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FUTURE DEVELOPMENTS FOR THE JOINT RESEARCH CENTRE

DISCUSSION PAPER FOR AN ORIENTATIVE DEBATE

(Communication from the Commission to the Council)

JOINT RESEARCH CENTRE (JRC) - 1984/1987 PROGRAMME

MID-TERM EVALUATION BY THE SCIENTIFIC COUNCIL

Scientific Council of the JRC

21.02.1986

JOINT RESEARCH CENTRE (JRC) - 1984/1987 PROGRAMME

MID-TERM EVALUATION BY THE SCIENTIFIC COUNCIL

FOREWORD

The Scientific Council has carried out an evaluation of the work of the Joint Research Centre during the first two years of the current programme ("The Mid-Term Evaluation"). This evaluation is required by the Council of the European Communities as one of the elements in the decision making process for the approval of the next multiannual programme. The evaluation is based on several inputs as mentioned in Chapter I.

The Joint Research Centre is described in Chapter II and the Scientific Council's evaluation of the JRC's work is given in Chapter III.

The general conclusions of this evaluation exercise and a summary list of recommendations are given in chapter IV. The recommendations should be read in the context of the page references given in the text.

Scientific Council
21 February 1986

Joint Research Centre (JRC) - 1984/1987 Programme
Mid-Term Evaluation by the Scientific Council

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CHAPTER I: Introduction

1.1. The Mid-Term Evaluation

Article 8 of the Council Decision of 22 December 1983[1] adopting the 1984 to 1987 JRC Multiannual Research Programme lays down that "Before the next proposal for a multiannual programme, the Commission shall submit to the Council and to the European Parliament a critical analysis carried out by independent experts of the programmes launched by the Joint Research Centre". This analysis shall contain a "quantitative and qualitative assessment" of the results of the research.

The Scientific Council was asked to undertake this task in view of its recent creation which would both ensure the independence of members' views and enable members to rapidly acquire familiarity with all aspects of research carried out in the Joint Research Centre's four Establishments.

1.2. The JRC Scientific Council

Established by Commission Decision[2], the Scientific Council normally meets six times a year to assist and advise the Commission on the implementation, management and mid-term programme evaluation of the Joint Research Centre's activities. It comprises a chairman, appointed by the Commission, and one leading scientist from each Member State appointed by the Commission on the basis of a least two nominations by the authorities of the State in question. Appointments are for three years and are renewable. The present composition is found in Annex I.

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1) OJ N° L 3/21 of 05.01.1984

2) OJ N° L 177/29 of 04.07.1984

The following meetings have been held:

1.	February	8	1985	Brussels
2.	March	26	1985	Brussels
3.	May	7-8	1985	Ispra
4.	July	8-9	1985	Karlsruhe
5.	September	24-25	1985	Brussels
6.	December	3	1985	Brussels
7.	January	30-31	1986	Petten
8.	February	20-21	1986	Geel

1.3. Basis of Evaluation

As a first basis for its evaluation work, the Scientific Council used the information gathered during its first 8 meetings held between February 1985 and February 1986. During 1985 it heard extensive reports on JRC activities by the Establishment Directors, the Research Action Programme Coordinators and other JRC staff. Another input came from the discussions with the JRC management on the preparation of the next Multiannual Programme proposal. The Scientific Council held one meeting in each of the Establishments (attemps to have more such meetings failed through lack of time of many Scientific Council members). This gave limited opportunities for visits to installations and contacts with staff.

As a second basis for its evaluation, the Scientific Council relied on the work and conclusions of the 8 sectorial Evaluation Panels appointed by DG XII. Six of these panels were constituted after creation of the Scientific Council and one or two Scientific Council members were included in each of them. As far as JRC activities are concerned, all panels had completed their work and their reports were available at least in draft form by early 1986. The list of Evaluation Panels with participating Scientific Council members is given below.

Evaluation Panel	Scientific Council Members
- Non-Nuclear Energies	Prof. WEAIRE, Dr. WEHENKEL
- Reactor Safety	Prof. GOEDKOOP
(Radioactive Waste Management)	
- (Safeguards and Fissile)	Prof. MACINTOSH, Prof. VAN HOVE
(Materials Management)	
(Nuclear Fuels and Actinides)	
- High Temperature Materials	Prof. NICOLAIDES, Prof. BÖHM
- Nuclear Measurements and Reference Materials	Prof. YOCCOZ
- Fusion Technology and Safety	Prof. CABIBBO
- Remote Sensing	-
- Environment	-

The Scientific Council invited all the Panel Chairmen to attend one of their meetings and seven of them were able to do so in January and February 1986. The full membership of the Evaluation Panels is given in Annex II.

Finally, the Scientific Council invited the four Establishment Directors to present mid-term status reports on the work of their staff covering the two first years of the 1984-1987 Programme. These reports are given in ANNEX III.

1.4. Acknowledgements

The Scientific Council would like to acknowledge the valuable assistance of Dr. M.D. Rogers in the preparation of this report, the JRC Management for their cooperation at all stages and to thank the secretarial staff at JRC Petten who were responsible for the typing. We would also like to thank the chairmen of the evaluation panels who attended our meetings and who provided very useful overviews of their evaluation results.

CHAPTER II: The Joint Research Centre

2.1. History

Established under article 8 of the Treaty of Rome (EURATOM) 17th April 1957, the Joint Research Centre was concerned exclusively with nuclear research. In the 1960s, the Centre was involved with the development of various reactor concepts during which time European Member States succeeded in establishing flourishing research and industrial activities for the commercial application of nuclear energy and isotopes. The JRC began to look more towards nuclear matters of public concern and in 1971 its mandate was extended to include non-nuclear community research. At the present time about two thirds of the total activities are related to the nuclear field both fission and fusion, and are mainly concerned with standards and public safety. Other research lies in the domains of environmental protection, alternative energies and other aspects of industrial technologies such as high temperature materials.

The JRC falls within the overall responsibility of the General Directorate for Science, Research and Development (DG XII) with which it was combined in 1982.

2.2. The Establishments

The JRC comprises four research Establishments and a Headquarters in Brussels. The authorized staff complement is 2260.

The GEEL ESTABLISHMENT is situated in Northern Belgium and is specifically described in the Euratom Treaty as "a bureau of standards specialized in nuclear measurements for isotope analysis and absolute measurements of radiation and neutron absorption". The Establishment has a series of well-equipped laboratories for preparing and assaying reference materials. Geel has an authorized staff complement of 198 and comprises Physics, Materials and Administration and Infrastructure Divisions.

The ISPRA ESTABLISHMENT which is situated on 162 hectares of land beside Italy's Lake Maggiore, is the largest of the JRC's four Establishments, employing three quarters of the JRC's total staff. Although it was initially intended as a purely nuclear research centre with the emphasis on nuclear safety, a large part of Ispra's activity is now devoted to other fields. These include, for instance, research in the environmental field, the use of satellites for agricultural purposes, and the study of non-nuclear energy sources, e.g. solar energy. The authorized staff level at Ispra is 1680. The Establishment comprises 3 Scientific Departments, a Projects Directorate and a Site Directorate responsible for administration, infrastructure, etc.

Research into plutonium and other actinides, the transuranium elements (highly radioactive substances predominantly produced in nuclear reactors) is carried out at the KARLSRUHE ESTABLISHMENT, which is located on the site of the German national nuclear research centre. Because the transuranium elements are highly radioactive and radiotoxic, the Establishment is equipped with highly specialized facilities. The Establishment has an authorized staff of 208 distributed between Chemistry, Physics and Administration Divisions with a department for technical services.

The PETTEN ESTABLISHMENT is situated in Northern Netherlands and is specialized in research into high-temperature materials. Its High Flux Materials Testing Reactor is one of the largest irradiation facilities in the EC and currently maintains its position as one of the busiest materials testing reactors in the world. The research activity of the Establishment is tailored to the industrial needs for materials for long-term service in high temperature agressive environments. Petten has 161 authorized staff organised into High Flux Reactor, Materials and Administration and Infrastructure Divisions.

2.3. The Research Action Programmes (RAPs)

DG XII research programmes (direct action programmes, cost shared programmes, concerted action programmes) are grouped into a series of Research Action Programmes of which the JRC programmes contribute to 5.

The following table indicates the titles of these five RAPs and the JRC programmes subdivided into projects (research areas) falling under the RAPs.

		Establishment
A.	RESEARCH ACTION PROGRAMME - INDUSTRIAL TECHNOLOGIES	
A.1.	Nuclear Measurements and Reference Materials	
	- Nuclear measurements	Geel
	- Reference materials	Geel
A.2.	High Temperature Materials	
	- Studies on steels and alloys	Petten, Ispra
	- Studies on sub-components	Petten
	- Studies on engineering ceramics	Petten
	- High temperature materials data bank	Petten, Ispra
	- High temperature materials information centre	Petten
B.	RESEARCH ACTION PROGRAMME - FUSION	
B.1.	Fusion Technology and safety	
	- Reactor Studies	Ispra
	- Breeding blanket technology	Ispra
	- Structural materials studies	Ispra, Petten
	- Risk assessment	Ispra
	- Tritium laboratory	Ispra
C.	RESEARCH ACTION PROGRAMME - FISSION	
C.1.	Reactor Safety	
	- Reliability and risk evaluation	Ispra
	- PISC (Project for Inspection of Steel Components)	Ispra
	- LWR Primary Circuit Components Life Prediction	Ispra
	- Study of abnormal behaviour of LWR cooling systems	Ispra
	- Source term studies	Ispra
	- LMFBR accident modelling	Petten
	- PAHR in-pile	Ispra
	- LMFBR material properties and structural behaviour	Ispra, Petten
	- Evaluation of a vibrating table	Ispra

		Establishment
C.2.	Radioactive Waste Management	
	- Radioactive waste management and the fuel cycle	Ispra, Karlsruhe
	- Safety of waste disposal in continental geological formations	Ispra
	- Feasibility and safety of waste disposal in deep oceanic sediments	Ispra
C.3.	Safeguards and Fissile Materials Management	
	- Methods and Instrumentation for the assay of fissile materials and containment and surveillance	Ispra
	- Safeguards data processing, transmission and evaluation	Ispra
	- Integration of safeguards activities	Ispra
C.4.	Nuclear Fuels and Actinides Research	
	- Operation limits of nuclear fuels	Karlsruhe
	- Transient behaviour of oxide fuels and fission product release under severe fuel damage conditions	Karlsruhe, Petten
	- Actinide cycle safety	Karlsruhe
	- Actinide research	Karlsruhe
D.	RESEARCH ACTION PROGRAMME - NON-NUCLEAR ENERGIES	
D.1.	Testing of Solar Energy Systems	Ispra
D.2.	Energy Management in Habitat	Ispra
E.	RESEARCH ACTION PROGRAMME - ENVIRONMENT	
E.1.	Environmental Protection	
	- Environmental chemicals	Ispra
	- Atmospheric pollution	Ispra
	- Trace metal pollution	Ispra

		Establishment
E.2.	Application of Remote Sensing Techniques	
	- Agriculture and Land Use	Ispra
	- Protection of the marine environment	Ispra
	- Natural disasters	Ispra
E.3.	Industrial Risk	
	- Accident prevention	Ispra
	- Accident management and control	Ispra
F.	SCIENTIFIC SERVICE ACTIVITIES	
F.1.	Exploitation of the HFR Reactor	Petten

CHAPTER III: Evaluation

3.1. General Considerations

The JRC programme under review consists of 12 research areas, representing 5 of the Research Action Programmes (RAP), plus one complementary programme (exploitation of the High Flux Reactor at Petten). The activities are carried out in 4 Establishments, and several activities involve staff and/or facilities in two or more of these Establishments. Some activities are rather special and involve relatively few people, some have a wider scope and involve more staff. It is clear that the JRC is a complex institution and therefore difficult to evaluate in all of its aspects. We shall first present a number of general considerations which apply to most activities, both in their aspects internal to JRC and in those concerning relations with the outside (i.e. with academic institutions, other research laboratories, Commission services, national authorities, regulatory and international organisations). We shall then comment on various specific points of the programme (Section 3.2) and continue with our remarks on methods of management, planning and control (Section 3.3). Our conclusions and a list of our recommendations are given in Chapter IV.

On the basis of our own findings and those of the sectorial Evaluation Panels, our global opinion is that the research activities of JRC are of generally good quality and that the staff is generally competent and well motivated. The significance of the work and the quality of the results vary from case to case, which is natural in view of the diversity of the topics included in the programme and of the fact that many of them are of rather limited scope. But the contributions made are often valuable and are in line with the research tasks assigned by the 1984-87 programme. A very positive feature is the success with which the JRC undertook in the last decade the new tasks attributed to it, in particular in non-nuclear areas, corresponding to the new orientations then given by the Commission.

