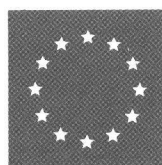
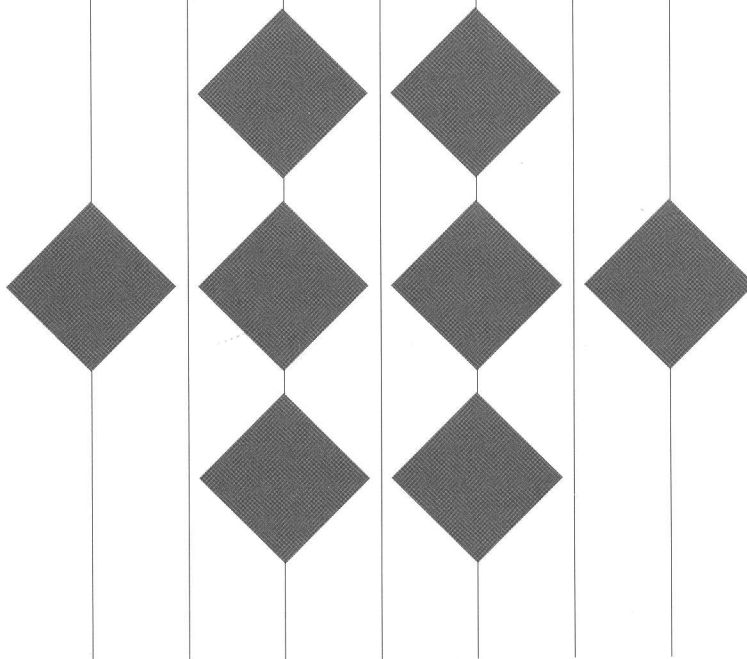


ANNUAL  
REPORT  
1990



JOINT  
RESEARCH  
CENTRE

COMMISSION OF THE EUROPEAN COMMUNITIES

Published by the

**Commission of the European Communities**

**Directorate-General of the Joint Research Centre**

**Legal Notice**

Neither the Commission of the European Communities nor any person acting on behalf of the Commission is responsible for the use which might be made of the following information.

**EUR 13572 EN**

Catalogue: CD-NA-13572-EN-C

© ECSC - EEC - EAEC, Brussels - Luxembourg 1991

Printed in Belgium



**Message  
from  
Vice-President Pandolfi**

1990

has been a year of planning and development for the Joint Research Centre. A considerable effort was applied by the Director General and his team of Directors to propose strategic options for the JRC at the turn of the century. Three options were examined by the JRC Board of Governors and myself, leading to a programme proposal for 1992-1994 aiming for a fully adapted and sufficiently flexible JRC to meet the challenges of the year 2000.

Whilst the future has been under discussion, the trend towards a closer association of the Centre with other Directorates General of the Commission to provide scientific and technical assistance to back up Community policies has continued to grow in a very significant manner, enabling the impact of the Joint Research Centre's work to be felt in all areas of Commission activity where science or technology play a role. Considered from a Commission standpoint, I believe that in this type of active participation in Commission affairs the most natural place of the JRC in Community life can be found.

Structurally, the JRC continues the policy of devolution of its Institutes by the gradual shifting of responsibility for local management to Institute's Directors who are thus able to act in a more direct, efficient and flexible manner. This evolution will help give «character» to Institutes and dispel the public belief that real contacts cannot be established with a «faceless bureaucracy».

Advice and guidance in choosing the right path and then following it for the JRC must be laid at the door of the Board of Governors and its Chairman, Sir John Kendrew, who takes up these points in more detail in his introduction. The Board's work is acknowledged with thanks.



*F. M. Pandolfi*

**Filippo Maria Pandolfi**  
Vice-President of the Commission of the European Communities

## Foreword

**D**uring 1990, the Board of Governors and the Joint Research Centre's senior management team led by the Director General, turned their attention to the future and spent much effort in the establishment of a strategic plan.

The first step resulted in a review of long-term strategy «JRC 2000», and a preliminary discussion by the Board on a possible future scenario was attended by Vice-President Pandolfi. A free exchange of ideas took place and the foundations were laid for the development of a 1992-1994 Multiannual Research Programme for the Joint Research Centre to be put before the Commission during the first half of the coming year. At the same time, the internal management of the Centre as a whole was in evolution, with central services being divested of a number of functions. Institute Directors assuming individual responsibility for a greater proportion of the day-to-day running of their Institutes. This was in agreement with the recommendations made by the Panel of Senior Industrialists which carried out a mid-programme evaluation.

An important landmark in the year is the Annual Report prepared by the Court of Auditors based on a close investigation of the Joint Research Centre by its inspectors. Detailed examination of a draft version of the Report by the Board's Sub-Committee for Staff and Finance, followed by discussion in plenary session led to the conclusion that many of the criticisms were of a constructive nature and would lead to improvements in operating procedures. However, there were also cases where the Commission was unable to share in the interpretation made by the Court, on the intentions expressed in the Council Resolution of 29 June 1988 regarding targets for contract research and a number of points concerning the application of recent early retirement measures in which the Court's findings did not entirely reflect the reality. The Commission, with the Board of Governors' encouragement, would be taking up those points when the Report will be scrutinized by the Budget Control Committee of the European Parliament.

The Board is particularly attentive to JRC staff and financial policies and aspects of both are closely followed and discussed at all meetings. A noteworthy feature of the year has been the formalization of cooperation agreements with other organisations on ongoing activities in a number of research areas, both within and without the Community, and the promotion of collaboration with new ones. The Board considers such openings to the outside world to play an essential role in assuring a proper position in the world for the JRC in its areas of expertise.

The present Report, issued at the three-quarters point of the 1988-1991 Multiannual Programme, bears witness to the progress made in carrying out research under the Decisions mentioned above.

At the same time, steady progress is noted with contract work for third parties where, although it seems unlikely that original optimistic targets will be attained by the end of the present Multiannual Programme, the Board has noted enthusiastic reactions from JRC clients and encourages the intense efforts being made to enlarge the order book. Work for other Commission services has reached saturation level and an increase in budget had to be requested for 1991. This, in itself, is a clear indication of the progress made by the JRC and the quality of its work.



