EUROPEAN COMMUNITIES

Information > R+D

SERIES: RESEARCH AND DEVELOPMENT

Nr. 1

On March 25th, 1976, the Council of the European Communities adopted a programme of crucial importance to the long-term future of energy supplies. The programme covers five years (1976-80) of research and training in the field of fusion and plasma physics. But what is fusion, why is it important and how has the European Commission acted to promote a joint effort in the member states of the European Communities.

What is fusion?

Existing nuclear power stations produce energy through the FISSION process - splitting the nuclei of the heavy atoms uranium or plutonium. FUSION, on the other hand, aims to smelt together the nuclei of light atoms such as hydrogen. This is the source of the sun's energy. And the fusion experiments now under way are in essence aiming to harness that almost inexhaustible source of energy for the benefit of man.

Its importance

First and foremost, successful development of the fusion process would mean abundant energy supplies as a consequence of little problem providing fuel. The basic reaction cycle of this process consumes Deuterium and Lithium. The first is isotope of hydrogen and is found in ordinary water. The second is the lightest of all metals and is found throughout the world in rock formations in virtually inexhaustible quantities. A few hundred grams of these elements fuelling the fusion process could supply as much energy as thousands of tons of oil or coal burned by today's convnetional methods. Taking into account all forecasts of future energy needs the importance of this long term solution for Europe hardly needs stressing

Besides the wide availability of fuels, fusion energy is safe for man and environment. In fact, there will be no possibility of uncontrollable growing chain reactions. Any breakdown in the apparatus containing the reacting fuel would cause the fusion process to stop immediately. Furthermore, the only radioactive material involved in the reactions, TRITINM, will be circulating in a closed cycle within the fusion power station. There are no fission products, which reduce the problem waste, handling of radio active material can be restricted to the site.

The problems

Since fusion appears to have so much in its favour, it may be asked why it is not already being used in preference to other energy sources. The answer is that there are enormous problems to be solved before fusion becomes a commercial proposition. The balance of informed opinion is that these problems can be solved - but only through an intensive effort over decades. For example, pairs of nuclei will only fuse if they are hurled against one another with great force. To produce that collision fierce temperatures of between 50 million and 150 million degrees centigrade are needed. Such temperature level means that the fuel can only exist in a special gaseous state called a PLASMA. It also means that no normal container could possibly hold the plasma. The walls would simply melt and the plasma would cool down.

To solve this problem, scientists are probing how magnetism could keep the plasma together and stop it from touching the container's walls. In Europe, research centres on the so-called "closed configuration" system, in which the plasma is kept in a doughnut-shaped vessel called a TORUS. Russion experience played an important role in convincing Europeans to investigate in particular a "closed configuration" system called the TOKAMAK since the early 1960's. Several Tokamak devices have been built by national laboratories in Community countries. But now a huge Tokamak - likely to be one of the world's biggest in the early 1980's - called JET (Joint European Torus) must be constructed to carry fusion research a step further. This project is far too massive for any one member country to undertake and is thus ideal for a community effort. (A separate information paper is being issued on the JET project.)

One other approach to the exploitation of fusion power must be briefly mentioned. It involves powerful laser beams concentrated on a fuel droplet or pellet to produce a plasma. This method is a competitor to the magnetic confinement approach already described and is under intensive study in the United States and the Soviet Union. The Community will keep in touch with developments, but does not plan to give the laser method top priority.

Community action and the Commission's role

The Commission has been advancing programmes for common action on fusion since the creation of the European Atomic Energy Community (EURATOM). Two five-year programmes were implemented between 1958 and 1967. Work continued on a year-to-year basis between 1968 and 1970. Then a third five-year programme was agreed to 1975.

The reasons for the Commission's particular stress on joint action in the fusion field are as follows:

1) No single member state could provide the necessary human and financial resources on its own.

2) A very long term effort is required - probably at least until the end of the century. Quick success is not to be expected.

3) All member states have growing energy needs and all stand to gain in the long run if the fusion programme is a success.

4) The safety of the fusion process is particularly important for Europe, considering the high population density and energy consumption pro capite of the European countries.

The Commission's role is, first, to coordinate the work going on in the different fusion laboratories in the member states. (See Annex)
A consultative committee for fusion composed of responsible officials of Governments participating in the programme and of the Commission, has been recently set up to advise the Commission on general policy in the frame of nuclear and energy research. Furthermore, there is a Liaison Group, made up of the scientific heads of the laboratories and representatives of the Commission, which advises on allocation of funds and new programmes. And there is a Committee of Directors, made up of the Directors of the laboratories and the Director of the Commission fusion programme, which oversees implementation of the whole programme.