The Scientific Council concurs with the view also expressed by most Evaluation Panels that everything should be done to increase the contacts and collaborations between JRC and the outside. Very good contacts exist for some of the activities, the willingness to collaborate seems to be widespread, but much more could be done. More numerous and more vigorous outside contacts would be productive in at least two respects. Firstly, some of the JRC activities would gain from being strengthened on the basic research side. Relevant basic research can enhance the flexibility and capacity for innovation of applied projects. It also helps to attract creative and ambitious research personnel by providing more opportunities for publication in academic journals. Much could be done in collaboration with universities and/or national laboratories. Secondly, the JRC work, being almost all of an applied character, can only be effective if care is taken that the results come to the attention of potential users (Community services, industry, national authorities) in a suitable form. The Scientific Council encountered many interesting cases of this happening, but found it difficult to obtain systematic information. Therefore we believe that the JRC should set up a suitable mechanism to monitor the use made of its research efforts.

Some of the Research Action Programmes covering JRC activities also entail collaboration with industry and with outside organisations (cost shared and concerted action programmes). In such cases the RAP framework provides another channel between the JRC and its European environment. We shall return to the managerial aspect of these interactions in Section 3.3.

One general problem that the Scientific Council wishes to bring to the attention of the Commission concerns the development of large computer codes for use outside the JRC. Even when such a code is finished and made available in the proper form, work will remain, because the users will require service and moreover new information will become available and require the code to be updated. As this will place an increasing burden on the JRC, ways should be sought to transfer this task to another organization that undertakes to perform it over a guaranteed period on a commercial basis. This entails legal problems that the JRC cannot be expected to solve.

3.2. Comments on specific research areas

A.1. Nuclear Measurements and Reference Materials

The shift of emphasis in the Community from fission to fusion entails a shift towards higher neutron energies in the measurement of neutron cross sections. In order to ensure the most efficient utilization of equipment and human resources, the collection of such data for fusion technology, as is the case for fission reactor data, should make full use of the existing international mechanisms for assigning priorities to the measurement needs.

As regards reference materials and methods, it appears that the requirements of the Community for work in the JRC are better expressed in the nuclear than in the non-nuclear field. In the latter one must recognize the important role of round-robin exercises as organized by the BCR. The task of the Geel Etablishment is mainly to calibrate standards, and, even if these concern also non-nuclear materials and problems, the obvious strength of the laboratory is in applying nuclear methods.

A.2. High Temperature Materials

In the ten years that have passed since this activity of the Petten Establishment was launched, it has already contributed notably to the application of high temperature materials in the Community and the Establishment now acts as a catalytic and co-ordinating centre for programmes involving high temperature alloys, ceramics and composites. One should be aware of the special nature of research in engineering ceramics, which will probably require a critical size of effort, that is larger than that currently planned, if the programme is going to achieve success. There should be emphasis on the development of test techniques and on continued close collaborative links with the programmes in the institutes of the Member States.

The Scientific Council is impressed by the quality of the work, but wants to stress, with the Evaluation Panel, that constant attention to the liaison with industry is essential for its continued effectiveness. At the same time, it finds its earlier remarks about basic research and links with the universities of particular relevance to these material studies.

B.1. Fusion Technology and Safety

In no field of research is the role of the Commission as prominent as in that of nuclear fusion, in fact all work in Europe is done with its, sometimes considerable, participation. As the achievement of a thermonuclear plasma is drawing closer, it becomes more and more important that the research effort is guided by conceptual design studies on reactors or at least on devices that come close to being reactors. Credit must be given to the JRC for having embarked on such studies at an early time, first as an in-house effort, later as the main European contribution to the IAEA sponsored INTOR-project and since a few years as a Commission contribution to the NET-project. Likewise, the JRC has played a central role in the launching of European participation in irradiation testing of structural materials in the IEA framework. As regards the participation of the JRC in the European fusion technology programme, the Scientific Council is in full agreement with the positive comments made by the Expert Panel on its usefulness and quality. However, some of the recommendations to broaden the work in certain areas might be misunderstood. Careful reading shows that, for instance in the important area of breeding blanket technology, in which the JRC concentrates on a liquid breeding material, no more is meant than that a "watching brief" is maintained on solid breeder blankets, a subject entrusted in the Community's fusion programme to six major fission energy laboratories working closely together. This is in harmony with the view of the Scientific Council that whenever possible, the Commission should, through association contracts, try to secure the participation of such national laboratories.

One area in which the JRC has now the chance of becoming prominent, and should try to do so, is tritium technology. For this is should exploit to the full the opportunities to be offered by the new European tritium laboratory.

It should be stressed that the ultimate success of the fusion programme will depend on the timely availability somewhere in the world of a copious source of neutrons with the energy relevant for testing reactor materials. The spallation source being studied in the JRC would be such a machine. However, it would produce neutrons over a wide range of energies, allowing also other types of research, and so its utility should be judged in a wider context.

C.1. Reactor Safety

This is by far the largest sector of JRC activites and it is therefore difficult to make general statements. A broad separation may be made between work mainly related to the thermal reactors, cooled and moderated by ("light") water (LWR) that now are dominant in nuclear electricity generation and that which is aimed at the fast breeder reactor (LMFBR), of which one full-scale example is now operating in the Community.
The LWR work went through a major upheaval in 1983 when it was decided to discontinue the Supersara project. This meant that further reactor safety research, at Ispra had to be done without neutrons. The JRC has adapted well to this change and managed largely to compensate for the

loss by other useful work. In fact, some of the facilities that became redundant are now used for other purposes, such as hot cells for a new stage in the highly successful PISC project for improving inspection procedures of steel components. In this case Ispra forms the hub of a widespread international effort. As nuclear power plants age, PISC and the closely related studies on primary circuit life prediction are assuming increasing importance. More directly in line with what was originally intended with Supersara are a number of projects on abnormal occurences that might ultimately lead to the release of radioactivity: the evaluation of reliability and risk (an important part being the management of data banks on which we have commented under 3.1), the study of abnormal behaviour of the LWR cooling system and the source term studies. The latter is an early activity in a very topical field and is being approached correctly in consultation with the many other groups already working in it. In contrast, cooling disturbances are studied on a large scale in the LOBI-facility and here the Scientific Council was gratified to learn that the results obtained during the period that operation of this facility was financed by the German Federal Republic have been made available generally. An important adjunct of this work is the development of computer codes, including those put at the disposal of the JRC by the French and German originators. Apart from the general comment made earlier, the Scientific Council supports the wish of the Evaluation Panel that the results of experiments performed with financial support by the Commission under the 1980-83 Shared Cost Action Programme, as far as they are found useful, be incorporated in these computer codes.

In fast reactors, a new situation has resulted from the decision of five of the member states to pool their efforts in order to bring this as yet very capital-intensive technology to commercial application. As a consequence the Commission, which has no formal relation with the Consortium formed for that purpose, should reconsider its role in fast reactor safety. This is the more so since one of the tenets of the Consortium is that core-disruptive accidents need no longer be considered in fast reactor design and much of the JRC effort, in particular the large and technically difficult in-pile PAHR and FARO experiments, is just in this area. This does not mean that these activities are no longer relevant for LMFBR licensing procedures and in fact there are clear examples of utilization of results obtained in these programmes, as well as of those from computer code development, sodium loop experiments and structural integrity studies at Ispra, in European prototype fast reactor projects.

One JRC activity in this area that merits special attention is the operation of data banks. It appears that there are often restrictions attached to the input-information, so that access to the data banks remains limited. It is difficult for the scientists concerned to improve this situation and it is suggested that the Commission gives more support to this important activity at the political level.

C.2. Radioactive Waste Management

The management and disposal of radioactive waste, more in particular because of the economic scale factor, calls for an international approach, even though at the present time this is difficult because of the sentiments widely attached to the subject. Thus it is to be welcomed that the Commission supplements its shared cost activities in research, development and demonstration projects in this area with work in the JRC. The Scientific Council has somewhat different appreciations for the three parts of that work. It has no reservations on the safety studies of geological disposal and neither about the JRC role in the international research on disposal in ocean sediments, although, given the political sensitivity of all disposal operations in the ocean, the work will for the foreseeable future be mainly a scientific contribution to oceanology.

As regards research in the third area, under the title Radioactive Waste Management and the Fuel Cycle, the doubts expressed by the Expert Panel on the largest part, the use of the PETRA facility, seem fully justified. The Scientific Council recommends that the objectives of PETRA be redefined.

C.3. Safeguards and Fissile Materials Management

The efforts of the JRC, complemented by those within the European Safeguards Research and Development Association, have produced a number of practical tools to guard against the abuse of fissionable materials, such as a tamperproof seals on reactor fuel elements. In addition, support is being given to the Commission in carrying out its safeguarding tasks. Perhaps most important, the research staff have taken pains to help introduce the (not always popular) safeguards measures through regular contacts with the operators of European nuclear installations. Now that the recent Non-Proliferation Treaty Review Conference has reaffirmed the international political basis for safeguards, these activities should be continued with, as is being proposed, an increasing emphasis on systems aspects.

C.4. Nuclear Fuels and Actinide Research

This programme chapter is executed entirely by the Karlsruhe Establishment. No part of the JRC comes closer to being a centre of excellence than this Establishment, both in the field of actinide chemistry and physics and in that of high-temperature chemical thermodynamics. In the opinion of the Scientific Council an effort should be made to maintain and strengthen this unique position.

On the other hand, as regards the more applied work on reactor fuel behaviour and on actinide safety, the Scientific Council would support the recommendations of the Panel to seek more integration with industrial activities in Europe. Furthermore those charged with the management of the Commission's research programme in reactor safety should be kept aware of the relevant work at Karlsruhe.

D.1. Testing of Solar Energy Systems & D.2. Energy Management in Habitat

In the field of non-nuclear energies, the activities of the JRC are mainly concerned with testing. They correspond well to the mission assigned on norms and standards. The quality of the work is good and particularly timely.

The excellent facilities for testing and development of testing methodologies, which have been set up in ISPRA and which are unique in Europe, together with its neutral role, enable the JRC to play the important role of a reference laboratory in setting up regulations, standards and codes of practice at the European level. The scope of the future programme could be enlarged to include various components involved in buildings (windows, wall and roofing components, regulation systems etc). A clear need for such a reference laboratory has been identified. The JRC has shown that it was able to play a major role in helping national laboratories to frame an agreement. We further recommend:

- The high scientific level of the JRC should be better publicised in all European countries.

- The JRC should maintain contact with the most recent progress in the leading non-European countries, which implies stronger links with laboratories outside of Europe.

- Research of a more basic character should be undertaken.

- The activities of the JRC in relation to developing countries should be strengthened and training activities could be implemented for such countries.

E.1. Environmental Protection

Even though environmental research is explicitely included in the mandate of the JRC one might question the basis on which, from the wide spectrum of Commission supported activites in this area, some activities were selected for execution at Ispra. The Scientific Council has the impression that initially this was subject to a certain arbitrariness but that a coherance has gradually developed. The present activites make use of the available infrastructure or are those concerning callibration and standards and comply with the mission of the JRC.
From the evaluation of the independant Expert Panel it is clear that the JRC has been successfull in launching this activity which was quite new to it. The Scientific Council strongly supports the view of the Panel that, since the Environmental Chemicals Data and Information system (ECDIN) has now been set up by the JRC, the Commission should either provide sufficient resources to continue this activity or decide to find another solution.

E.2. Application of Remote Sensing Techniques

Although none of its members is an expert on remote sensing, the Scientific Council is impressed by the interest and importance which a vigorous development of this field would have for the European Community. In line with the recommendations of the Evaluation Panel, we believe that the Commission should develop an overall policy on applications of remote sensing. Its implementation should make use of the valuable expertise already available in the JRC, for which this may become an important growth area.

E.3. Industrial Risk

Due to the lack of expertise amongst its members and the fact that as yet no Expert Panel has evaluated the work in this new research area, the Scientific Council was not in a position to judge the work in any detail. However, it is convinced that the JRC, with its extensive experience in nuclear safety, is in an excellent position to contribute also to this field.

F.1. Exploitation of the High Flux Reactor

Now that the reactor vessel has been replaced and a number of other improvements made, the HFR will be able to support a wide variety of research activities for many years to come. The emphasis here will, as in the past, be on materials research and component testing for interested parties in the participating Member States. Nevertheless, the Scientific Council believes that also a number of JRC research areas could benefit from an increased use of the HFR and recommends that this should have the attention of the management. This is particularly true for the materials work at Petten and here it would be useful to have available neutrons of longer wavelength. This lends support to the plans for installing a cold neutron source.

3.3. Planning, Management and Control

Planning is one of the most important and most difficult tasks of management for large research institutions. It is evident that multiannual planning is needed, but the planning procedure should allow for a degree of short-range flexibility within specific research areas and also for a degree of long-range stability at the level of general orientations. The time scale of the present multiannual planning procedure of the JRC is four years, which is reasonable and close to the practice of other research organizations.