**Sir John Kendrew**  
Chairman of the Board of Governors



# CONTENTS

## INTRODUCTION

<b>1. 1990: FROM THE CONSOLIDATION PHASE TO NEW PERSPECTIVES.....</b>	<b>11</b>
<b>2. MAIN ACHIEVEMENTS AND MILESTONES .....</b>	<b>19</b>
2.1. Specific Programmes .....	20
2.2. Exploratory Research .....	44
2.3. S/T Support for Community Policies .....	48
2.4. Work for Third Parties .....	65
2.5. Participation in EUREKA .....	74
2.6. Associated Laboratories .....	77
<b>3. RESOURCES .....</b>	<b>83</b>
3.1. Human Resources .....	84
3.2. Finances .....	86
3.3. Large Installations .....	88
<b>ANNEXES .....</b>	<b>93</b>
ANNEX A Financial Accounts .....	94
ANNEX B Publications, Euro Courses, Application of Results .....	96
ANNEX C Exhibitions and Fairs, Press and Public Relations .....	99
ANNEX D Board of Governors and Organisation Chart .....	101
ANNEX E Glossary of Acronyms and Abbreviations .....	103
List of Tables and Figures .....	103

INTRODUCTION

# WHAT IS THE JOINT RESEARCH CENTRE

---

**T**his report presents the achievements of the European Commission's Joint Research Centre for 1990.

The Joint Research Centre of the European Communities is a European scientific and technical research centre established by the Member States of the European Community. Its four sites in Belgium, Germany, Italy and the Netherlands house eight different institutes, each with its own focus of expertise.

The JRC performs scientific research and technology development for the Commission of the European Communities, national agencies, universities and corporate clients from Community Member States and other countries.

The scientific, regulatory and administrative bodies of the Community are the JRC's main users. They seek to increase the competitiveness of European industry within an open market, and for this they need pre-formative and pre-competitive research.

The Community also carries out science that must be done on a European scale: provision of reference material and measurement techniques, database services, environmental observations, research on safety, all of which depend on the transfer of scientific capabilities throughout Europe.

National governments and private corporations also utilise the resources of the JRC to carry out contract research. With facilities and areas of expertise unique in Europe, the JRC serves a special role as a resource for organisations whose research needs exceed their own internal capacity, or who wish to benefit from the availability of specific JRC facilities and talent.

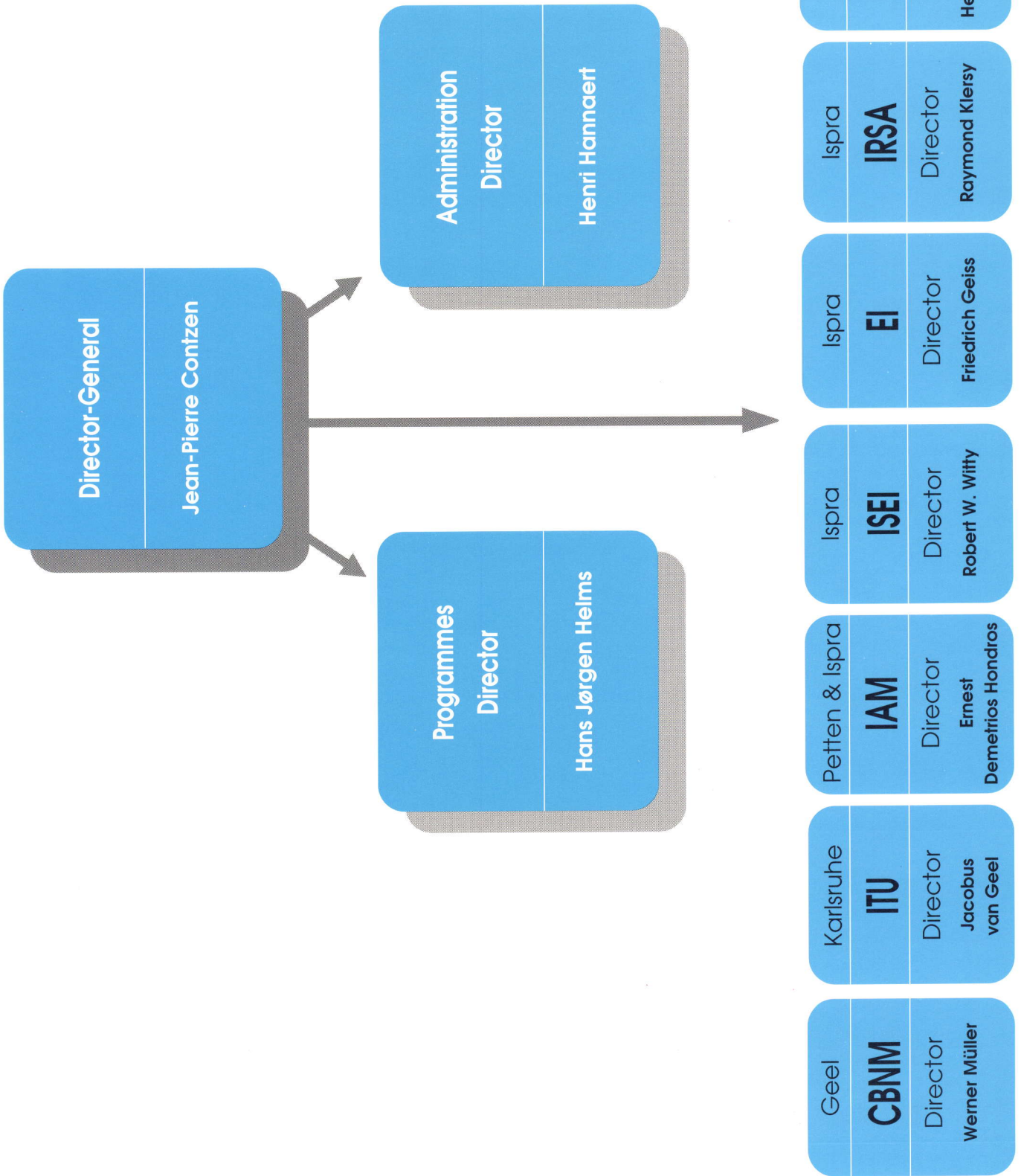
## 2,000 people in eight institutes and four geographical sites...

