

EURATOM'S RESEARCH ACTIVITIES

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for

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1. Since Euratom came into being, somewhat over four years ago, two significant sets of facts have occurred in atomic energy in the European Community.

First, the national atomic programs have progressed. Research establishments have been finished and have assumed full activity, or continued their work. Some industrial action has developed, both in design and in manufacturing. Some reactors have been completed and have started operation. But these are all test reactors, or reactor experiments. None of them deserves to be considered as industrial machines, or even as prototypes, in the true meaning of the word. However the construction of a few such machines has continued, or has been started, during the period under review.

This, of course, stems from the well known comfortable situation of the conventional power industry. But, also, and specially when taken together with the delays and troubles which befell the experimental machines, this emphasizes the youth and immaturity of atomic development, and the magnitude and diversity of problems which must be solved to create a new big industry when not only new machines, but new materials, and new safety problems must be studied, mastered and reduced to manufacturing and operating conditions all at once.

Second the Community has become a reality and, as a scientific and technical working organization, it has overcome its worst teething troubles. While you may legitimately accuse me of being at the same time judge and party, I shall take the liberty to say  
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that we are, now, on a level with most national organizations, and that we are considered as valid and serious partners by them as well as by powerful atomic energy establishments outside the six countries.

2. 2.1 We are now finishing our first program, and discussing our proposals for the next five years with the national authorities. This is, therefore, a convenient time to summarize what we have done, explain why we did it so, and state what we want to do, and how.

2.2 By the end of the year we shall have committed practically all the money which the Treaty had stipulated for us, namely 215 M \$. As, for various reasons, the preparatory and build up periods have lasted over 2 years of the five, it means that this spending will have taken place mostly in 2 1/2 years, starting in mid 1960.

While this is a great amount of public money, let us not forget that it is well under one fourth of what the member states will have spent on similar activities during the same time. And this ratio takes added significance when you remember that the atomic business is widely different from one country to another, not only when one looks at the overall amount, but also if one considers the expense in relation to population or to gross national income.

It is therefore clear that we are now a significant factor in the field, but by no means a major one, and, still less, in a position to dictate policy even if we wished to do so - which is not the case.

2.3 According to the provisions of the Euratom treaty, which happen to coincide with those of common sense, we have, on one side helped national programs, and, on the other, carried out independent actions.

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These latter are unavoidable for two reasons. First, many things need doing which are not included in the national plans, and we are doing some of them - not all, by far. Second we could not wisely and efficiently help, advise, or associate with, national activities if we did not possess independent means of action and of judgement.

2.4

2.4.1 Our own action is carried out in, and through, the establishments of the Common Research Center. There are four such establishments: the main one is at Ispra (Italy); another one will start at Petten (Netherlands); the third, at Geel (Belgium) is the Bureau of Nuclear Standards and the fourth, at Karlsruhe, now building, will be the "European Institute for Transuranium Elements". The names of the last two explain clearly what they are destined to do, and I shall not, for lack of time, say any more about them now.

The first two are described as "general competence establishments". This means that they should be able to do all sorts of things in atomic energy. It does not imply that they have license to do anything. We aim, on the contrary, at clear cut programs.

In addition some projects are managed from Brussels by my direct assistants, together with a minimum staff, and with the help of the establishments.

2.4.2 A fundamental character of our establishments is that they are based on previously existing national centers. This was imperative to us for many reasons, namely:

- a) it emphasizes the fact that the Community is not distinct from the member countries; -
- b) it saves time; -
- c) above all it creates our own means without adding to the dispersion which is, to our judgement, a great drawback to the development of independent atomic energy in Europe, as compared with the situation in the other great atomic powers.

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At the same time such transfers must not diminish national efforts; this is why a special national contribution is always provided for in the agreements. Thus our original 215 M \$ have been appreciably increased.

2.4.3 The first task of an establishment is to live, namely to create efficient and thrifty general services-administrative and technical.

The next is to carry on the operation of the special facilities existing there. This is the case for the Ispra and the Petten reactors.

Finally, an establishment must have main aims in life. These direct its activities; their achievement gives a measure of the efficiency of the organisation; they create a sense of urgency and polarise the team work. At the same time, the various technical needs create nearly infinite opportunities for those fundamental researches which maintain the scientific standard, and are necessary to morale in a population of skilled engineers and scientists.

But it is fundamental rule with us that to divorce applied and fundamental research would be fatal to an atomic energy research establishment.