The Scientific Council wants to stress that imposing a detailed and rigid multiannual plan would be counterproductive. Within the task assignments of the plan, enough short-range flexibility must exist to adjust and possibly re-orient specific activities in response to the scientific and technological developments inside and outside the JRC, taking into account that the optimal dates for such adjustments cannot be expected to coincide for the various ongoing research activities. At the other end of the spectrum, a planning procedure that creates a break and a new start every 4 years would be disastrous. On many research topics a long-range stability over more than 4 years is essential at the level of basic orientations. In many cases also, the phasing out of a research line, the building up of a new one or the optimal exploitation of facilities require coherent planning over more than 4 years. Finally, a degree of long range stability of orientations is desirable for building up expertise, motivation and whenever possible excellence among the research staff. This is of particular importance for the coming 10 to 15 years when many JRC staff members will reach retirement age. The future personnel policy will have to be properly matched with the long-range programme orientations.

Having in mind now these general considerations, the impression given by the multiannual JRC programme is one of stifling rigidity. It shows planning schedules for every research area, usually broken down in tasks and even sub-tasks, each of them with a time scale on which mile-stones appear to be firmly anchored for the full duration of the programe. In practice, however, the Scientific Council has found that, at least for the programme 1984-87, considerable adaptations have been made, even in the first year, with in many cases new milestones being erected. We welcome this flexibility and recommend that multiannual plans should be somewhat less detailed and should be reviewed and, if necessary, updated on a yearly basis.

This observation leads the Scientific Council to call attention to the manner in which other large research organizations are combining the desiderata of short-range flexibility and long-range stability. It is based on a rolling procedure which every year adjusts and/or redefines the various parts of the programme for the multiannual period (e.g. 4 years) ahead. The definition for the first year is precise and compatible with the budget for that year. The definition for later years leaves growing flexibility on details and concentrates gradually more on basic orientations, including the long-range ones. The Scientific Council believes the planning procedure of the JRC must be improved in this direction.

The advisory mechanisms and decision making procedures now in existence for the JRC are complex and ponderous (see ANNEX IV for a full list of bodies involved in this process). These numerous deliberations take much time of the JRC-staff and add considerably to the overhead costs of the JRC. Consequently every effort should be made to improve the efficiency of the advisory and decision making procedures and to ensure the necessary short range flexibility. At the same time one would like these consultations to strengthen links with shared-cost activities and with national organizations involved in the same RAP. In the past more opportunities for this were offered by the

Advisory Committees on Programme Management, but of course at the expense of consumption of even more time. The Scientific Council has the impression that the Member States could profitably make more use of the opportunity they have of adding to their delegations on a case-by-case basis staff members of appropriate research organizations.

Related problems are the tasks to be performed by the JRC for other services of the Communities (i.e. for Directorates-General other than DG XII) and the interaction with cost-shared action programmes in which the JRC participates. This interaction is structured in many different ways. Thus following a decision of the Council of Ministers in December 1984 the cost-shared actions in reactor safety were merged with those of the JRC and are now financed from the JRC budget. In fusion technology, on the other hand, the JRC activities form part of the general fusion programme as determined by the Consultative Committee for the Fusion Programme. In other areas the two kinds of activities are managed more or less separately. In the opinion of the Scientific Council this should be changed, and one should create a common management for the JRC and the cost-shared actions in all research areas of the JRC programme.

On the matter of external control of the JRC activities, the Scientific Council was impressed by the quality and effectiveness of the 8 sectorial Evaluation Panels which recently reviewed all JRC programmes. In 6 of the Panels Scientific Council members participated at least on a part-time basis, and relevant parts of the panel reports were used in preparing the present evaluation. Unfortunately, six of the panels started their work rather late in 1985, so that very little time was available for the Scientific Council to study their findings before finalizing the present report. In the future a more practical calendar should be followed for the evaluation work. This should not be difficult to achieve and the necessary relations between evaluation and planning could well be incorporated in the rolling approach to programme planning advocated by the Scientific Council.

Without consultation the Scientific Council has been informed that lower budgets have suddenly been decided for JRC for the years 1986 and 1987. The measures envisaged by the JRC management to cope with this new situation were discussed by the Scientific Council while the present evaluation was in preparation. We wish to submit the following considerations in this respect :

i) Budget reductions imposed at short notice are notoriously counter-productive in research organizations. They lead to improvised money-saving measures whose detrimental effects often turn out to be costly in the longer run.

ii) This is particularly true for the JRC because several activities are already carried out at minimum level, which makes proportional reductions over wide areas unacceptable. Discontinuation of some activities would be preferable but is almost always impossible to implement with immediate effects.

iii) The complex advisory and decision-making mechanisms of JRC (see Annex III) are very slow and therefore incapable of dealing with sudden changes.

CHAPTER IV: Conclusions and Recommendations

4.1. Conclusions

As already mentioned in Section 3.1, our global evaluation is that the research activities of the JRC are of generally good quality and continue to be in good accord with the 1984/1987 programme. Some activities are more successful than others, some delays have occurred, some programme elements have had to be adjusted, but such events were exceptional and the JRC management was very cooperative in discussing the reasons.

As mentioned in Section 3.2., there are a few areas where policy decisions should be taken. This holds notably for fast reactor safety (C.1.) and application of remote sensing techniques (E.2.), for which general orientations should be provided without delay in order to introduce the necessary adjustments in the current and the next multiannual programmes. In addition the serious doubts raised about the PETRA project (C.2.) must be faced and other recommendations of the sectorial Evaluation Panels will have to be taken into account.

The staffing and equipment situation in JRC are generally adequate, but increases are desirable in certain areas. If this cannot be achieved by an overall increase of resources, the necessary reductions of lower priority activities must be integrated in the next multiannual programme and preparatory measures must be taken in 1986. On many research topics, JRC activities are carried out by small teams at a minimum level of staff and of research funds. Consequently, a proportional reduction of programmes would create subcritical situations in several sectors, and complete discontinuation of certain activities would be the only acceptable solution.

While the situation has improved over the last few years, the JRC must continue to expand its relationships with outside institutions (universities, national and international laboratories, industry, regulatory agencies etc.). This will require greater emphasis on indirect actions, rationalization of the use of major facilities at European level and interchange of personnel resources between laboratories.

The Scientific Council attaches great importance to the scheme by which scientific visitors and younger fellows can work in the JRC Establishments for limited periods with JRC financial support. This scheme which had been interrupted was reactivated in 1985 at the request of the Scientific Council. The Scientific Council has come to the conclusion that the present numbers of scientific visitors and fellows are insufficient in view of the research opportunities available in the JRC and recommends a substantial increase in these numbers.

Regarding management and advisory structures (Section 3.3.), the Scientific Council wishes to stress the following general points. The top management structure should be such as to bring into contact whenever possible the JRC activities and the cost-shared actions belonging to the same Research Actions Programmes. The two advisory bodies competent for JRC as a whole, the Board of Governors and the Scientific Council, must coordinate their work as much as possible. The advisory bodies for specific research areas must be so constituted that they involve all the expertise needed for the areas they have to cover. A formula will have to be found for creating links between these specialized bodies, the Scientific Council and the Board of Governors.

Our recommendations are listed below in summary form. They should be read in the context of the considerations in sections 3.2., 3.3. and 4.1.

4.2. General Recommendations

1.a. JRC planning procedures should be improved towards a system which includes precise definitions for the year ahead, in concert with the budget for that year. The definition for later years should contain growing flexibility on details and should concentrate on more basic orientations including long range ones. (page 21)

1.b. JRC multiannual plans should be reviewed and updated on a yearly basis. (page 21) The JRC programme progress reports should be produced annually rather than semi-annually.

2. A more practical calendar should be used for future JRC evaluation studies. This should be integrated in the rolling approach to programme management advocated in recommendation 1. (page 22)

3.a. Every effort should be made to improve the efficiency of the advisory and decision making procedures of the JRC to ensure the necessary short range flexibility. (page 21)

3.b. The advisory bodies for specific research areas must be so constituted that they involve all the expertise needed for the areas they have to cover. (page 24)

4. A common management for the JRC and relevant cost shared actions should be created for all research areas in the JRC programme, and should be such as to bring into contact whenever possible the JRC activities and the cost-shared actions belonging to the same RAP. (page 22 and 24)

5. The work of the Board of Governors and the Scientific Council should be coordinated as far as possible. (page 24)

6. Formal links must be created between the specialized advisory bodies, the Scientific Council and the Board of Governors. (page 24)

7. Increases of staff are necessary in certain areas. If this cannot be achieved by an overall increase in resources, the necessary reductions in lower priority activities must be integrated in the next multi-annual programme and preparatory measures must be taken in 1986. (page 24)

8.a. Every opportunity should be taken to increase contacts and collaborations between the JRC and outside bodies (universities, national and international bodies, industry, international and regulatory bodies). (page 11 and page 24)

8.b. The Scientific Council recommends a substantial increase in the numbers of scientific visitors and younger fellows working in the JRC Establishments. (page 24)

9. The JRC should give greater emphasis to indirect actions, rationalization of the use of major facilities at European level and to interchange of personnel resources between laboratories. (page 24)

10. The JRC should set up a suitable internal mechanism to monitor the use made of its research efforts. (page 11)

11. The marketing and maintenance of large computer codes developed by the JRC should be transferred to an outside organisation. (page 12)

4.3. Programme Related Recommendations

(Nuclear Measurements and Reference Materials)

12. The collection of neutron cross sections at higher energies for the fusion programme should make full use of existing international mechanisms for assigning priorities. (page 12)

(High Temperature Materials)

13. Constant attention to the liaison with industry is essential for the continued effectiveness of the programme. (page 13)

(Fusion Technology and Safety)

14. Whenever possible the Commission should try to secure the participation of national laboratories through association contracts. (page 14)

15. The JRC should exploit to the full the opportunities of becoming prominent in the field of tritium technology via the new European tritium laboratory. (page 14)

16. The utility of the spallation neutron source which is under study should be judged in a wider context than the fusion programme. (page 14)

(Reactor Safety).

17. The results of the 1980-83 shared cost action programme should be incorporated on the abnormal occurrence computer codes developed by the JRC where this is found to be useful. (page 15)

18. In the light of the new fast reactor consortium formed by five Member States the Commission should reconsider its role in fast reactor safety R&D. (page 15)

19. Problems of confidentiality can limit access to data banks reducing the potential value of this activity. The Commission should attempt to improve this situation via support at the political level. (page 16)

(Radioactive Waste Management)

20. The PETRA project must be reviewed in the light of the doubts expressed by the Evaluation Panel. (page 16)

(Safeguards and Fissile Materials Management)

21. JRC safeguards work should continue with an increasing emphasis on systems aspects. (page 17)

22. (Nuclear Fuels and Actinides).
The unique position of the Karlsruhe Establishment as a centre of excellence should be maintained and strengthened. (page 17)

23. With regard to applied research (at Karlsruhe) the JRC should seek more integration with industrial activities in Europe. (page 17)

24. The management of the Commission's research programme in reactor safety should be kept aware of the relevant work at Karlsruhe. (page 17)

(Testing of Solar Energy Systems and Energy Management in Habitat)

25. The high scientific level of the JRC should be better publicised in all European countries. (page 18)

26. The JRC should maintain contact with the most recent progress in the leading non-European countries, which implies stronger links with laboratories outside of Europe. (page 18)

27. Research of a more basic character should be undertaken. (page 18)

28. The activities of the JRC in relation to developing countries should be strengthened and training activities could be implemented for such countries. (page 18)

(Environmental Protection)

29. The Scientific Council strongly supports the view of the Evaluation Panel that, since the Environmental Chemicals Data and Information System (ECDIN) has now been set up by the JRC, the Commission should either provide sufficient resources to continue this activity or decide to find another solution. (page 19)

(Remote Sensing)

30. The Commission should develop an overall policy on the applications of remote sensing. (page 19)

(High Flux Reactor)

31. The JRC would benefit from increased use of the HFR in support of a number of research areas and this should be investigated. (page 20)

ANNEX I

Current Scientific Council Membership

Prof. L. VAN HOVE, Chairman,	European Organisation for Nuclear Research (CERN), Genève
Prof. H.H. ANDERSEN,	H.C. Oersted Institutet, Copenhagen
Prof. H. BOEHM,	Kernforschungszentrum Karlsruhe,
Prof. N. CABIBBO,	Istituto Nazionale dela Fisica Nucleare, Rome
Prof. J.A. GOEDKOOP	Rijksuniversiteit Leiden
Prof. P. MACQ,	Université Catholique, Louvain-la-Neuve
Prof. C.A. NICHOLAIDES,	Hellenic Research Foundation, Athens
Prof. D. WEAIRE	Trinity College, Dublin
Prof. C. WEHENKEL,	Institut Supérieur de Technologie, Luxembourg
Dr. J. WILLIAMS,	Atomic Energy Research Establishment, Harwell
Prof. J. YOCCOZ	Centre National de la Recherche Scientifique, Paris

Two members resigned during 1985 due to pressure of other commitments but nevertheless managed to make a significant contribution to the work of the Scientific Council:

Prof. A. MACINTOSH,	H.C. Oersted Institutet, Copenhagen
Dr. L.E.J. ROBERTS,	Atomic Energy Research Establishment, Harwell

ANNEX II

Membership of the Evaluation Panels

N.B. The contract for membership of an evaluation panel is awarded on a personal basis and not to the organisation which the individual normally represents.