**THE Joint Research Centre's 2,000 staff - three-quarters of them scientists and technicians- works in eight institutes, at four sites, each in a different member state:**

- Geel in Belgium, 80 km north-east from Brussels,
- Karlsruhe on the Rhine Valley in Germany,
- Petten in the Netherlands, 60 km north of Amsterdam,
- and the Centre's largest site at Ispra, 60 km north-west of Milan in Italy.

<i>CBNM</i>	<i>The Central Bureau for Nuclear Measurements (Geel)</i> CNBM's activities are devoted to the promotion of European standards and to the determination of reference data and materials in the nuclear as well as in the non-nuclear sector.
<i>ITU</i>	<i>The Institute for Transuranium Elements (Karlsruhe)</i> ITU investigates the chemical and physical properties of actinides and performs detailed nuclear safety studies of interest to the nuclear industry and licensing authorities, including studies on fuel behaviour under irradiation, waste management and safeguards analysis.
<i>IAM</i>	<i>The Institute for Advanced Materials (Petten &amp; Ispra)</i> IAM concentrates on the characterisation and testing of the behaviour of materials and components under complex environments (both non-nuclear and nuclear), the development of materials processing technologies and of new functional materials.
<i>EI</i>	<i>The Environment Institute (Ispra)</i> EI performs research on both indoor and outdoor pollution, and has developed information databases directed at environmental concerns. Studies encompass air and water pollution, food analysis, toxicology of trace substances, and the impact of chemical, toxic and radioactive wastes on human health and the natural environment.
<i>IRSA</i>	<i>The Institute for Remote Sensing Applications (Ispra)</i> IRSA applies remote sensing to land monitoring and management, marine environment and resources and agricultural statistics. It also develops and tests new techniques in remote sensing.
<i>IST</i>	<i>The Institute for Safety Technology (Ispra)</i> IST has programmes on non-nuclear and nuclear industrial risk, with particular emphasis on thermodynamic chemistry, and structural reliability. It operates all the major technology facilities at Ispra.
<i>ISEI</i>	<i>The Institute for Systems Engineering and Informatics (Ispra)</i> ISEI performs research on reliability and performance of complex systems, on major technological hazards and on risk management. Areas of expertise include non-nuclear energies, fusion, fissile materials, safeguards and high risk industries. It also develops sophisticated informatics applications such as databases, expert systems, parallel computing, mathematical modelling and telecommunications.
<i>IPTS</i>	<i>The Institute for Prospective Technological Studies (Ispra)</i> IPTS monitors the state of science and technology and evaluates the potential effects of the technological choices facing Europe to enable industrialists and policy makers to assess the future impact of their decisions.





## HOW to read this report...

**THE** Joint Research Centre carries out a variety of research programmes, and in reporting on such an active and multifarious institution as the Joint Research Centre, a good deal of detail is inevitable. It is also difficult to summarise them easily without some overlap.

**This report therefore looks at the JRC's work from several angles: its purpose, its resources and the outputs it makes. It describes the Centre's work first of all according to the major programme heading under which they fall.**

The first three sections of chapter 2 describe the JRC as it works within the European Commission itself.

In section 2.1, you will find described first the twelve long-term research programmes it is undertaking, listed for convenience institute by institute. Next, section 2.2 picks out the progress made in exploratory research, in which the JRC "follows its nose", investigating the potential that lies behind new ideas.

The third section of chapter 2 looks at the many ways the JRC contributes to policy formation by aiding the other parts of the Commission. This section is arranged according to the policy field in question, from international co-operation through transport and energy to forward studies.

The final three sections of chapter 2 deal with the JRC and the outside world. Section 2.4 reports on the growing number of contracts carried out for industry and government world-wide, and the following two sections focus on the JRC as a collaborative partner - both within the Eureka initiative, and in its own Associated Laboratories scheme.

Chapter 3 deals with the resources of the JRC.

The first resource to be described is the very people who make up the JRC. The permanent staff of scientists, technicians and administrators have been joined by a number of visiting researchers, as section 3.1 tells.

Section 3.2, the summary financial report for the year, covers the JRC's financial resources. Further detail can be found in annex A.

Much of the Centre's research relies on the unique facilities it possesses for simulating and testing new processes and materials. These are considered in turn in section 3.3.

The report finishes with the varied outputs that the Centre makes into the world of science and technology: its many publications, training courses, exhibitions and visitors, not forgetting the products that are now on industrial markets thanks to JRC research.

1990:

FROM THE

CONSOLIDATION  
PHASE

TO

NEW PERSPECTIVES



1990

saw the JRC start to develop new scientific perspectives following the 1988 reform which was consolidated in 1989. The benefits of this major reform are now becoming manifest with increasing accountability at the operational level and increasing scientific dynamism.





1990:  
FROM THE  
**CONSOLIDATION  
PHASE  
TO  
NEW PERSPECTIVES**

**THE current four year programme of the JRC will be terminated at the end of 1991. Therefore the JRC is preparing its own strategic plans for both the medium and long term.**

**Consequently a major review of the long-term strategy («JRC 2000») was undertaken during the year and the resultant plan is now being discussed with the JRC Board of Governors.**

#### ■ JRC's more dynamic structure

The new structure of the JRC was strengthened during the year by merging two institutes whose interests were clearly closely linked, namely the Institute for Systems Engineering and the Centre for Information Technologies and Electronics.

This merger had been recommended by the mid-term JRC Programme Evaluation Panel and agreed by the JRC Board of Governors. The resultant eight institutes (Central Bureau for Nuclear Measurements; Transuranium Elements; Advanced Materials; Remote Sensing Applications; Environment; Systems Engineering and Informatics; Safety Technology and Prospective Technological Studies) are steadily increasing their operational and budgetary independence and of course their accountability. This growing independence is concurrent with a consolidation of their role in the world of scientific and technological research and development.

The new Institute for Prospective Technological Studies has had a successful first full year of operation with a number of well-received reports to its credit. The Evaluation Panel recommended that this institute should be relocated eventually to a «green-field» site. This proposal is under active consideration.