2.4.4 Ispra possesses important computing machines (digital and analogue) which are needed for reactor work. But they are also used for computations asked for by the other communities, by national centers and industries. And they serve also an independant research program in automatic translation and automatic documentation. The first derives from the Babel situation in the world, where the need for a common vehicular language has not yet been recognized and cared for. The second is a necessity in front of the exponential increase of the factual capital of science and technology. These two very active programs have provided us with valuable and stimulating international connexions.

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2.4.5 The main center of interest for Ispra is the development of the "Orgel type of reactors. These use natural uranium for fuel, (in the form of ceramic compounds, perhaps even of alloys), heavy water as moderator, high boiling organic compounds as heat transfer medium, and special preparations of light metals as structural components. This combination holds reasonable promise of industrial future. At the same time it can profit from, and contribute to, the development of other heavy water reactors developed on the national scale. We may come back to this subject at question time if you wish to elaborate on it.

I shall limit myself here to say that the main departments in Ispra (reactor physics, materials, engineering) are for the time being mainly or wholly engaged in Orgel problems. The work, coordinated under my direct supervision, by a project leader and his staff, gives rise, in addition, to numerous and important research contracts placed in the member countries.

Orgel is also the occasion for very active cooperation with American and Canadian laboratories. This shows - if it were necessary - that the Orgel concept is considered of value by respectable organisations.

2.5 A great fraction of our funds (over one third) are spent outside our own establishments\*. But our outside spending never takes the character of grants. Giving grants is the business of numerous national and international organisations. While this is an efficient and valuable method of promoting and orienting research, it is not ours.

We deal either through definite research contracts, through associations aiming at wide objectives, and through the power reactors participation scheme.

\* In addition to this, one must, of course, count the important development and construction contracts placed by the establishments themselves.

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2.5.1 The main body of research contracts is linked with the US - EURATOM agreement. This aims at the construction in Europe of American type reactors, it being understood that European industry must take the greatest possible share in construction as well as in related research and development work. However part of the R & D is to be carried out in America. The Euratom Commission pays for work in Europe; the AEC pays for work in the US; the amounts are to balance at the end. Decisions on the projects to select are taken by a joint US-Euratom board; results are open without restriction to both parties.

So far, 94 R & D contracts have been placed, most of them in the Community. They deal with problems related to water reactors, and mainly concern fuel elements, reactor tank construction, special materials, fuel chemical processing, recycling of plutonium, waste treatment.

In addition to good quality research in Europe - and to the construction of one boiling and one pressurized water reactor - this agreement has led to the increase of intimate relationship between European and American laboratories.

2.5.2 The general condition of the power industry, alluded to above, has led the Commission to recognize that, in order to promote in good time, a European nuclear industry, incentives are now necessary for the building of nuclear reactors. The participation program is, therefore, open to electricity producers who intend to build industrial nuclear plants - I mean good enough and big enough plants - and who accept to share completely the know-how so obtained with others, under the aegis of the Commission. The Commission contributes moderate amounts towards various expenses which will help establish european industries. Three reactors have been so far accepted in this framework (one graphite gas cooled; one boiling water ; one pressurised water).

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2.5.3 The associations are created when, for long term research, the Commission finds national projects which can usefully be extended. This is done in the following way: the national undertaking is transformed into a joint operation in which the two parties contribute to funds and to management. In addition, and this is the most important feature, the actual work is carried out by a mixed team, the original group being increased by non nationals belonging to, or sponsored by, the Commission. The proportion of such Euratom staff may reach 50 % of the graduates working on the project.

Such associations have been established, or are being negotiated, in many important fields.

But before giving some details, I would like to say that:

a) the experience so far is a success. While such set-ups do have their problems, the results are good, as well from the scientific as from the administrative and - why not say so - political points of view; -

b) a very great amount of patience, diplomacy and firmness of purpose has often been necessary to persuade the desirable partners. Many years of persistent efforts have sometimes been necessary. This is one more case when it would have been easy to yield to the temptation of isolated action, and it shows again how strongly we are toiling towards cooperation and coordination.

The associations cover the following fields:

Thermonuclear (fusion) processes.

Nearly all non military research in this field is or will soon be included in Euratom associations. It is already so in France and Italy; partly in Germany. Another German association and one in the Netherlands are in the making. And Belgium has found it sufficient to send good scientists in our associations.

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Fast reactors.

We can hope for a similar consolidation of all Community work, in the near future, in the most important field of fast neutron breeder reactors. An association with the French CEA is nearly ready; negotiations are getting under way with Germany. Such a consolidation will, of course, help to establish and increase collaboration with the US and UK in this field.

As always we have not waited for formal agreements before starting some collaboration.

Here again, the pressure for and temptation of independent action were very strong and we have had steadfastly to resist many of our advisers or senior staff members in order to follow the above described course.

