, even if not participating financially, could grant the installation Joint Enterprise status or facilitate its financing.

- Promotion of a Community policy for industrial property: the aim would be to avoid the progressive subordination, both on the technical and commercial plane, of Community concerns to foreign enterprises with a large portfolio of patents. A number of measures are foreseen to give the Community nuclear industry adequate protection for patents, the commercial exploitation of new products, the concession of licences to third parties, etc.

- Promotion of a Community supply policy: the document puts a series of questions regarding the long-term supply outlook, and the rôles of industry and public authorities regarding the prospection, mining, stocking and supply of natural uranium. A further question is whether enterprises should undertake the production of enriched uranium in order to gain partial or total independence in this field. Other problems are, in particular, the preparation of uranium and the economic exploitation of plutonium produced in the Community.

- Regional policy: such questions as the industrial decentralisation made possible by nuclear energy and the possibilities of attracting to or expanding in the Community industries consuming large quantities of energy, particularly electricity.

- Export policy: among the concrete actions which could be undertaken are the prospection of markets, the establishment of links with potentially importing countries, a Community export credit and guarantee scheme, the cover or reassurance of guarantees which could be granted to European manufacturers, and encouragements or aids to Community industries for demonstration of the operation of small or middle-sized power reactors.