#### ■ The JRC's role for Science and Technology in Europe

The four titles under which the new JRC executes its research and development programme, namely Framework Programme, Support for (other) Commission Services, Exploratory Research and Work for Third Parties, are now firmly in place and all the individual project work schedules are identified under one or other of these headings.

The project work schedule system is operating well and each schedule clearly identifies the project aims, progress to date and expected progress for the year to come, together with the resources (manpower plus budgetary) which will be expended on the project. The assembly of Annual Work Schedules constitutes the JRC annual work plan which is agreed by the Board of Governors who then monitor progress throughout the year.

The evidence for the scientific dynamism of the JRC is contained in the following chapters of this report. Not only is the JRC executing work of

good quality within its own laboratories but more and more it is acting as one of the interlocutors for science and technology in Europe.

It would be invidious in a general introduction to highlight a particular achievement in the work of one or other of the eight institutes. However as an illustration of the importance of the Framework Programme work of the JRC mention could be made of the FARO project which is concerned with studies of phenomena which could occur in case of severe degradation of a nuclear reactor core. The success of difficult tests where large  $UO_2$  molten mass interacting with the coolant were studied have attracted the interest of the international community.

### ■ New facilities

The capability of the JRC is being rapidly extended. The surface modification laboratory for advanced materials which has been dubbed «The Laser Foundry» is now operational within the Institute for Advanced Materials. Progress continues with the construction of the Tritium Laboratory which will be commissioned in 1991 and the Reaction Wall Laboratory which will be completed in the end of 1991.

The last of these in particular continues to attract external interest and we expect that its eventual research programme will make a significant impact on norms and standards.



The reaction wall test facility under construction on the Ispra site of the JRC.

### ■ Support for the Commission

The demand for work to be carried out under the Support for the Commission programme has been particularly marked.

In fact demand has exceeded the budget and the JRC Board of Governors has recommended an increase in this budget from 120 Mecu to 130 Mecu



for the 1988-1991 period in order to accommodate more of the demands. During the year a number of multiannual agreements has been signed by the Director General of the JRC with other Commission Services in order to provide a degree of continuity and long-term planning within the Support for the Commission programme.

This is a clear reflection of the increasing confidence in the JRC's reputation within the customer/contractor framework and a recognition of the efficiency of its services in solving current problems.

### ■ Outside Contracts

Third Party contract work continues to grow but has not yet reached the anticipated levels. Increased efforts to promote marketing are underway. Nevertheless, the work which has been carried out has been universally recognised by the customers as being of high quality. The Mid-Term Evaluation of the JRC Programme, which was carried out under the Chairmanship of Dr. H. Beckers of Shell International at the end of 1989, noted that: «... from a limited number of customers who were questioned, scientific quality, value for money, speed of response and quality of reporting were highly praised.».

The winning of Third Party contracts from outside the Community is particularly noteworthy and therefore the contract signed this year with the US Nuclear Regulatory Commission for work on nuclear safety should be mentioned.

### ■ Links with associated laboratories

The JRC has forged a number of formal links with associated laboratories in the Member States and in some cases these links will be used to carry out Third Party work.

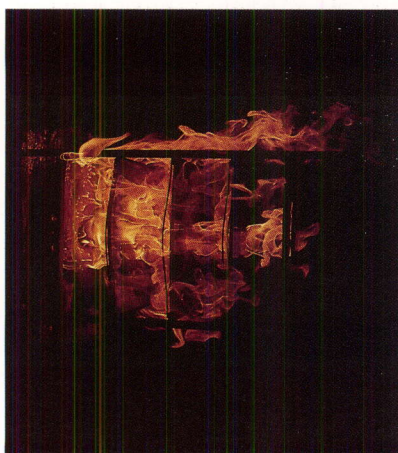
A good example is the E-MARC consortium which has been formed between the Institute of Advanced Materials and laboratories in the Netherlands, the United Kingdom and Italy. E-MARC represents in total about 1000 researchers and technicians in the materials field and a wide range of advanced equipment for research, development and characterization of advanced materials.

The reinforcement of links with Member State laboratories, whether formal or informal, is an important aspect of the JRC strategy for the future. We expect the number of seconded staff from national laboratories to the JRC to grow and, of equal importance, for JRC staff to be attached to such laboratories for specific projects.

The collaboration of the JRC with CEA/IPSN in the Phebus Programme (Reactor Safety) and the detachment of JRC staff to Cadarache for this programme is a good model for such links.

### ■ Exploratory research

The scientific vitality of the JRC has been stimulated by the vigorous implementation of Exploratory Research activities. From the inception of



Study of aerosol dispersion in (simulated) glove box fires. The burning of a plexiglass stack, (ITU)



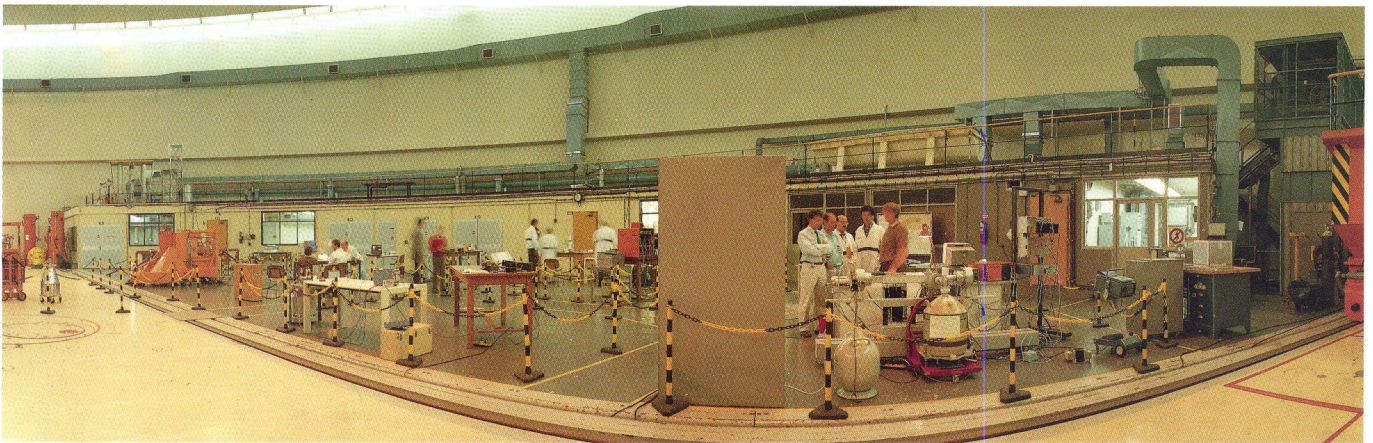
this type of activity only two years ago a large number and variety of projects have been launched.