High flux reactors.

The most modern of such reactors in Europe, BR 2 in Mol, is run by association between Euratom and the Belgian CEN.

Miscellaneous.

Homogeneous reactors; some nuclear physics, applied radiobiology in agriculture, and in animal studies, as well as isotopic geology have given occasion for other associations with French, Belgian, Dutch and Italian organisations. Some exist also (in particular in Germany) in the most controversial field of nuclear merchant ships.

OECD undertakings.

We can consider as associations the Halden and the Dragon OECD projects (in which the Commission has joined on behalf of the six countries) because these projects, like our associations are characterized by a national start, followed by joint financing, joint management, and international teams.

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The Halden project (in Norway) concerns a modest reactor experiment on boiling heavy water reactors.

The Dragon project is an important development towards high temperature, gas cooled reactors. It derives from a British project. It should logically be linked with the BBC/KRUPP AVR undertaking. This is another association which we have been looking to, for well over three years now, and which has been recently accepted, at last, by the German authorities.

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Having thus given a short - yes, short - account of what has been, and is being, done since 1958, I would like to present some general basic considerations underlying the second five years plan proposals, which should bring us from 1963 to the end of 1967.

- a) The actions described above are well launched, but they are far from being finished, and thus will be the major undertakings of the second plan. Some of them have nearly reached a steady operation volume (Orgel); others must increase considerably (fast reactors).
- b) While the scope and rythm of past development has been gratifying. We must realize that Euratom is living dangerously, in particular as far as senior staff is concerned. Men having at the same time the necessary general caliber and the particular training and experience are very scarce. But the success of our action lies in our ability to recruit enough of them, or, failing this, in our daring and good judgement in promoting young men to positions of responsibility. Both courses of action are not too much helped by the conditions of service in Euratom (salaries as well as recruitment and promotion procedures), which, more and more, become less favorable than those offered by public or private atomic enterprises to the key men we are considering.

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- c) This makes it all the more imperative to maintain a minimum rate of growth in our activities so as to ensure the feelings of urgency and opportunity necessary to healthy establishments, and without which the best of the staff are tempted to leave. A 10 to 15 % yearly increase is none too big.
- d) In the same connexion, and thinking of unforeseen developments, it is necessary to provide for a reasonable amount of unprogrammed and of marginal research. This does not cost much in equipment, as no new heavy machines can be involved at early stages.
- e) The time has definitely come when national and community programs can and must be intimately connected. It is possible because, as we said, both national organisations and the Common Research center are mature institutions. It is necessary for obvious reasons of sound management of our resources. It is therefore a duty of all of us to perform, casting away on all sides all institutional selfishness. The Treaty provides all the necessary mechanisms, particularly after they have been supplemented by the "Consultative Committee for Nuclear Research" where the men responsible for programs in the member states and in the Commission jointly discuss all matters relevant to plans and budgets. This Committee, and its subgroups, have been very active and useful in the last year. It will have reached its goal when it has really become the joint planning group, for nuclear affairs, of the whole Community (member states and Commission).

- 4) It is now rather easy to figure out what the second five years plan must look like.

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Its three main features are:

- a) active furthering of actions already in hand; -
- b) within the minimum healthy rate of growth; -
- c) with just enough leeway to maintain a sensible measure of exploration in new fields.

4.1 Both a global approach and an item by item reckoning lead us to total appropriations of 480 M \$ in the five years 1963 to 1967. At the same time the staff numbers should progress from somewhat over 1900 to over 3500 with an average number under 3000.

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4.2.1 No new establishments of the Common Research Center should be created; those already in existence should reach a rather steady condition of activity.

4.2.2 The main lines of reactors to be developed should be those already defined, namely:

- a) "Orgel" mostly by our own work in Ispra and by contracts; -
- b) fast reactors, using plutonium as fuel, mainly by association contracts, gathering the forces of the Community in the national projects already under way; -
- c) high temperature gas cooled reactors, again by the development of existing or new associations.

4.2.3 Accessorily other industrial reactor types will be considered or contributed to:

- a) The R & D program already under way in the framework of the US-Euratom agreement should be continued, and adapted to industrial and technical circumstances as they develop.
- b) Variants of reactor types can be usefully worked on without involving the same sort of expense as the

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setting up of an entirely new family (that is up to 400 M \$ from first experiment to really industrial models). Nevertheless one must be very careful - perhaps all the more careful - in embarking on such work. This is why development of ordinary water, or heavy water reactors, such as integral superheat, or spectral shift, or fog cooling, must not be entered into without full consideration.

Some development work in these lines is useful and non committing.