1. Non-Nuclear Energies

Chairman: Mr. P. CHEMILLIER
Centre Scientifique et Technique du Bâtiment (CSTB), Paris

Prof. C. BOFFA
Politecnico di Torino, Torino

Mr. J. CHADJIVASSILIADIS
Public Power Corporation, Athens

Dr. H.-J. STOECKER
KFA-PLE, Jülich

Prof. D. WEAIRE
Trinity College, Dublin

Prof. C. WEHENKEL
Institut Supérieur de Technologie, Luxembourg

2. Reactor Safety

Chairman: Dipl.-Ing. A. BRANDSTETTER
Interatom, Bergisch-Gladbach

Prof. Dr. J.A. GOEDKOOP
Rijksuniversiteit, Leiden

Prof. A. JAUMOTTE
Université Libre de Bruxelles, Bruxelles

Mr. G. MALHOUITRE
Electricité de France, Chatou

Dr. B. TOMKINS
U.K.A.E.A., Risley

Prof. G.B. ZORZOLI
ENEA, Roma

3. Radioactive Waste Management
Safeguards and Fissile Materials Management
Nuclear Fuels and Actinides
(Nuclear Fuel Cycle)

Chairman: Mr. A. GAUVENET
Independent Consultant, formerly Electricité de France, Paris

Dr. H. ESCHRICH
Eurochemic, Geel

Prof. A.R. MACKINTOSH
H.C. Oersted Institutet, Copenhagen

Dr. H. ROMETSCH
NAGRA, Baden

Prof. L. VAN HOVE
CERN, Genève

Dr. J.K. WRIGHT
Central Electricity Generating Board, London

Mr. M. ZIFFERERO
IAEA, Vienna

4. High Temperature Materials

Chairman: Dr. R.J.E. GLENNY
Independent Consultant, formerly - RAE Farnborough

Prof. H. BOHM
KfK, Karlsruhe

Prof. P.J. GELLINGS
Technische Hogeschool, Twente

Prof. P. GOBIN
Université de Limoges, Limoges

Dr. G. LANZAVECCHIA
ENEA, Roma

Prof. C. NICHOLAIDES
Hellenic Research Foundation, Athens

5. Nuclear Measurements and Reference Materials

Chairman: Dr. N. HANSEN
Risø National Laboratory, Roskilde

Prof. H.J. ACHE
Kernforschungszentrum, Karlsruhe

Dr. D. BROWN
Atomic Energy Research Establishment, Harwell

Dr. A. MICHAUDON
Institut Max von Laue-Langevin, Grenoble

Prof. J. YOCCOZ
C.N.R.S., Paris

6. Fusion Technology and Safety

Chairman: Prof. M. HAINES
Imperial College of Sciences & Technology, London

Prof. N. CABIBBO
Istituto Nazionale Fisica Nucleare, Roma

Mr. J.G. CROCKER
EG & G Idaho Inc., Idaho Falls

Mr. LECOMTE
FRAMATOME, Paris

Mr. E. MERZ
KFA, Jülich

7. Remote Sensing

Chairman: Mr. R. GIBSON
British National Space Centre, London

Mr. G. BRACHET
Centre National d'Etudes Spatiales, Toulouse

Prof. F. CAMBDU
EARSEL, Toulouse

Mr. G. DUCHOSSOIS
European Space Agency, Paris

Prof. L. GUERRIERO
C.N.R., Roma

Prof. Dr. G. KONECNY
Universität Hannover, Hannover

Dr. L. MEREDITH
Goddard Space Flight Research (NASA), Maryland

8. Environment

Chairman: Prof. Dr. G.M. FULGRAFF
formerly - Secretary of State, Health Ministry, Berlin

Mr. D.C. ABBOTT
Laboratory of the Government Chemist, London

Prof. L. GIANNICO
Ministero della Sanita, Roma

Prof. J. JACQUET
Electricité de France, Paris

Prof. A. NOIRFALISE
Centre d'Ecologie Rurale et Forestière, Gembleux

Prof. J.H. KOEMAN
Agriculture University, Wageningen

ANNEX III (1)

JOINT RESEARCH CENTRE, GEEL ESTABLISHMENT
MID-TERM REPORT TO SCIENTIFIC COUNCIL JANUARY 1986

SCOPE AND OBJECTIVES OF THE PROGRAMME

The research programme of JRC Geel CBNM called "Nuclear Measurements and Reference Materials" belongs to the Research Action Programme "Industrial Technologies".

The objectives of the project Nuclear Measurements are:

- to improve the quality of nuclear data for standards
- to extend the neutron data bases required in the EC for fission power development
- to measure differential neutron data for the development of NET (Next European Torus) and to coordinate this with similar neutron data evaluation activities in Europe
- to measure radionuclear decay of nuclides
- to determine neutron flux and dose absorbed by humans.

The project Reference Materials is concerned with nuclear and non-nuclear reference materials.

The objectives in the area of nuclear reference materials are:

- to provide certified EC reference materials for analyses in the fuel cycle, for reactor dosimetry and for measurement of environmental radioactivity
- to provide targets and samples for nuclear research and reactor dosimetry
- to collaborate in interlaboratory measurement evaluation programmes to improve the quality of analytical measurements within the EC
- to improve existing techniques to meet the increasing requirements for accuracy
- to develop new analytical methods.

The objectives in the area of non-nuclear Reference Materials are:

- to utilize CBNM's expertise in the nuclear field for non-nuclear reference materials
- to support BCR activities.

In addition support is given to the Commission, mainly as assistance to various aspects of safeguards.

RESULTS 1984-1985

The milestones of the two projects "Nuclear Measurements" and "Reference Materials" are indicated in the planning tables attached to this report.

The shaded areas represent the parts of the programme realized on December 1985.

The highlights are mentioned below; the different activities are indicated with the same symbols as in the planning tables.

Nuclear Measurements

a) **Nuclear Data**

A. Nuclear Data Standards

The $^{235}U(n,f)$ standard cross-section was investigated up to 6 MeV neutron energy for fission fragment angular-, mass-, and kinetic energy distributions. The results allow for a better understanding of the fission process.

The spectrum of spontaneous fission neutrons of ^{252}Cf is widely used as a standard spectrum, but the nature of the fission neutrons is not well known and the theoretical representation of the spectrum is uncertain. Therefore a detailed measurement of the spectrum contributions as a function of the fission fragment parameters was performed.

The determination of the $^{235}U(n,f)/H(n,p)$ cross-section ratio to better than $\pm 3\%$ was found to be feasible providing a sufficiently homogeneous CH_x-radiator, with accurately known hydrogen content, is available.

B. Data for Fission Technology .

A cold moderator of liquid methane, installed at the linear accelerator, was used for low-neutron energy (1 meV - 1 eV) measurements of $^{235}U(n,f)$, $^{238}U(n,\gamma)$ and η of ^{235}U. Final data for $^{235}U(n,f)$ and $^{238}U(n,\gamma)$ are expected in 1986. The η -experiment at the Linac will be followed by an experiment at a reactor beam guide in order to have better background conditions in the thermal energy range.

The resonance parameters of three separated iron isotopes were analysed (except for one important ^{56}Fe resonance).

Resonance parameters for about 350 resonances of three separated Cr isotopes were determined.

The $^{241}Am(n,\gamma)$ and the $^{243}Am(n,f)$ cross-sections in the keV and MeV energy range respectively were determined.

C. Data for Fusion Technology

The pulsed white neutron source of the linear accelerator obtained with a U-Hg target was used to determine the double-differential emission cross-section of ^{7}Li. To improve the statistical accuracies for higher primary neutron energies these measurements will be complemented by runs using a U-Be target. A method was developed to determine for ^{7}Li angular distributions of inelastically scattered neutrons (Q = -478 keV) by analyzing Doppler-broadened γ lines.

b) Nuclear Metrology

D. Nuclear Metrology

A ^{93m}Nb solution was standardized by liquid scintillation counting in an international exercise for use as a reference material for reactor neutron dosimetry. Also the KX-ray emission probability was determined with much better accuracy.

A technique was developed for the preparation and standardization of efficiency-calibration sources for quantitative X-ray measurements with Si(Li) detectors below 5 keV. 1.5 keV Al KX-rays, excited by the 5.9 keV Mn KX-rays (emitted in the decay of ^{55}Fe) were measured in a gas-flow proportional counter.

CBNM participated in two international intercomparisons organized by BIPM and measured the activity concentration of a ^{133}Ba and a ^{109}Cd solution, which lead to a more accurate assay of these two nuclides.

Monoenergetic neutrons are available from CBNM's 7 MV VdG-accelerator for energies between 0.2 and 20 MeV. Standardized techniques to measure the fluences by recoil proton detection in proportional or telescope counters were checked by associated particle counting. Interlaboratory comparisons at 0.5, 1, 2.5, 5 and 15 MeV neutron energy add additional confidence to the accuracy. Experience was acquired in ionometric dose determination and applied to neutron irradiations of biological samples.

A graphite calorimeter for gamma-ray dose measurements was constructed and is operational. A tissue-equivalent plastic calorimeter is under construction for neutron dosimetry. Tests are going on for a water calorimeter.

Reference Materials

a) Nuclear Reference Materials

A. Nuclear Reference Materials

EC-NRM 171, ^{235}U isotope abundance certified reference material for gamma spectrometry was prepared and assayed in collaboration with NBS. In 1980 the project started at CBNM. The preparation of the 700 reference samples (sealed cans) was followed by an intensive testing and characterization work in the following years at CBNM and NBS. A positive advice was given by the Nuclear Certification Group in December 1984 and the EC-Certificate was issued by CBNM in June 1985.

The Euratom Working Group on Reactor Dosimetry identified in 1982 the EC needs for reference materials for neutron dosimetry. The goal is to standardize European measurements. CBNM started with the procurement and conditioning of the first materials, and coordinated the characterization activities. At the end of 1985 two RMs can be offered: Ni with very low Co content, and $^{238}UO_2$ spheres with very low ^{235}U content.

B. Nuclear Targets and Samples

Since 1980 about 3500 special samples and targets were prepared, characterized and delivered to requestors from national organizations, industries and universities. Only samples and targets which are not commercially available were prepared.

b) **Non-Nuclear Reference Materials**

D. Surface Reference Materials

In 1985 accurate Au layer thickness standards were prepared at CBNM by deposition in ultra high vacuum (UHV) and by weighing the deposit in situ using a UHV balance. These absolute standards will be used in a Bureau Communautaire de Référence (BCR) project aiming at the establishment of working standards for industrial Au coating measurements.

E. Support to BCR

40.000 reference materials of BCR stored at JRC-Ispra and JRC-Petten were transferred to Geel. Connected with the storage is the dispatching of these reference materials to customers (700 RMs in 1984, 839 RMs in the first semester of 1985). In parallel the preparation of the conditioning work for biological material started. All activities will be concentrated in a special building of which the construction is being finished.

c) **Support to the Commission**

Guided by CBNM and KfK, and in collaboration with NBS, a large-scale measurement evaluation programme on the determination of element and isotope content of input samples of reprocessing plants was carried out. 33 laboratories of 15 countries or international organizations participated under the auspices of the European Safeguards Research and Development Association (ESARDA) and with the support of the International Atomic Energy Agency (IAEA). 60.000 analytical data were evaluated and the final report (3 Volumes) was published in 1985.

PROBLEMS

Nuclear Measurements

- In the field of "Nuclear Data for Fusion Technology" measurements were delayed due to:

  - difficulties during the construction by an external firm of the U/Be target,
  - changes in the construction of the Van de Graaff building (a change in priority in favour of Surface Reference Materials).

- It was not possible to allocate qualified staff for the mass spectrometric determination of the atomic weight of silicon. The activity will be delayed by at least one year.

Reference Materials

- The preparation of plutonium elemental reference materials was delayed by four years due to difficulties in obtaining plutonium base material.

- The preparation of PuO_2 gel-spheres for Pu isotopic reference materials which is being carried out at JRC Karlsruhe was delayed, but the situation has now significantly improved.