As is to be expected some have proved to be successful and have been extended, such as the Boron Neutron Capture Therapy work which was described last year. Others have been less promising or were brought to successful completion and have not been continued. Nevertheless all of the projects have contributed to the vitality of the Centre.

The spin-off has also been considerable. The work on the Micro-Hydrodynamics of Laser Melted Pools for example will lead to collaboration with two national laboratories on the practical aspects of welding; it may also have considerable application to plasma disruption simulation in thermonuclear fusion processes.

#### ■ International links

The JRC has always had good international links. In the past these were mainly related to nuclear research and development, for example collaboration with the USA and IAEA. This collaboration still continues with mutually beneficial work in the fields of nuclear safety and safeguards.



Pre-PERLA activities: The PERFORMANCE Laboratory (PERLA) during a training exercise for Euratom and IAEA Inspectors (IST)

A particularly good example is the PISC project (Project for the Integrity of Structural Steel Components) which is jointly sponsored by the OECD (NEA) and the CEC. This successful project, in which the JRC has a major role and which is now in its third phase, includes both Community and non-Community Countries.

In recent years international cooperation has been considerably broadened in scope and by country - particularly through the various visiting researchers schemes. Visiting researchers from as far afield as North and South America, Japan, India, etc have contributed to JRC programmes. The EC is now, of course, promoting links with Eastern European countries and here also the JRC is playing its part.

A small number of visiting researchers from these countries have spent time in the JRC laboratories and we expect this number to grow. Senior staff have

visited the USSR during 1990 for bilateral discussions and a contract was signed with a USSR Institute for use of a safeguards instrument developed by the JRC in the framework of the collaboration with IAEA.

Links with Japan are also very important. Several Japanese scientists have worked in the JRC laboratories in a range of mutually interesting fields and also JRC scientists visited and worked in Japanese laboratories. Finally, an agreement was signed with Japan (JAERI) which was also concerned with the field of nuclear material safeguards R&D.

Mention has already been made of cooperation with the IAEA. In addition there are a number of cooperative actions with the ESA and the JRC is also contributing to the World Meteorological Organisation of the UN. Continuing informal links with CERN are also worthy of note.

### ■ Renewed scientific vigour

As predicted in the 1989 Annual Report a number of the older personnel took early retirement during the year. The recruitment policy of younger scientists during the same period has produced a reduction in the average age of staff. At the same time there has been an increase in staff mobility both within the JRC and between the JRC and other Commission Departments. The numbers of visiting researchers (grant holders and visiting scientists) has now reached its planned level; at the end of the year there were a total of 185 visiting researchers working in the JRC.

The Board of Governors of the JRC has continued its invaluable work of advising the Director General on all aspects of the JRC programme and management.

During the year the Board met 4 times and it is fair to say that the implementation and consolidation of the reforms would have been much more difficult without the Board's assistance.

The individual institute advisory boards are functioning to the benefit of the institute programmes at some JRC Institutes and steps are taken to establish advisory boards for the remaining institutes. The reformed JRC Scientific Committee which has members drawn from all the institutes represents a good mechanism for communication between the scientific and technical staff and senior management on all matters relating to the scientific programmes.

### ■ Dialogue with Parliament

The Joint Research Centre acknowledges the very fruitful dialogue it maintains with the European Parliament, notably with its Committee on Research, Energy and Technology (CERT) and its Committee on Budgetary Control.

Beyond regular contacts between Members of the Parliament and Commission staff, a meeting between Members of CERT specially entrusted with the monitoring of the JRC and the Board of Governors took place in September; in view of its positive results, it was decided to hold this type of

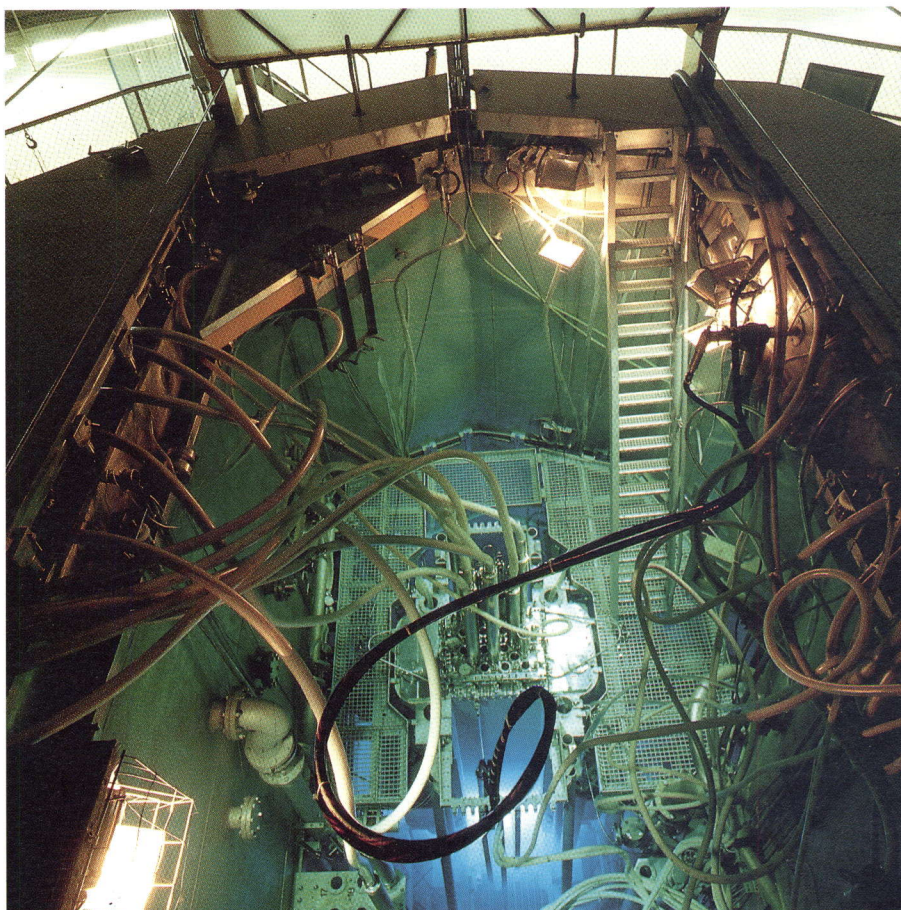


encounter at regular intervals. Furthermore, the Members of CERT undertook information visits to most of the sites of the JRC.