Beyond that, the Communities provide additional scientific and technical staff and - not least - make a substantial financial contribution. Between 1971 and 1975 the Community provided some 71 million units of account to the research effort. This sum went mainly to meet up to 25 per cent of the general expenses of the associated laboratories (salaries, running costs etc) and up to 45 per cent of the construction costs of large experiments recognised as having a special interest for the community. The interest of other countries in the fusion programme of the Community is illustrated by the recent joining of Sweden to this programme and by the wish expressed by Switzerland to join it.

The new five-year plan

The plan proposed to the Council in July 1975 continues much of the work undertaken in the previous five years and focuses very strongly on the JET project.

In March 1976, the Council approved expenditure from the community budget of 124 million units of account to cover:

a) Cost of equipment for projects given priority status (see below).
b) The cost of staff mobility.
c) The cost of other (non-priority) projects.

The priority projects (which the Commission is expected to finance at a rate of about 45 per cent) are as follows.

1. Tokamak systems

Even while JET is being built, experiments will continue on existing Tokamaks and two more (medium-sized) may be built. The experience gained will be highly relevant to JET.

2. High beta systems

Beta is a measure of how economically the energy creating the magnetic confinement system is being used. It could be that present Tokamak designs prove to be insufficiently economical. So research must continue on alternatives which might prove more effective.

3. Low beta systems

This refers to another kind of magnetic confinement system known as a Stellarator. It is more difficult to build than a Tokamak but possibly gives greater flexibility of operation. Work will continue on this during the five-year programme although the U.S., which pioneered the Stellarator, has now abandoned the system.

4. Heating and Injection Processes

Work must go ahead on ways of heating the plasma to the fierce temperatures needed for fusion. One method under study is to inject high energy neutral beams to bring the plasma up to the required heat.