- In the overall execution of the project lower priorities were given to the activities "RMs for biological materials", expecially to "Low level RMs". This management decision is based on two considerations:

  - newly engaged staff had to be trained to obtain expertise in the field, and

  - the specifications, the construction and the financing of a clean lab (to be used for biological RMs) had to be re-examined and final approval for its realization still has to be obtained.

- The three additional posts foreseen for "Support to BCR" could only be allocated and partly filled during the year 1985, instead of at the beginning 1984. This caused delays in the work of "Nuclear Targets and Samples" and "Support to BCR".

CONCLUSION

The Direction of JRC Geel considers at this moment to interrupt temporarily activities in the field of "Low level RMs'". This activity which is also proposed for a future multiannual programme will be rediscussed during the second half of 1986.

All other programme items will be continued.

PROGRAMME: Nuclear Measurements and Reference Materials — PROJECT LEADER: A. DERUYTTER

PROJECT: Nuclear Measurements

GOAL: Measurement of nuclear data for fission and fusion technology and development and application of nuclear metrology

TITLE OF OBJECTIVES	ACTIVITIES	PLANNING 1984	1985	1986	1987
a) Nuclear Data					
A Nuclear data standards	1. Neutron data standards	1	2	3	
B. Data for fission technology	1. Measurement of cross sections of actinides	1	2	3	
	2. Measurement of cross sections of structural materials		1	2	3
C Data for fusion technology	1. Measurement of neutron emission cross sections (^{7}Li, Pb, Be)	1	2, 3		
b) Nuclear Metrology					
D. Nuclear Metrology	1. Metrology for radioactive decay		1	2	
	2. Neutron Dosimetry	1		2	
E. Atomic Weight of Silicon	1. Measurement of isotope abundances of Si				1

MILESTONES

The work consists of a large number of individual tasks, each of which will be sustained through the programme until completed. The time table below only gives the planned realisation dates for some major data requirements and for equipment and facilities having a major impact on the execution of the programme.

IDENTIFICATION

a) Nuclear Data

A.1 1 Measurement of fission fragment angular distribution of ^{235}U.
A.1.2 Study of the ^{252}Cf fission neutron spectrum as a function of the fission fragment emission angle and also as a function of fission fragment mass and energy.
A.1 3 Measurement of ^{10}B(n,α) relative to H(n,p).

B 1 1 Commissioning a cold moderator at the Linac in view of the shape measurements of the capture and fission cross-sections of ^{235}U and the capture cross-section of ^{238}U in the neutron energy range 0.002 eV to 1 eV (start of the measurements).
B.1.2 Availability of low energy shape of η and σ_f for ^{235}U and σ_γ for ^{238}U in view of solving the discrepancy between calculated and measured values of "the temperature" coefficient of thermal reactors
B.1.3 Accurate measurement of the ^{239}Pu(n,f) cross-section.

B.2 1 Availability of resonance parameters from mainly capture cross-section measurements for separated isotopes of the structural materials Fe and Cr.
B.2.2 Availability of resonance parameters from mainly capture cross-section measurements for separated isotopes of the structural material Ni.
B.2.3 Commissioning of a detector system for inelastic neutron scattering cross section measurements on structural materials, installation of a high resolution detector station for capture γ-ray measurements in neutron resonances of structural materials.

C.1 1 Commissioning of a suitable (U-Be or Ta-Be) target for fusion data measurements at the Linac
C.1 2 Availability of double differential neutron emission cross-sections for ^{7}Li for fusion neutronics calculation
C 1 3 Commissioning of a "white source" of neutrons for fusion data at the Van de Graaff

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b) Nuclear Metrology

D.1 1 Production of low X-ray standard sources for the calibration of Si(Li) detectors between 1 and 5 keV
D.1 2 Completion of a 4π(pc)-γ coincidence counting system for standardization of radionuclides decaying by electron capture

D.2 1 Availability of a standardized neutron flux with monoenergetic neutrons at the Van de Graaff to be used as a calibration facility
D.2 2 Commissioning of a tissue-equivalent calorimeter at the Van de Graaff

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E.1 1 Availability of an improved value for the atomic weight of silicon, to contribute to a better value of the Avogadro constant

PROGRAMME: Nuclear Measurements and Reference Materials

PROJECT LEADER: R. LESSER

PROJECT Reference Materials

GOAL Preparation, analyses and distribution of reference materials

TITLE OF OBJECTIVES	ACTIVITIES	PLANNING 1984	1985	1986	1987
a) Nuclear Reference Materials					
A. Nuclear Reference Materials	1. RMs for elemental analysis			1	2, 3
	2. RMs for destructive isotope analyses			2	1
	3. RMs for non destructive isotope analyses		1		
	4. RMs for reactor dosimetry		1	2	
B. Nuclear Targets and Samples	1. Preparation and analyses of targets and samples	1	2	3	4
b) Non-nuclear reference Materials					
C. RMs for biological materials	1. Traces of metals in biological materials			1	
	2. Low level RMs				1
D. Surface reference materials				1	
E. Support to BCR	1. Preparation and analyses of samples	1		2	
	2. Distribution of samples	1		2	
MILESTONES					

IDENTIFICATION

A.1.1. EC-Certification of a first series of "Uranium minerals and ores for the elemental assay of uranium".
A.1.2. EC-Certification of a second series of "Uranium minerals and ores for the elemental assay of uranium".
A.1.3. EC-Certification of "Plutonium reference materials for the elemental assay of plutonium".

A.2.1 EC-Certification of "Plutonium reference materials for isotopic assay by mass spectrometry"
A.2.2 EC-Certification of "Uranium reference materials for isotopic assay by mass spectrometry".

A.3.1. EC-Certification of a set of "^{235}U abundance reference materials for gamma spectrometry"

A.4.1 EC-Certification of a first series of "Reactor dosimetry reference materials".
A.4.2 EC-Certification of a second series of "Reactor dosimetry reference materials".

B.1.1. to B.1.4. Annual Report on preparation and analyses of samples and targets.

C.1.1 Isotope dilution mass spectrometry technique developed for the determination of a first series of trace elements in biological materials.

C.2.1. Characterization of natural matrix materials for low level radioactivity.

D.1 Production of reference surface layers.

E.1.1 Start of Construction of BCR building.
E.1.2 BCR building in service.

E.2.1 Ongoing activity
E.2.2 Ongoing activity

ANNEX III (2)

JOINT RESEARCH CENTRE, ISPRA ESTABLISHMENT
MID-TERM REPORT TO SCIENTIFIC COUNCIL JANUARY 1986

A. Introduction

This report summarizes the highlights of the work done at Ispra during 1984 and 1985 for the 1984/87 multiannual research programme. More detailed accounts are found in the semestrial programme progress reports or the numerous specialised communications, which average about one thousand per year and are listed in an annual Publications Bulletin. For comparison with the Yellow Book, Second Editon, the report is arranged according to the project areas, but is too short to be taken as a detailed verification of intention and result.

In general the upheaval caused in the nuclear domain by the cession of SSTP has been surmounted and the new projects such as PERLA, PETRA, PISC are firmly established. Medium size installations like LDTF and FARO were commissioned in February 1985. The new programme Industrial Risk has taken on significant proportions.

Although the programme was launched by the Council decision of December 1983 there were left unsaid or unclear some elements which slowed up progress. The complement of 2260 posts was not immediately available, the project of European significance was not chosen, the pre-pension exercise was not approved. Through various vicissitudes, including a period of provisional twelfths for the budget, these matters were not resolved before July 1985.

B. Progress and Achievements

B.1. Fusion Technology and Safety

Reactor studies

In the area of components design the Ispra concept of a first wall, constituted by a tight box enclosing the breeding blanket and separately cooled, is now accepted as a basic solution for the NET-design. Technological tests are in progress in collaboration with industry. The $^{17}Li^{83}Pb$-water cooled breeding blanket on which Ispra has worked for several years is now accepted as the reference concept for the liquid breeder option in the NET studies.

Structural Materials Studies

In the area of thermo-mechanical behaviour of the first wall under cyclic heat load Ispra has acquired a leading position in Europe. Thermal fatigue experiments on tubes have been completed and tests on the NET-first wall panel with thermal fluxes up to 0.5 MW/m^2 are in progress.

Creep and fatigue tests in the Ispra cyclotron on the NET-reference SS 316-L type of steel are now advanced in data collection and the first results look promising. In general the cyclotron operation, involving also irradiations for outside organisations, has been quite satisfactory.

The test performed in 1984 at the HFR in the frame of the IEA-Implementing Agreement on the so-called Oak Ridge matrix of stainless steel has been considered by the non-European partners to be of vital interest.

The now completed characterisation of the commercial Mn-Cr austenitic steel supplied by Creusot-Loire (AMCR) has shown that this steel looks attractive from the point of view of mechanical strength as compared to SS 316-L up to 500°C. At higher temperatures the mechanical properties of such steels are strongly influenced by deformation-induced transformation from the austenitic to the martensitic phase. This experimental fact suggests the need to reduce the Mn-content. This corrected composition is being defined together with our British colleagues (Culham). In general the interest in Europe for Mn-Cr steels as low activation materials has been markedly increased in recent years due to Ispra work.

The conceptual design of a spallation neutron source, intended to simulate the fusion neutron damage in first wall materials, has been completed and the results submitted to the European Fusion Technology Committee for further action.

Breeding Blanket Studies

Acquisition of the physical and chemical properties of $^{17}Li^{83}Pb$ for the data base entrusted to Ispra, is now almost finished. Relevant experimental results have been obtained by measurements of the H_2-solubility and the study of the role of impurities (oxygen and nitrogen) on the compatibility with steel.

Risk Assessment

Significant results have been obtained in simulating by an electron gun the thermo-mechanical effects of a plasma disruption on the first wall. It has been shown that coatings (such as TiC) can prevent the instability of the melted layer of the structural materials (steel) in contact with the vacuum of the torus. The water-$^{17}Li^{83}Pb$ interaction experiments on small scale specimens (shock-tubes) performed in 1984 have led to a first evaluation of the pressure peak and wave propagation in case of a coolant tube rupture in a liquid breeder blanket.

Tritium Laboratory Studies

The feasibility contract awarded to several European organisations in 1984-85 have been very useful for the definition of the technical specifications of the laboratory, the construction of which has been decided by the Council (July 1985).

B.2. **NUCLEAR FISSION**

B.2.A. Reactor Safety

The Council's Decision (December 1984) to charge the JRC with the management of the Shared Cost Actions (SCA) has implied a considerable amount of work from the programme management and the scientific divisions, but it has also allowed the extension of the JRC programme and more intensive collaboration with the national institutions.

The main results in the different research areas (direct actions) are as follows:

Reliability and Risk Evaluation

The first phase of the Benchmark Exercise on Common Cause/Mode Failure Analysis, consisting of a review of the different applied methodologies, has been completed in 1985. Concerning the items of the European Reliability Data System: the Abnormal Occurrences Reporting System is now operational with a large amount of data supplied by different countries: Data for the Component Event Data Bank have been supplied by several utilities. In common with data suppliers, a pilot exercise is under way in order to define by 1986 the operational rules and data analysis procedures.

Considerable progress was made with the project of a System Response Analyser, a tool by which safety and system designers will be able to perform time-dependent system dynamic analysis taking into account the behaviour of the operator. In particular the simulation of the Auxiliary Feed Water system and the application of the DYLAM methodology to operator intervention modelling were successfully made.

PISC

The PISC II round robin test was successfully completed in 1985 with a detailed evaluation of the results. The new exercise PISC III has been defined and agreed at OECD level in 1985. Hot laboratories have been equipped for the comprehensive, non-destructive examination of contaminated structures.

LWR Primary Circuit Component Life Prediction

After completing the installation of the structural reliability laboratory the tests on the first 1/5-scale pressure vessel model were started in 1984 (hydrotests, inspections, etc.). A first version of the end-of-life prediction code RELIEF has been completed and is being assessed. The code ELISA for surface strain measurement by laser interferometry has been developed and validated.

Study of Abnormal Behaviour of LWR Cooling Systems

After the recommissioning of the test facility LOBI-MOD2, which has been considerably modified and upgraded for the Small Break and Special Transient tests, the experimental programme was restarted in April 1984.

To date, a total of 11 tests of the LOBI-MOD2 programme (small break, special transients, natural circulation, secondary cooling system, etc.) have been successfully performed, comprising the OECD international standard problem N° 18 (ISP-18). A large amount of test documentation has been produced and analysis work carried out. The US RELAP-5-MOD1 code has been assessed and considerably improved (version RELAP-EUR).

The assessment activity on the two European codes CATHARE and DRUFAN was successfully started.

Source Term

The period 1984-85 has been mainly used to identify the unsolved problems and the research needs in the Community. Some of the existing codes for the source term calculation (in particular for the study of fission product and aerosol behaviour in PWR containment) have been installed at the JRC and used for comparative calculations and model assessment.