The work of the Mid-Term Programme Evaluation Panel, which has been referred to above, must also be fully acknowledged. Their work was carried out under a tight time schedule but the resultant report was comprehensive and most valuable.

The Court of Auditors conducted a detailed examination of the JRC during the year 1990. If the Commission does not fully share the observations made by the Court, it acknowledges the constructive comments contained in the report of the Court and improvements stimulated by these criticisms are already being implemented.

Lastly, as has been frequently stressed, the most valuable asset of the JRC is its staff. Without their enthusiasm and hard work none of the progress reported in the following pages would have been possible. The Commission and the Director General would like to take this opportunity to acknowledge also the support it has received from many external bodies and individuals not otherwise mentioned in this report.



View from the top of the reactor vessel of the HFR Petten.

# MAIN ACHIEVEMENTS AND MILESTONES

**T**his

chapter outlines the major achievements of the JRC, as it carries out its four main functions:

- Specific research programmes on a multiannual basis
- Exploratory research to open up new avenues and maintain scientific excellence
- Support activities at the request of other Commission services
- Work under contract for third parties.

The JRC also helps scientific cohesion within the Community by participating in the Europe-wide EUREKA projects and regrouping interlinked activities under such schemes as Associated Laboratories.



MAIN  
ACHIEVEMENTS  
AND  
MILESTONES

# 2

## 1 JRC

# *Specific Research Programmes*

**THE JRC specific research programmes are concentrated in three major topics:**

- ***Modernisation of industrial sectors, notably by prenormative research,***

The completion of a large internal market by 1992 will bring a significant increase in the demand for new standards, new codes of practice and new safety and quality control regulations. This is essential in order to assure full accessibility of markets, to avoid distortions of competition and to protect consumers: it is also a significant factor in strengthening the competitiveness of European industry at international level.

- ***Enhancement of safety and the prevention and mitigation of accidents,***

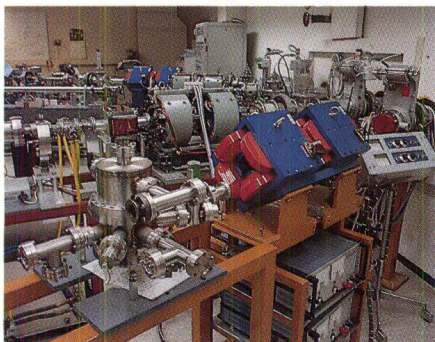
The subject of improving safety and prevention and mitigation of accidents is increasingly exercising the minds of the general public and politicians: their concern has been aroused both by nuclear accidents, since Chernobyl, and by other industrial industries, following the accidents at Seveso, Bophal and, more recently, Basle. This subject has quite a significant influence on public acceptance of technological innovation and is therefore an important aspect of the development of industrial competitiveness.

- ***Surveillance and protection of the environment.***

The environmental monitoring and conservation activity similarly reflects an acknowledgement of public concern for a better quality of life in an environment which, unfortunately, faces deterioration. Greater safety and a protected environment restored to its proper state will undoubtedly play a key part in securing public acceptance of new technologies.

**The contribution of each of the JRC's institutes to these programmes is summarised here.**

Experimental area for surface analysis experiments at the 3.7 MV Van de Graaff accelerator



### **The Specific Research Programmes**

The JRC is currently carrying out 12 long-term specific research programmes, in the following areas:

- Environmental protection
- Application of remote sensing techniques
- Industrial hazards
- Advanced materials
- Nuclear measurements and reference materials
- Reference methods for the evaluation of structural reliability
- Reactor safety
- Radioactive waste management
- Safeguards and fissile material management
- Nuclear fuels and actinide research
- Fusion technology and safety
- Reference methods for non-nuclear energies

These 12 programmes contribute to preserving the European quality of life and environment, while safeguarding its technological future and its energy base.



## The Central Bureau for Nuclear Measurements (CBNM)

The CBNM at Geel is dedicated to the promotion of European Standards and the harmonisation of reference methodologies and materials, and executes the Nuclear Measurements and Reference Materials Programme.

### ■ Nuclear Measurements

Nuclear measurements were carried out according to the needs of international organisations like the IAEA, NEA and the BIPM and at the request of national institutions.

The CBNM has successfully completed a study of mass and nuclear charge distributions of fission fragments for the spontaneous fission of  $^{252}\text{Cf}$  which is now being submitted for publication in «Nuclear Physics».

At PHYSOR - '90 (International Conference on the Physics of Reactor Operation, Design and Computation) in Marseille, CBNM scientists presented the results on low energy  $\eta$  (number of emitted neutrons per neutron absorbed) of  $^{235}\text{U}$ . Results on the low energy cross-sections and Westcott factors (describing the deviation from the  $1/v$  fission behaviour) for the fissile nuclides  $^{233}\text{U}$ ,  $^{235}\text{U}$  and  $^{239}\text{Pu}$  (earlier results) and  $^{241}\text{Pu}$  were also presented at PHYSOR. The findings are important because exact knowledge of the fission cross section at low energies is vital to reactor design and operation.

An evaluation work under an IAEA Coordinated Research Project covering X- and Gamma-ray emission probabilities of 23 radionuclides that will be applied to the calibration of detector efficiency was finished and the IAEA is to publish the results.