So called reference designs and (or) economic studies can be very badly misleading when, as is too often the case, they are based on insufficient nuclear and engineering data.

The construction of very small industrial plants may be a somewhat more expensive manner of making essentially the same mistake and we shall try to avoid encouraging it. Let me give a somewhat excessive example of what I mean: does anyone here imagine that the construction and operation of a nuclear powered fishing trawler would be a significant step towards the advent of a nuclear merchant fleet? Might it not rather ridicule the whole undertaking?

Let us therefore commit ourselves to an open minded but lucid and deep exploration of any such schemes, and resolve not to be drawn into operations the scope of which is not well defined, and desirable, from the start.

Most likely any such operations would be of a definite industrial character. They would therefore go beyond the Commission's research program. But they might be dealt with as "common enterprises" as defined in Chapter V of the Treaty, and they might need a R & D program in which the Commission could take an active interest.

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- 4.2.4 The Commission will continue to operate, or share in the operation of materials testing reactors. It will also further cooperation in this field and in the neighbouring questions of ancillary equipments and of "hot" laboratories.
- 4.2.5 The knowledge of solid materials, in particular metals, ceramics, and cermets, can very much be enhanced by the use of neutrons both as probes to explore structures, and as projectiles to disturb them. It has therefore been suggested that Euratom, alone or in association with member states, might build in Ispra a "hyperflux" reactor for studies of that sort. This most interesting project shall be very carefully examined, because such a reactor raises by itself important and difficult problems, and because its operation and use would exert a great influence on the very spirit of the Ispra establishment.
- 4.2.6 We should keep alert and informed in some sidelines which may assume importance in the future, so as to be ready to get into action when needed. The auxiliary power sources for space probes, for instance fall naturally in the field of the Karlsruhe Transuranium Elements Institute from the chemical point of view, and, from the physics one in that of the direct conversion group of Ispra.

Our interest in high temperature reactors may lead into the very high temperature machines which are considered for space propulsion.

When member nations decide to get together for their endeavours in space it might be considered logical, and appropriate, that they entrust to an already existing and competent Community the relevant nuclear parts of such programs.

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4.2.7 Without going into details the following must be mentioned, for the sake of completeness

- a) thermonuclear work will go on; -
- b) activity will be maintained in the various chemistry fields associated with atomic energy, from fuel processing to waste products treatment and disposal, and to isotope applications; -
- c) in addition to the regulatory role entrusted by the treaty to the Commission in matters of safety and public health, research relevant to these problems will be maintained. From this stems a biology program which, prepared and begun in the last eighteen months, should go into regular steady operation during the second five years period. Here again we shall mostly work by association with national institutions.

4.2.8 Documentation (current and futuristic) and teaching cannot be neglected.

Documentation must inform all, and first those who give us the means of working, on what we are doing, We shall take the greatest pains to provide quick and accurate information on worthwhile matters. We shall take no lesser pains to avoid overloading the communication channels with irrelevant or immature material.

Documentation must also digest and direct to its place of use information on what the rest of the world does. We shall therefore keep up the work mentioned earlier on machine processing of non numerical data, including languages.

In teaching our job is not to increase the formal university and technical schools courses (although we are, of course, willing to help in harmonizing specialised nuclear departments). We would rather concentrate on furthering the links between universities, technical schools, and nuclear centers (this is the system of

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"stages" already in operation) and to contribute, in all possible manners, to the transformation of specialists of all disciplines, at various stages of their professional life, into nuclear engineers, or into users of nuclear and paranuclear techniques.

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Since we have issued, somewhat over three months ago, the first outline of our second five years program, active and continuous discussions have been taking place between the member states and the Commission.

It has been a great satisfaction to us that the exchange of views has been lively, but that in our opinion - there has been no fundamental opposition to our proposals. Indeed, in quite a number of cases, they have been considered too modest, and we have been urged to increase the intended appropriations.

This exchange of views will continue. A revised edition of the tentative program will be prepared, and we hope that it will be possible to have a decision from the Council of Ministers before the summer holidays. We could then prepare and submit in due time the 1963 budget estimates, which would embody the new thrust of the Community towards its nuclear aims.

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So far we have considered the Community as it exists now. We all are deeply aware that, early in the second five years period, it might be increased by the entry of new partners, among them U.K., the major nuclear nation of western Europe.

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Fortunately the nuclear world is now open enough for us to know that such an event, however momentous, should not change the basis of development outlined above. Of course many adjustments would be necessary, including major ones. But I'm confident that the main lines would stand and only be strengthened. It is too early to say anymore on this subject which, however, could not but be mentioned here to day.

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