The contract for the JRC participation in the international programme LACE (LWR Aerosol Containment Experiment) has been agreed at the end of 1985.

LMFBR Accident Analysis

A new improved version of the European Accident Code (EAC) was released to the Member States in 1985. The Na boiling test with wire spaced short bundle, and part of the transient tests on PEC bundle have been performed. The analysis of results is under way.

Concerning the operation of the FARO facility, melting of a large UO_2 mass has been reached several times: in the last two tests release of part of the molten UO_2 in the test section has been obtained, although the experimental procedure has to be improved.

The analytical tools (JOULE, PLUG, PHEAT) developed for FARO test analysis have been improved and documented. The DYNJET code for plate perforation by UO_2 jets has been completed and is being tested and validated with the available experimental data.

PAHR In-Pile

The tests at SANDIA (US) were concluded in 1985. Important results on the UO_2 bed coolability in presence of Na at high temperatures have been obtained. A first scoping test (without UO_2) was performed at Grenoble in 1985. The research programme in support of the European tests (material at high temperature, instrumentation, 2D code development) gave very good results. The preparation of the irradiation tests G1 at Grenoble and M1 at Mol suffered a few months of delay and are expected in the first half of 1986.

LMFBR Material Properties and Structural Behaviour

The experimental tests of the IDEAS programme (fracture toughness of irradiated stainless steel) are almost completed and the analysis of results is under way.

The Large Dynamic Test Facility has been extensively operated and dynamic tests on austenitic steel specimens of different shapes have been started.

Shared Cost Action

Concerning the SCA's, the programme has been defined in detail during 1985, a series of calls for proposals appeared in the Official Journal and, after discussion with CGC-5, several contracts have been launched, in particular part of those related to PISC and the contracts for the participation in the in-pile test programme on local subassembly accidents at SCARABEE and BR2-Mol.

B.2.2. Radioactive Waste Management

Waste Management and the fuel cycle

The setting up of PETRA is proceeding according to plans. A 6-month delay in the decommissioning of the ESTER-1 plant, due to a contamination of the cell's front face, can be partially overcome by rearrangement of successive actions.

The pneumatic channel to transfer active samples from PETRA to the radio-analytical laboratories in building 46 was installed.

PETRA is expected to start active operation in spring 1987 (three months delay as compared with original planning).

Safety of waste disposal in continental geological formations

The PAGIS action (Performance Assessment of Geological Isolation Systems) has entered into its second phase (calculation of doses and probability of exposure). PAGIS is jointly coordinated by JRC and the shared-cost action programme with participation of the most important national laboratories.

A similar project structure, with participation of JRC in the coordination, is being set up for the MIRAGE project (MIgration of RAdionuclides in the GEosphere).

The computer code LISA for probabilistic risk assessment is fully operational and has been transferred to several European laboratories involved in the PAGIS action. An intercomparison with the Canadian code SYVAC is under way.

Laboratory studies on the degradation of conditioned waste in geological disposal conditions and on radionuclide migration are proceeding according to schedule, with the main emphasis on the behaviour of Np, Tc, Am and Pu as risk-determining radionuclides.

Feasibility and safety of geological disposal in deep oceanic sediments

In the framework of the NEA seabed working group the JRC participated in the international cruise ESOPE for site characterisation of the two study zones in the Atlantic (the Great Meteor East and the Nares Abyssal Plain), with contributions to on-board geochemical characterisation and to data transmission from penetrators.

B.2.3. Safeguards and Fissile Material Management

Methods and Instrumentation for the Assay of Fissile Materials and Containment and Surveillance

In the field of destructive assay, after a successful development of a quadrupole mass spectrometer for UF_6 samples, a second type of instrument has been tested on Uranium Oxide samples in a fuel fabrication plant.

The main effort in this research area has been dedicated to the design of the PERLA laboratory, for which the licensing procedure has now started.

In the meantime the PREPERLA laboratory has been constructed and will be ready for use in March 1986.

As to the area of containment and surveillance, the main results are related to the development of ultrasonic sealing systems for BWR fuel assemblies.

Safeguards Data Processing, Transmission and Evaluation

The local area network, linking the various computing facilities dedicated to the safeguards programme, has been installed in 1984 and is now used by four different laboratories for software development and for the demonstration of an integrated safeguards data evaluation system.

Furthermore, very encouraging results were obtained in the development of an on-line computer based automatic image processing system. This has lead to specific requests from DCS and IAEA for their image examination procedures.

Integration of Safeguards Activities

For the examination of the material accountancy data from plant operators, the IAEA data base has been interfaced with a statistical accountancy package developed at Ispra.

IAEA has requested an important extension of this activity for the future.

First laboratory results were obtained in the field of image understanding with artificial intelligence and remote operation using robots for verification of nuclear materials storage areas.

B.3. NON NUCLEAR ENERGIES

Photovoltaic System

Conclusion of the acceptance tests of sixteen EC photovoltaic pilot plants have been carried out. For this purpose a new portable instrument for electronic load measurement was designed and an automatic data acquisition system was set up.

Specification 502 for Qualification Test Procedures for Photovoltaic Modules has been published. This is an updated version of Specification 501, resulting from two years of experience in qualification testing of commercial modules.

JRC has been designated as the Operating Agent for a collaborative project on photovoltaic solar energy under the Industrialised Countries Summit Working Group on Technology, Growth and Employment. Monocrystalline, polycrystalline, amorphous silicon cells, delivered from Japan, Italy, France, Germany and the USA, were tested in the period July 1984 - May 1985. Pre-and post campaign measurements were performed at Ispra and after an experts' meeting in September 1985 a final report with conclusions and recommendations was published by the JRC.

Thermal Conversion

The JRC has initiated a new phase of activity of the European Collector and Systems Testing Group, comprising some twenty laboratories. Main subjects of the coordinated research programme are the development of test procedures for air collectors, unglazed collectors and for domestic hot water systems, together with studies on durability and reliability.

Correlation testing was carried out in fields for durability testing of the thermal collectors, CTF-1 (clean air reference test field at Ispra) and CTF-2 (industrial atmosphere close to a power station in Lombardy).

Ispra collaborated in the work of a special commission to the UEATC (European Union of Agreement grouping the Official standards organisations of several European countries), involved in the preparation of directives for solar thermal collectors to be used in buildings. A document was completed in 1985 and is submitted to the procedure for formal approval.

Energy Management in Habitat

A technico-economic optimisation method for hybrid systems involving heat pump and seasonal storage was developed. This method is based on a parametric approach and determines the range of costs of the solar components within which such systems remain profitable. The optimisation methodology was applied to "case studies" in the frame of Task VII of the IEA-Solar Heating and Cooling Cooperative Programme.

The first prize in the selection of posters at the biannual International Congress INTERSOL 85, Montreal (Canada), with a report on seasonal storage in the ground, was awarded to JRC Ispra.

For the IEA cooperative programme on Energy Conservation in Buildings the JRC, as leader of a sub-task, organised an experts meeting at Ispra of Task XI, Energy Auditing, on 15 - 18 October 1984, and is preparing a "Source Book for Energy Auditing".

B.4. ENVIRONMENT

B.4.1. Environmental Protection

ECDIN

The semi-operational marketing study for ECDIN (Environmental Chemicals Data Information Network) has been successfully concluded after a two-year test period resulting in an increasing use of ECDIN by paying users. A restricted and provisional EINECS inventory, covering more than 95% of the final content, is now available for Member States authorities to handle the 6th Amendment of the 67/548/EEC directive.

Indoor Air Pollution

The relevance of indoor air quality assessment has been clearly demonstrated by JRC results indicating indoor concentrations of volatile organic compounds consistently higher than outdoor concentrations by a factor of 2 to 10. Preparatory work for the validation of exposure models and the design of an indoor test facility has started. A major achievement is the drafting of a working protocol for indoor pollution emission measurements.

Air Quality

The negligible role of CO as precursor for the photochemical ozone formation has been confirmed and the role of nitrogen oxides as promotors for this reaction evaluated. The rate constant of the reaction CO + NO_3 under tropospheric conditions has been determined.

Central Laboratory Air Pollution

A "Central Laboratory for Air Pollution Measurements" has been set up for the implementation of the EC 80/779 Council Directive on limits and guidelines for SO_2 and suspended particulates. A reference method for SO_2 is now well established and an intercomparison method for SO_2 and particulates has been performed within Member States. A monitoring station for atmospheric pollutants is now routinely run at JRC Ispra.

Pollution Mass Balance and Transport

Air mass trajectories have been determined in many field experiments (Baden-Württemberg, Toscany and Switzerland) by SF_6 tracer techniques which now operate routinely in the 50 km range. The analysis of the new perfluorcarbon tracers is now available and first field tests have been started at Ispra.

The participation in and sponsoring of the TULLA project (mass balance of atmospheric pollutants in Baden-Württemberg) permitted to accomplish a project of real European dimensions. JRC has been directly involved with its mobile teams on tracers and correlation spectroscopy and sponsored, in collaboration with DG XII/G, airborne measurements. The field campaign was successfully concluded in March 1985.

Isotopic Sulphur Experiment

A feasibility study for an isotopic sulphur experiment around an oil fired power station was successfully concluded. The planification of a regional scale experiment with enriched S34 tracers has been stopped as budgetary and organisational questions are still unresolved.

Ispra Mark 13A and desulphurisation

The Ispra MARK 13A process for flue gas desulphurisation entered a new phase with the decision to construct and operate a pilot unit for the desulphurisation of the through-put of 20.00 m^3/h flue gases of an Italian refinery. Laboratory work for a combined desulphurisation/denoxing process has been delayed as technical difficulties for the choice of a suitable catalyst were encountered.

Trace Metal Pollution

Work on "Exposure & Health Effects of Trace Metals" progressed according to planning. The ultraclean laboratory technique for sampling, handling, storage and biochemical fractionating of human tissues is in an advanced development stage. Report on the metabolism of As, Tl and V for laboratory animals are available.

Trace Metal concentrations (As, Sb and Se) in fly ash leachates have been determined and the dynamic environmental model for the transfer of chromium from a fly ash depository to man via soil/groundwater/foodchain now also considers the chemical specification of this element.The Athens lead experiment, although progressing well, has been partially delayed by organisational constraints. The issue of the final report of the Isotopic Lead Experiment (ILE) is postponed to 1986.

Water Quality

For the "Water Quality" activity the determination of the trophic level of the Lago Maggiore/Monvallina test site is almost completed and a sufficient data base on the trace metal concentrations in the rivers, the bay and sediment is available.

The ecotoxicity studies in fresh water under seminatural conditions (enclosure technique) yielded results on the synergetic and antagonistic effects of the trace metals Cd, Zn and Cu on fresh water communities.

B.4.2. Applications of Remote Sensing Techniques

Rural Land Use in less-favoured areas (LFA)

A collaborative program associating laboratories and institutes of all the Member states with this project has been set up. Three working groups are operating since mid-1985. The first large scale soil occupation inventory (district "Ardèche") has been initiated, using TM-Landsat 5 imagery and ground truth surveys, conducted by the French Ministry of Agriculture.

Agricultural Production in Sahelian Countries

The development of the hydrological model of the Niger flood has been continued, both by the method of the indicator pools observable by satellite and by the method of watershed analysis and modelling. The data collecting platform installed at the site of Kankan (Guinea) is operating and transmitting via Meteostat 7 hydroagrometeorological variables to Conakry (Guinea) and JRC Ispra.

Oil Slicks detection: exercises at Sea

At the same time that the final report Archimedes-1 (Netherlands, 1984) was issued, the Archimedes-2 exercise took place in October 1985 near Heligoland (F.R.G.). While Archimedes-1 was mainly devoted to the use of microwave radiometers for oil slick thickness measurements, Archimedes-2 has put emphasis on the use of a synthetic aperture radar. Both reports, after issue of Archimedes-2 in 1986, will permit a complete view of oil detection problems.

Coastal Transport of Pollution

The final report on the campaign Adria-83 has been published. The hydrodynamic 3 D-model of the Northern Adriatic is working in the passive mode and is being confronted with typical situations observed by the coastal zone colour scanner of the NIMBUS-7 satellites and processed so as to extract thematic maps of suspended matter and chlorophyll.

Laser-induced fluorsensor

The original principle of fingerprinting hydrocarbons by their spectral and temporal fluorescence response to a short laser pulse having been demonstrated, a prototype of an airborn instrument is under development.

SAR-580 Campaign

Publication in July 1985 of the final report: general conclusions (Vol. 1) and individual contributions (Vol. 2).

B.4.3. Industrial Risk

Industrial Systems Safety and Reliability

The idea of a common exercise on safety analysis of a "benchmark" plant pursued within ESRA (European Safety and Reliability Association) and other European institutions confirmed the interest in starting an activity in this direction. A first workshop has been organised in which significant case studies, already studied elsewhere, have been critically analysed and objectives and content of the exercise discussed. JRC has been requested to develop a benchmark proposal for 1986.