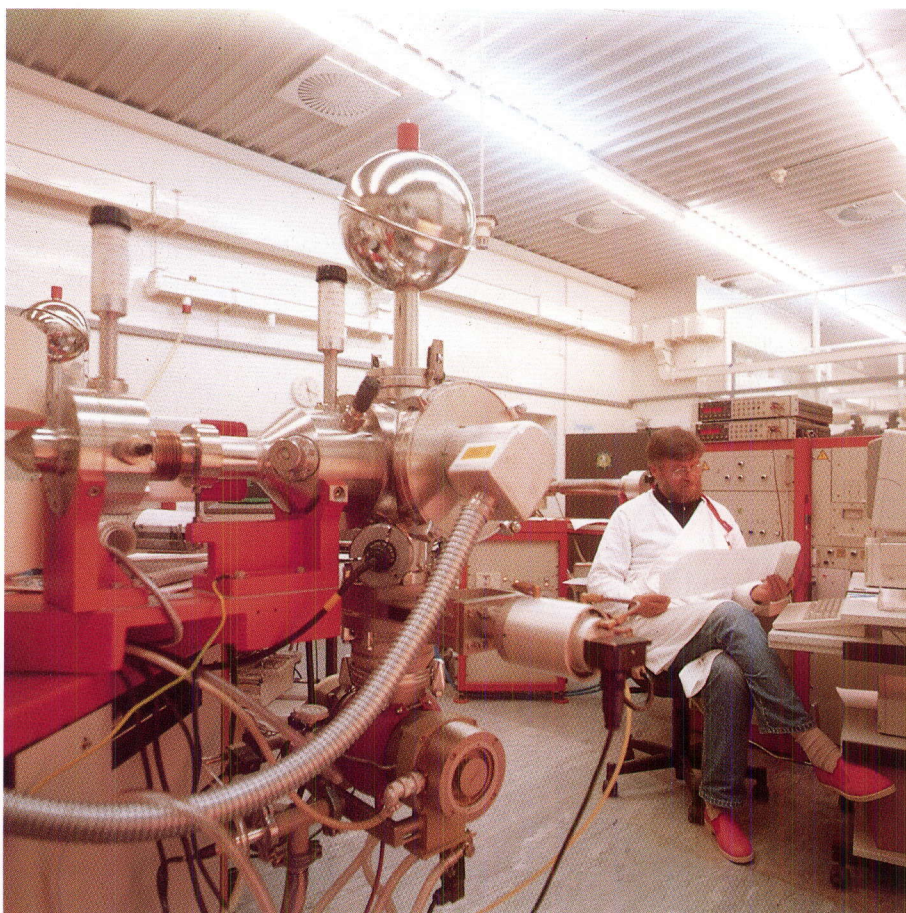


Control room of the Electron Linear Accelerator



### ■ Reference Materials

High quality nuclear reference materials have been prepared, characterised and certified at CBNM; they are used in the field of commercial transactions and nuclear safeguards. Scientific competence in nuclear measurements and in refined analytical techniques is applied to quality control programmes in both nuclear and non-nuclear fields.



Mass spectrometer for precise isotope abundance measurements

EC certification of  $\text{PuO}_2$  reference material for elemental analysis in the fuel cycle as well as Al and two Nb reference materials for dosimetry or monitoring work in reactor operation have been finalized; reference materials are now available for use.

The CBNM prepared several spike reference materials to keep reference materials stock according to needs such as  $^{233}\text{U}$  and  $^{239}\text{Pu}$ . Constant use in European laboratories means that spike Reference Materials stock had to be renewed. As part of their safeguards work, staff also developed solid or mixed U/Pu spikes which will improve input analysis of reprocessing plants.

A clean-lab is being built on schedule and should be finished by the end of 1991; it is to be used for highly precise determination of traces of toxic and essential elements, in the frame of methods, developments and certification in support of EC Directives.



## The Institute for Transuranium Elements (ITU)

The ITU at Karlsruhe executes the nuclear fuels and actinide research programmes which aim to improve the safety of the nuclear fuel cycle. The Institute also contributes to the Radioactive Waste Management Programme.

### ■ Basic Safety Research on Nuclear Fuels

Research carried out as part of an OECD/NEA-coordinated study of fuel and debris from the Three Mile Island Reactor-2 core melt-down accident, revealed that fuel melting must have occurred at temperatures far below the melting point of pure  $UO_2$ .

The heat capacity of  $UO_2$  up to 8000K was measured for the first time and a sharp drop was observed at the melting point. The results are being analysed according to predictions from current studies on reactor melt-down.

The Institute helped in the development of the European Accident Code for fast reactors, and the TRANSURANUS code describing the behaviour of nuclear fuel pin under irradiation, has been incorporated into it.

### ■ Actinide Determination and Recycling

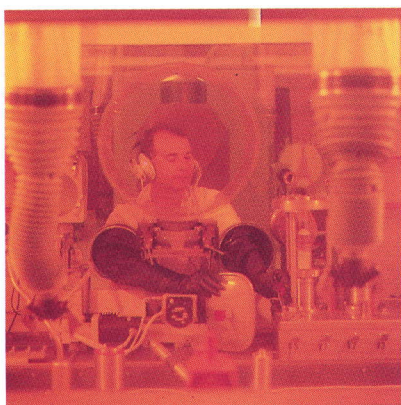
The results of the KNK II irradiation experiment with minor actinides has been compared to theoretical calculations of nuclear data in cooperation with CRIEPI and general agreement was found. A new separation scheme for minor actinides has been set up.

### ■ Characterisation of Waste Forms and High Burn-Up Fuels (Programme on Radioactive Waste Management)

Studies into the characterisation of nuclear waste forms aim to assess the thermal and mechanical stability of unprocessed spent fuels and of high level vitrified waste under long-term storage conditions. Measurements of the radioactive nuclide inventory, determination of the redistribution of actinides and fission products, performance of leach tests with various leachant compositions and investigations into the effects of radiation damage on the long-term storage behaviour of the waste material are all part of this work.

Leach tests on active glasses showed no noticeable differences compared with non-active specimens subject to the same treatment, except for the behaviour of the actinides which needs further study.

Gamma-spectroscopy of waste forms was performed using an existing facility and the measured characteristics interpreted through isotopic correlations.