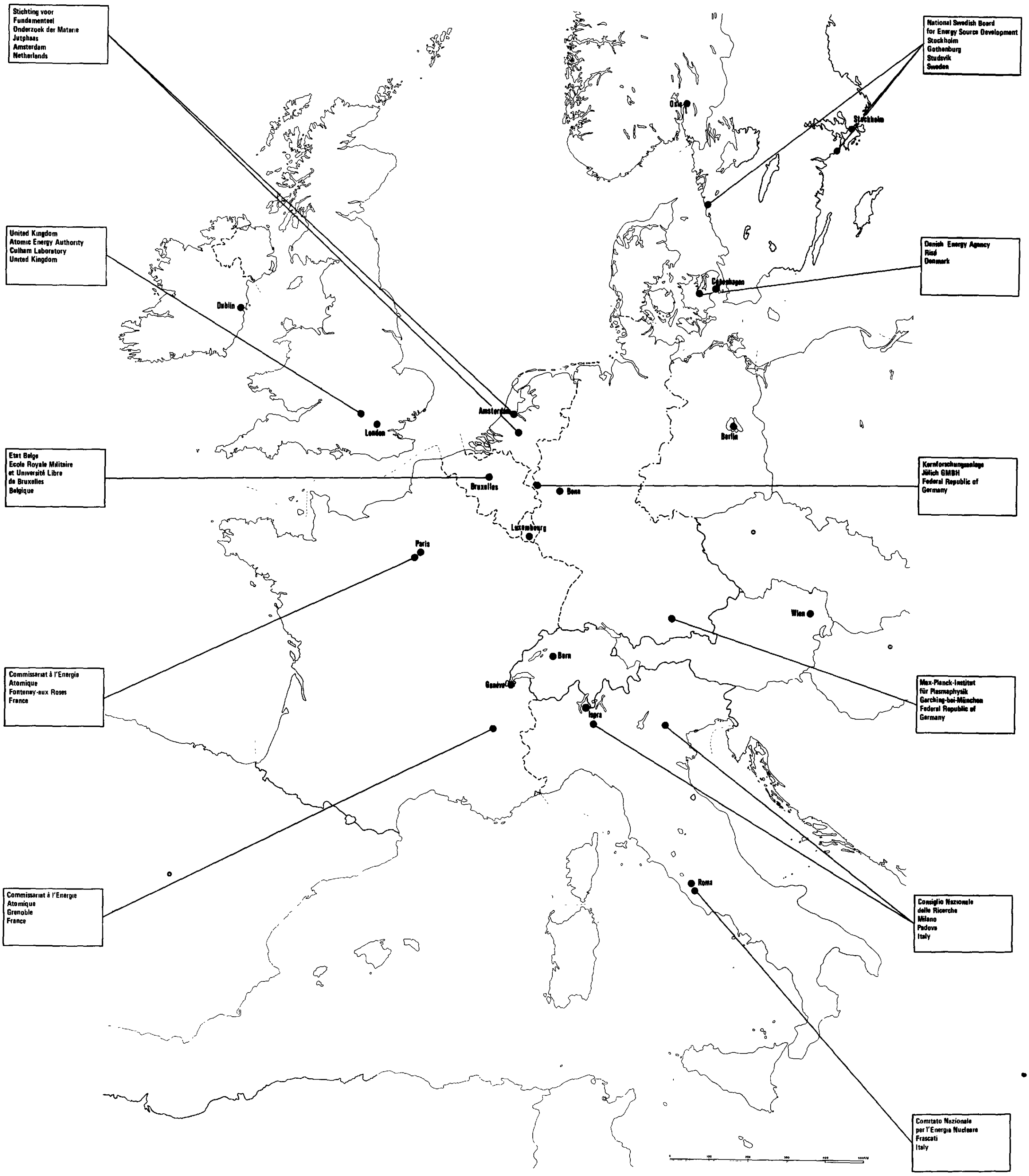
5. Technology

This heading covers such problems as construction and control of power supplies, vacuum techniques, selection of materials and so on. Advances in all these areas will be needed if the JET project is to be a success. Moreover conceptual studies on the design of future fusion power reactors will be carried on.

6. Very high density processes

This involves that alternative to the magnetic confinement process already mentioned (p. 2) using laser beams to bombard the fuel. The current programme is an ambitious yet balanced and realistic plan to keep European fusion research at the forefront of development of this new and abundant energy source. With the construction of JET Europe will strengthen its leadership in the development of controlled fusion and maintain its position as a valid partner for international cooperation. A decision must be taken soon if JET is to be built as hoped in 1980, but not just for JET itself. JET is an integral part of a truely European programme linking all Community activities into a joint action programme yet with an open mind for any exchange of information or even direct participation.

Year of Association	Associated Organization	Laboratories	Scientific Staff 1973-1974
1959	Commissariat à l'Energie Atomique (France)	Fontenay-aux-Roses, Grenoble	114
1960	Comitato Nazionale per l'Energia Nucleare, Consiglio Nazionale delle Ricerche (Italy)	Frascati Milan Padua	65
1961	Max-Planck-Institut für Plasmaphysik (F.R. of Germany)	Garching	178
1962	Stichting voor Fundamental Onderzoek der Materie (Netherlands)	Amsterdam Jutphaas	56
1962	Kernforschungsanlage (F.R. of Germany)	Jülich	47
1969	Belgian Government	Ecole Royale Militaire Université Libre Bruxelles	24
1973	United Kingdom Atomic Energy Authority (Britain)	Culham	167
1973	Atomenergiekommissionen (Denmark)	Riso	9


Stichting voor
Fundamenteel
Onderzoek der Materie
Jutphaas
Amsterdam
Netherlands
National Swedish Board
for Energy Source Development
Stockholm
Gothenburg
Studsvik
Sweden
United Kingdom
Atomic Energy Authority
Culham Laboratory
United Kingdom
Danish Energy Agency
Risø
Denmark
Etat Belge
Ecole Royale Militaire
et Université Libre
de Bruxelles
Belgique
Kernforschungsanlage
Jülich GMBH
Federal Republic of
Germany
Commissariat à l'Energie
Atomique
Fontenay-aux Roses
France
Max-Planck-Institut
für Plasmaphysik
Garching-bei-München
Federal Republic of
Germany
Commissariat à l'Energie
Atomique
Grenoble
France
Consiglio Nazionale
delle Ricerche
Milano
Padova
Italy
Comitato Nazionale
per l'Energia Nucleare
Frascati
Italy
Oslo
Stockholm
Copenhagen
Dublin
London
Amsterdam
Berlin
Bruxelles
Bonn
Luxembourg
Paris
Wien
Bern
Genève
Ispra
Roma

Subscription free of charge by written request to:

COMMISSION OF THE EUROPEAN COMMUNITIES
Directorate-General Information
Rue de la Loi 200 — B-1049 Brussels