As far as the implementation of the Major Accident Reporting System (post-Seveso directive) is concerned, criteria for incident reporting have been finalized and the collection forms accepted by the Member States Competent Authorities. The layout of the bank has been designed and the development of the relevant software will be started in 1986.

Structural Safety and Reliability

This activity has been focussed on tests on aged components. It is envisaged to insert our activity in joint European programmes such as the "Joint programme" led by British Petroleum and concerning full scale tests to failure of three big pressure vessels (cat reformers) after twentyfive years of operation in a refinery. JRC is involved in the evaluation of the results and in laboratory tests on specimens taken from the vessels.

Management of Risk

A book on Regulating Industrial Risk has been edited by Butterworths (London & Boston) in October 1985.

The structure and design of a software system to support the management of hazardous substances has been defined. The integrated software system has been completed as a demonstration prototype to implement several working examples of the methods and approaches that have been proposed.

Dispersion of Chemicals

A collaboration between JRC and ENI ((Ente Nazionale Idrocarburi, Italy) on the project FIREXP has been started aiming to study the dispersion of flammable materials, the effectiveness of forced dilution techniques, the modelling of industrial fires and the transient overheating of vessels and structures.

Chemical Waste

Steps to develop a decision support system for the management of super-toxic compounds based on actual data from the Seveso accident have been started. The first module of the system concerned with "Identification of the Threat" is under development.

Protection against Runaway Reactions

A round table discussion on the chemical aspects of runaway reactions (with experts from the Member States) has contributed to define topics and dimension of a possible activity of the JRC in this field. Attention was focussed on comparison and validation of different test methods for bursting discs and pressure relief systems in general. Complementary research in the field on multiphase-multicomponent fluid flow has been started to provide basic understanding of prototypical phenomena and furnish quantitative data for the development of models.

C. SUPPORT TO RESEARCH

Improved support to research actions from the various Site services was the result of the restructuring they underwent. The extra wing to the Management building was completed and occupied in June 1985, thus releasing space long destined to renovation and to the concentration of some research groups. The computing centre was reinforced in December 1984 by the addition of a second Amdahl CPU, and a service bureau employed to give access to CRAY super computer facilities. The Establishment organised a number of international conferences in the fields of fusion technology (SOFT), Physico-chemical behaviour of atmospheric pollutants, safeguards and nuclear material management, solar central receivers, analysis design and evaluation of man-machine systems (IFAC), reactor safety (SMIRT post-conference seminars), a large number of specialised workshops and several Ispra courses. These actions lead to a constant, stimulating flow of international visitors who usually comment favourably on the researchers and the laboratory facilities.

D. Conclusions

The Establishment has done what was expected in the first two years of the program. There has been a significant improvement in working conditions which must be pursued in the interests of safety, hygiene and economy. The pre-pension scheme will permit a valuable incursion of young blood and some new competences into the staff-spectrum, but it will be an injection and not a panacea.

Our efficiency will be criticised as always, especially by those who cannot or will not understand our purposes. There is a risk of disappointing those who believed that the burden of procedural restraints would be relieved by the creation of the Board of Governors and the Scientific Council, since the European economic climate seems to vitiate the goodwill of the latter.

We must make greater efforts to demonstrate that our activities belie our reputation, and direct that effort to the quarters where is matters.

The major part of future research production will necessarily depend on the present collection of skills, competences and experience, and it is profoundly to be hoped that the level of resources will be maintained so as to conserve the momentum gained through many positive changes.

ANNEX III (3)

JOINT RESEARCH CENTRE, KARLSRUHE ESTABLISHMENT
MID-TERM REPORT TO SCIENTIFIC COUNCIL, JANUARY 1986

1. Structure of the Programme

In the framework of the Commission's "Research Programme Fission", the programme "Nuclear Fuels and Actinide Research", executed 1984-1987 by the European Institute for Transuranium Elements at Karlsruhe, consists of the projects Operation Limits of Nuclear Fuels, Transient Behaviour of Oxide Fuels and Fission Product Release under Severe Fuel Damage Conditions, Actinide Cycle Safety and Actinide Research.

2. Important Results

2.1. Optimisation of Dense Fuels

After ten years of operation the project "Swelling of Advanced Fuels" has been concluded during the first year of the present programme period.

With the results obtained, the knowledge about carbide fuels in the Community has attained a level which would allow the fabrication and irradiation of He-bonded carbide pins designed to reach a burn-up of about 12 a/o.

Early in 1985 a decision was taken to choose nitride fuel for fast breeder reactors as a subject of further study and to compare it with the performance of carbide fuel.

Work on nitrides has been started with the study and development of adequate fabrication processes. The evaluation of a short term irradiation experiment with carbide fuel has confirmed the previously established mechanisms of restructuring in dense fuels at the beginnning of pin life.

2.2. Properties of Reactor Materials at Very High Temperature

In the sub-project "Properties of Reactor Materials at Very High Temperatures", the theoretical and experimental investigations of the Equation of State of UO_2 was brought to an end. A combination of mass spectrometric, Langmuir probe and high tension diode studies, applied for the first time to the laser vaporisation process, resolved previous discrepancies between measured and calculated vapour pressures by an enhanced rate of evaporation due to ion emission. It has been shown that intrinsic ion emission can contribute to the net evaporation rate only if the resulting positive space charge can be neutralised, which can be accomplished by the presence of "hot" electrons in the plasma.

For a programme on the measurement of the specific heat and density of liquid UO_2, a first series of experiments involving pulsed multibeam laser heating, multi-wavelength pyrometry, microfocus X-ray shadow technique and TV monitoring for beam adjustment and profile detection was launched.

2.3. Transient Behaviour of Oxide Fuels

In the project "Transient Behaviour of Oxide Fuels" advances in modelling of fission product behaviour in the fuel lattice under the influence of a transient have been made together with improvements in the gap conductance and gas release sub-models of existing codes.

An investigation of the phenomenon of "centre retention" in a transient tested fuel was carried out by comparing sections from different positions. Replica electron microscopy has revealed variations in the population of gas bubbles in the different sections which could not be reconciled with EPMA observations.

Hot cell annealing experiments showed agreement with other out-of-pile gas release data and proved that this method can be employed for critical comparison with nuclear tests.

2.4. Formation of Actinides In-Pile (FACT)

In view of a planned irradiation of neptunium and americium containing fuel in a fast flux, minor actinide mixed oxides of the type ($MA_{0.5}U_{0.5}O_{2-x}$) have been fabricated by gel supported precipitation (with MA = ^{237}Np, ^{241}Am).

From a cost/benefit analysis of MA recycling performed in subproject FACT it appears that the reclycling in a FBR is neutral in cost. Whereas the short term risk is negligibly enhanced, a long term 200-fold reduction of the radiological risk compared with direct storage of spent fuel can be achieved.

First studies of the compatibility between sodium and the MA-fuel indicate that for a specified O/M ratio the fuel resists attack by Na sufficiently well.

The mean thermal conductivity of $U_{0.5}Am_{0.5}O_{2-x}$ has been measured between 1800K and the melting point.

2.5. Safe Handling of Nuclear Fuels

In Sub-Project SHAPE the adhesion of (U, Pu)O_2 aerosol particles to various substrates was investigated.

Large-scale fire experiments with burning "contaminated" glove box materials under laboratory conditions were performed. Up to 90% of the contaminant was found to become airborne, about 3% was carried into the ventilation exit channel.

From the observation of spherical plexiglass particles in air which had swept over heated plexiglas it was concluded that resuspension of containment particles from plexiglas surfaces should be possible even without combustion.

In small-scale fire experiments it was observed that re-suspension of contaminated particles is most effective from regions outside the flame.

With the visualisation and graphical representation of the three-dimensional flow-field in a ventilated enclosure, a prerequisite for the calculation of the aerosol distribution in a glove box under working conditions became available.

Exposure of rats to indium-doped alumina aerosol in the context of a biochemcial investigation of plutonium aerosol uptake in lungs and subsequent neutron activation analysis of the lung tissue indicated the amount of aerosol taken up during the experiment to be about ten times lower than expected. 111 days after intratracheal instillation of U,Pu-oxide particles in rat lungs, clusters of particles were found surrounded by iron-containing areas up to several micrometers in diameter.

Diffusion and sintering studies performed within the frame of this activity revealed that, contrary to the case of U, Pu-mixed oxide fuel, uranium dioxide can be sintered at lower temperatures and within shorter times to technologically relevant densities, if sintering is done in an oxidising atmosphere (instead of a reducing one, commonly employed).

2.6. Reprocessing of Nuclear Fuels (REPRO)

In sub-project REPRO, problems related to the head-end steps in reprocessing of spent advanced fuels are still under study, however the emphasis is gradually shifting to questions concerning reprocessing of oxide fuels.

An analytical method has been developed for the determination of oxalic acid and mellitic acid in MC dissolver solutions; the acids were isolated via their lead salts.

From the analysis of the off-gas grom UCN dissolutions it can concluded that the initial reaction rate (fuel-nitric acid) increased and the C-atoms were replaced by N-atoms.

The adaption of the methods to be used in a multipurpose unit for the recovery of actinides has been extended by including Np into the scheme.

The Cm/Am separation by cation exchange under high pressure in a pH gradient has been optimised.

The problems posed by ^{14}C as produced in nitride fuels upon irradiation have been addressed by calculation of the rate of formation of this nuclide in a fast flux (KORIGEN) and by measurements on a few samples of dissolved MN. The off-gas from nitride dissolutions was found to contain elementary nitrogen and in the resulting solution ammonium-ions were determined by spectrophotometry.

The measurements of ammonium ions in the dissolver solutions from U(C,N)-materials showed the NH_4-concentration to be proportional to the content of nitrogen in the starting material.

The degradation experiments on the TBP resins continued for up to 16 months (10^7 rad) without any sign of deterioration of the resin. These tests were substantiated by electron microscopy.

2.7. Actinide Research

Sub-project "Actinide Chemistry" reports the preparation of $^{242}PuSb$ single crystals by the "mineralisation" technique. Procedures for the analysis of the pnictides have been elaborated. More than 2g of van Arkel protactinium have been refined for low temperature specific heat measurements, Mössbauer studies and the synthesis of compounds.

The surface of the $PuFe_2$ intermetallic compound has been analysed by electron spectroscopy: the untreated sample was covered by Fe_2O_3 and PuO_2; sputtering resulted in the detection of Fe and Pu_2O_3.

Whereas attempts failed to prepare AmO_2-single crystals by high temperature solution growth from molten $Pb_2V_2O_7$, uranium doped ThO_2-single crystals could be prepared.

The structures of two organometallic compounds ($U(C_9H_7)Br_3 2THF$, Na^+ (TbTETA) 6 H_2O 1/2 NaCl) were determined to study bonding and coordination geometry of organometallic systems containing F-block elements. Likewise, the structure of the cyclopentadienyl complex HCp_3UX (X = Cl, Br) was determined.

"Actinide Physics" continues the investigation of properties under high pressure, since the participation of f-electrons in bonding depends on the overlapping of the corresponding electron orbitals, hence, on the atomic distances. As the pressure behaviour of Ce and of Am are expected to be similar, high pressure structural studies of cerium metal up to 30 GPa were performed using synchrotron radiation; the α-U high pressure form of Ce could not be confirmed (collaboration with University of Copenhagen).

The investigation of ^{248}Cm-metal prepared at the Oak Ridge National Laboratory broadened the understanding of the heavier actinide metals. Curium metal exists in at least three distinct pressure allotropes. The double-hexagonal close packed (dhcp) normal pressure allotrope remains stable up to about 23 GPa. Up to at least 39 GPa the structure is cubic close-packed. A second high pressure phase is formed above 43 GPa and is retained up to at least 52 GPa.

Possible spectral changes due to the perturbation of 5-f electronic orbitals in actinide compounds were investigated by studying the effect of pressure on the absorption spectra and the crystal structure of anhydrous AmI_3. The spectrum of the hexagonal form of AmI_3 at normal pressure was compared with that of the orthorhombic form at pressures of about 7 GPa.

The crystallographic properties of $Bk_{1-x}Cf_x$ alloys (x = 0.35 and 0.60) under pressure have been measured. At pressures of 34 and 35 GPa, respectively, there is a transformation to an α-uranium type orthorhombic structure, accompanied by a sudden decrease in volume.

The effect of valence on diffusion of actinides in fluorite type actinide dioxides was investigated by using Th, U and Pu as tracers and ThO_2 as matrix. First results on the diffusion of Th^{4+}, U^{4+} and Pu^{4+} in single crystals of ThO_2 and at temperatures between 1600 and 2500°C show practically identical diffusion rates indicating that the ionic size (Th^{4+}: ionic radius 1.02 Å, U^{4+}: 0.97 Å, Pu^{4+}: 0.93 Å) is of little importance to diffusion.

The neutron diffraction study of the plutonium-hydrogen system has been continued by the investigation of $PuD_{2.33}$ and $PuD_{2.65}$. Like $PuD_{2.25}$ the hydrides investigated crystallize in a fcc structure. No evidence for a structural phase transition between room temperature and 75K was founded. The ordered magnetic moment deduced from neutron diffraction data points towards the existence of Pu^{3+} in all investigated hydrides.

The results of a detailed neutron diffraction study of β-UH_3 and β-UD_3 indicate a merely localised behaviour of the 5f electrons in these hydrides.

The equation of state of Pu metal at finite temperatures was calculated and the absence of magnetic order in the δ-phase explained.

Inelastic neutron scattering spectra for a monodomain single crystal of PuSb have been measured - the first inelastic neutron scattering data ever obtained for a transuranium system. The results indicate that the magnetic exchange interactions are highly anisotropic.

Elastic neutron scatering studies of PuAs and PuSb have been made. The magnetization densities and magnetic phase diagrams and moments have been measured.

Neutron scattering experiments on a single crystal of NpAs were started. Three phase transitions were detected in the inelastic scattering experiments and below the Neel temperature of 173K the magnetic structure was found to be an incommensurate longitudinal sine wave.

In studies of Mössbauer experiments on the Pu-Sb-Y system an unusual indirect exchange mechanism between 5f electrons in Pu has been proposed.

The heat capacity of PuSb between 10 and 300K has been measured. This experiment is the first of a series of various physical measurements on this system, stimulated by the observation of novel magnetic excitations.

3. Conclusion

Work during the first two years of the Nuclear Fuels and Actinides Research Programme proceeded according to schedule.

Minor difficulties arose due to uncertainties about the continuation of severe fuel damage studies at Ispra, to which the Karlsruhe Establishment should contribute.

Start on the study of dense fuel performance was delayed since a decision on the type of fuel to be investigated was taken only in 1985 by the advisory bodies.

It can be stated, that also during the present programme period contacts with other national and international research organisations active in the field are excellent.

The Evaluation Panel seems in general to be satisfied with the methods employed and the results obtained.

ANNEX III (4)

JOINT RESEARCH CENTRE, PETTEN ESTABLISHMENT
MID-TERM REPORT TO SCIENTIFIC COUNCIL JANUARY 1986

Introduction

The work of the Petten Establishment has two distinct points of focus: the exploitation of the High Flux Reactor, and research in engineering materials, in particular the Industrial Technologies Programme in High Temperature Materials. Historically, these activities have evolved separately, however the future will see efforts towards closer integration.

The High Flux Reactor is essentially a materials testing facility which utilises highly enriched uranium fuel elements. It has been operating at 50 MW in support of a wide range of research projects for client Member States and for Community programmes. The projects include work on the development of light water reactors, the irradiation testing of fissile and structural materials and, as part of the development of fusion reactors, the testing of candidate wall and blanket materials. In addition, there is an active programme of production of radioisotopes for medical, industrial and scientific applications.

The High Temperature Materials Programme is targetted to the needs of European industry for materials to perform well in high temperature, aggressive atmospheres. Thus, it aims to stimulate and provide understanding, essential test data and measurement techniques in order to assist industries in the power generation, chemical engineering and transport sectors to select the most advantageous steels, superalloys and ceramics for the intended end purpose.

PROGRESS AND ACHIEVEMENTS

1. The High Flux Reactor Programme

1.1. The period under review encompasses two distinctly different activities:

a) dismantling and rebuilding of the reactor vessel in 1984, and
b) restart and operation of irradiation cycles in 1985.

In broad terms, the objectives set out for operation and utilisation in 1984-85 have been met. The reactor is now poised to exploit the enhanced irradiation capacity for materials testing and improved ease of experimental utilisation. At the same time, the refit has created opportunities for the improved exploitation of neutron beams as an investigative tool.

The vessel replacement project experienced minor delays but remained essentially inside the milestone scheme set out for the 84/85 period. The HFR returned to full power on 14th February 1985, and the reactor has since then operated without problems, meeting all the anticipated performance criteria.

A comprehensive technical and financial report and several journal articles on the vessel replacement have now been published.

1.2. Survey of upgrading and development

In relation to the milestones set for the 1984-1987 programme, we note the following progress:

Action	Planned	Present Status
Reactor complex outbuilding	1985/86	Under preparation
Replacement of pool circuit heat exchangers	1985	Delayed to 1986 (less urgent than anticipated)
Replacement of primary circuit heat exchangers, primary pump motor replacement studies	1985/86(87)	On schedule
New hot cell telemanipulators	1984/86	Complete
D_2O tank installation	1986	Work continuing (behind schedule)
Refurnishing of control room instrumentation	1987	Under study
Be reflector elements	1987	Ahead of schedule (1986)
Medium activity laboratory design study	1986	Delayed (less urgent than anticipated)
Studies on a core conversion to low-enriched fuel and connected power increase	1986/87	On schedule
Upgrading of the central data acquisition and processing system DACOS	1984/85	Delayed (1986)
Installation and operation of remote encapsulation facility EUROS	1986	Completed

1.3. Applications

After re-starting and following a test cycle in February 1985, the experimental equipment was re-installed and the irradiation work carried out as planned in the following areas:

a) safety of light water reactors, in particular transient fuel tests and experiments simulating accident scenarios;
b) development of high temperature reactors by irradiation testing of fissile and structural materials;
c) safety of fast reactors by advanced fuel testing under steady-state and transient conditions as well as irradiation testing of structural materials;
d) technology and safety of fusion reactors, by irradiation testing of candidate first-wall and blanket materials;
e) production of radioisotopes and neutron activation analysis for medical, agricultural, industrial and scientific applications:
f) fundamental research using the horizontal beam tubes;
g) neutron radiography.

For a variety of reasons, the overall reactor utilisation was somewhat below the anticipated figure. However, there are good prospects for the utilisation of the neutron beams as an investigative tool in connection with the Establishment's Materials Programme. This is now being closely examined.

1.4. Miscellaneous

The HFR Programme hosted the 1985 Meeting of the Reduced Enrichment Research and Test Reactor (RERTR) Programme. 40 papers were presented to 120 participants from all over the world.

2. High Temperature Materials

2.1. The aims of the programme are to encourage within the Community the development and application of high temperature materials required for advanced technologies. This is being carried out by:

a) Maintaining a centre of expertise in HTM research as a basis for expert guidance to Community technological interests: the studies are aimed to provide a generic understanding of the behaviour of materials under the conjoint influence of corrosion, mechanical loading and high temperature: and

b) Furnishing an HTM information service by monitoring European materials research and utilisation, identifying critical needs and future trends, providing a forum for information exchange, stimulating joint European actions in materials research and developing a European HTM Data Bank.

The current 1984-87 programme has evolved from the previous 1980-83 programme, to embrace a further area of HTM interest, viz engineering ceramics, to uprate testing facilities from simplified environments of corrosion and mechanical loading to accurate service simulation, and to develop the Data Bank from pilot to operational status.

Steady progress has been forged on a broad front in this Programme. Where delays arose, these were primarily due to complications in the development of complex testing facilities and their associated safety requirements.

2.2. Programme Progress

The programme is being executed within 5 projects (Steels and Alloys, Sub-components, Engineering Ceramics, HTM Data Bank and HTM Information Centre).

A major advance in the experimental programme has been the successful introduction of sulphur bearing gases into the unique facilities for testing under complex environmental conditions, making these more representative of industrial service environments with respect to temperature, gaseous corrosion and stress.

The project on STEELS & ALLOYS is executed in four closely coordinated activities, involving corrosion, corrosion protection, creep and fatigue.

The corrosion studies have demonstrated the importance of Cr- and Al-rich oxides in controlling alloy sulphidation, particularly at 800°C. The concomitant screening of suitable coatings and claddings on appropriate austenitic substrates for corrosion protection has been achieved. Certain problems of ferritic-austenitic interface degradation have been identified in thermal fatigue situations. Through creep testing of selected steels in corrosive environments, the threshold boundaries of the different corrosion regimes have been mapped out with respect to temperature, corrosive gas potential and stress. Investigation of creep deformation and fracture shows the influence of sulphidation in reducing creep ductility and the improvement in life observed in carburising/oxidising atmospheres. Fatigue studies into crack initiation and life endurance testing of Alloy 800H in air and vacuum from 500 - 900°C shows the influence on oxidation of life, which varies across the temperature range by an order of magnitude. Work on this alloy continues with investigations on micro- and macro-crack growth behaviour, for improved life prediction.

In a complementary study into ALLOY SUB-COMPONENTS, correlation of uniaxial with multiaxial creep behaviour of Alloy 800H has been achieved by mathematical modelling and verified experimentally. This has required the development of high temperature measurement methodologies for multiaxial strain. The work is now being extended to the effect of in-situ corrosion. The design of a thermal gradient test rig is in progress.

The new project on ENGINEERING CERAMICS includes aspects of processing and characterisation of ceramics materials. Methods of characterising the starting ceramic powders and routes for fabrication of ceramic sample components have been developed. The preparatory work for optimisation of processing parameters is now in progress. Property and microstructural characterisation of ceramics is moving well with the establishment of test and anaysis methodologies and preliminary corrosion and mechanical property studies on silicon nitride materials in conditions simulating candidate service applications have been started. The programme expertise in HT corrosion has attracted attention from a number of countries with a view to closer collaboration.

The operation of the HTM DATA BANK, including input from COST collaborations, the evaluation of data held, and the investigation of means to extend the scope of the Bank, has been achieved. An interface system for on-line access is under development. The project has contributed at scientific and management levels to the DG XIII "Communities Programme for the Development of Specialised Information Market in Europe".

The HTM INFORMATION CENTRE has concentrated upon,

a) The promotion of information exchange by organising scientific meetings (conferences, workshops), covering aspects such as material potential, innovation and performance in service environments, and by conducting studies to review further research needs e.g. ceramics and ceramic composites; and

b) The encouragement of cooperative actions in Europe e.g. BRITE, and DG XIII Information Market.

3. GENERAL COMMENTS BY ESTABLISHMENT DIRECTOR

The mid-term progress in executing the Establishment Programmes is such that there are no major anxieties in our being able to meet the broad Programme objectives by the time of its expiry. Inevitably, there will be some delays and missed targets on specific aspects of projects (some of which can be discerned now), but the overall position is that the Programmes are well on course.

The balance between fundamental and applied science is currently weighted heavily on the side of the latter. This is largely because of pressures over the years form advisory bodies for industry targetted research, and as a result, the gearing of the staff towards short-term to mid-term technological objectives. There is a need to redress the balance and to re-align some projects to include a stronger basic component. We must invest in seed-corn research. The presence of stagiaires and visiting Research Fellows will be a healthy move in this respect. The application of cold neutron probes for basic studies of materials micro-structure is also being planned.

All cases where delays have occurred in the execution of the Programmes or where progress has not been remarkable, may be attributed to insufficient human resources. Although objectives are matched to available resources during the initial planning stages, we are subjected to unanticipated requests for staff participation in Community and Member States initiatives - important requests which must be met - with the consequence of diluting the effort available for some Programme objectives.

The HTM Programme has been subjected to an external "peer review" evaluation and the findings vindicate the broad sweep of the Programme, its requirements by European industry and its execution. We note the principal recommendations: to strengthen even further the industrial contacts and to emphasize the fundamental aspects of the work. These recommendations are welcome, and are not contradictory, but it will tax the skills of management to accomplish them within the existing resources.

ANNEX IV

JRC Advisory and Decision Making Bodies

1. Political Bodies

- The European Parliament
  - Committee on Energy, Research and Technology
  - Committee on Budgets
  - Budget Control Committee
- The Council of the European Communities (Research) or (Economy and Finance) or (General Affairs)
  - Committee of Permanent Representatives
    - . Atomic Questions Group
    - . Research Group
    - . Budget Committee
- The Economic and Social Committee of the European Communities
- The Commission of the European Communities

2. JRC Governing Bodies

- The Board of Governors
- The Scientific Council
- The Director General
  - The Scientific Committee (internal - advisory to the D.G.)

3. Scientific and Technical Advisory Bodies

- Euratom Scientific and Technical Committee (STC)
- Scientific and Technical Research Committee (CREST)
- Specialised advisory committees:
  - 6 Management Coordination Consultative Committees (CGC) meeting in variable configurations
  - Consultative Committee for the Fusion Programme (CCFP)
  - Fusion Technology Steering Committee (FTSC)
  - HFR Advisory Committee for Programme Management (ACPM)
  - Specialised Evaluation Panels (8 in 1984/86)