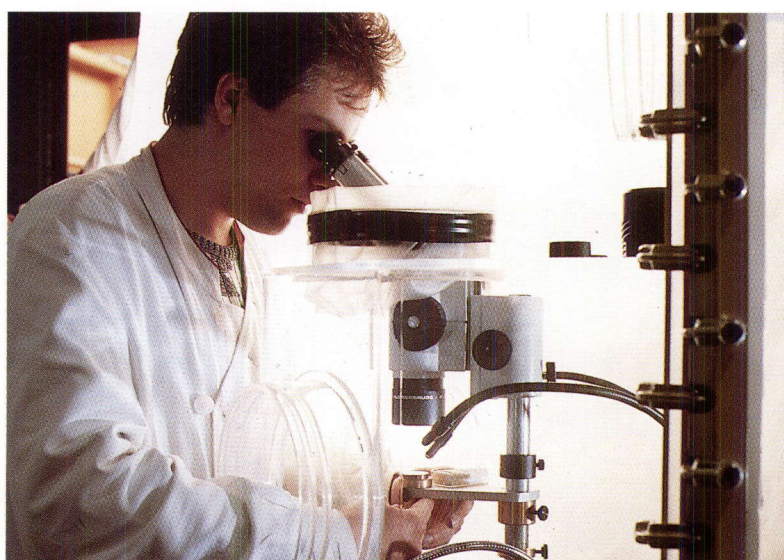
Characterisation of Radioactive Waste. Adjustment of a collimator and detector for micro gamma scanning accessed from the back of a hot cell



Actinide Research: Preparation of a sample for the measurement of the electrical resistivity under very high pressure.

## ■ Actinide Research

The central objective of actinide research at the Institute is to explain the electronic structure of actinide metals and actinide compounds, in particular the behaviour of the 5f electrons. A key problem with this



research is the change in binding energy of the 5f electrons, which occurs about in the middle of the actinide series and which strongly affects the physical and chemical characteristics of these elements and their compounds.

These goals are approached through both experiment and theory. An important basis for the experimental study is the preparation of polycrystalline and single crystal samples of actinides of high specific activity, and their careful characterisation.

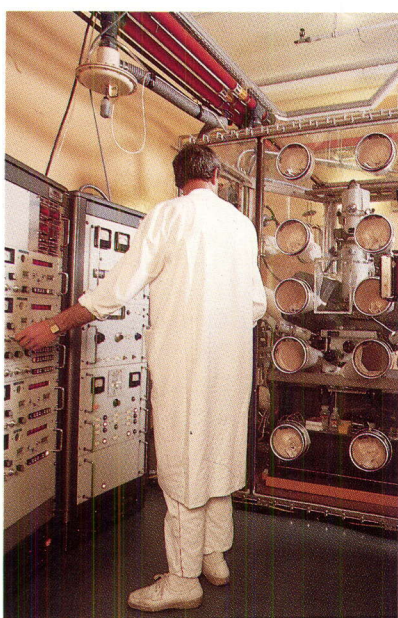
For the first time single crystals of the compounds  $\text{PuNi}_2$ ,  $\text{NpSn}_3$ ,  $\text{PuPt}_2$ ,  $\text{PuAl}_2$ ,  $\text{NpBi}$ ,  $\text{Pu}_4\text{Sb}_3$  and  $\text{U}_5\text{Sb}_4$  were prepared in previously unattained large sizes and/or purity levels.

Magnetic properties of actinide compounds with the transition metals could be interpreted by a new type of hybridisation of 5f electrons, based on neutron diffraction experiments.

A new database for thermophysical data of actinides (THERSYST) was implemented and almost 300 data sets were analysed with recommendations for confidence levels given.

## ■ Development and Performance Assessment of Measurement Systems for Fissile Materials

An expert system, based on the Laboratory's existing quality control scheme, was developed in a bid to improve the overall accuracy of the analyses to a margin of 0.1%.



Actinide Research: Special glove box installation for the electron microprobe analysis of materials containing americium and curium



## The Institute for Advanced Materials (IAM)

During 1990 the IAM consolidated previous high standards on both the Advanced Materials programme and other projects with which it is involved.

The Institute for Advanced Materials has initiated the build up of networks on advanced materials R&D topics considered important for European technological developments and with good potential for marketable products. Here, in areas such as new Intermetallics, in long ceramic fibres for composites reinforcement, experts from industry and research are joining forces on highly coordinated research projects. These actions have been initiated in close cooperation with appropriate cost shared actions, such as BRITE/EURAM and the Community Bureau of Reference (BCR).

In connection with standards and codes of practice developments for advanced materials, the Institute's viewpoint has always been that the availability of standards at the early stage of development of new technologies assist market penetration and create momentum innovation as well as providing commercial knock-on effects and assurance of end-use performance.

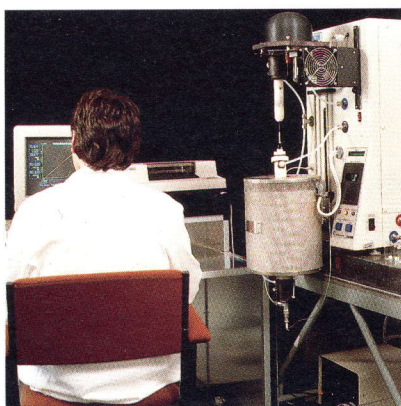
Consequently, efforts are growing rapidly with pre-normative R&D, where possible with the support of industry. In particular, in cooperation with the Directorate General «Internal Market and Industrial Affairs» the Institute, backed by the appropriate industrial firms, set up a European standard action for advanced ceramics to be executed by the European standards bodies CEN/CENELEC.

An interesting feature noticed this year is that the projects under Exploratory Research which were embarked upon in the last two years by the Institute, are already beginning to influence the shape and character of the Institute.

These activities - such as Boron Neutron Capture Therapy which is attracting interest all over Europe, the joining of metals and ceramics with the recent successful demonstration of serious improvements in the properties of joints through ion implantation pre-treatments; the computer modelling of micro hydrodynamic Marangoni flows which are providing a scientific explanation for important metallurgical phenomena - these project areas will constitute the launching pad for new projects in the next Framework Programme.

### ■ Corrosion Studies

Under its corrosion studies project the Institute introduced sophisticated highly sensitive thermobalances which allowed the kinetics by which engineering ceramics degrade to be established continuously at temperatures up to 1700°C.



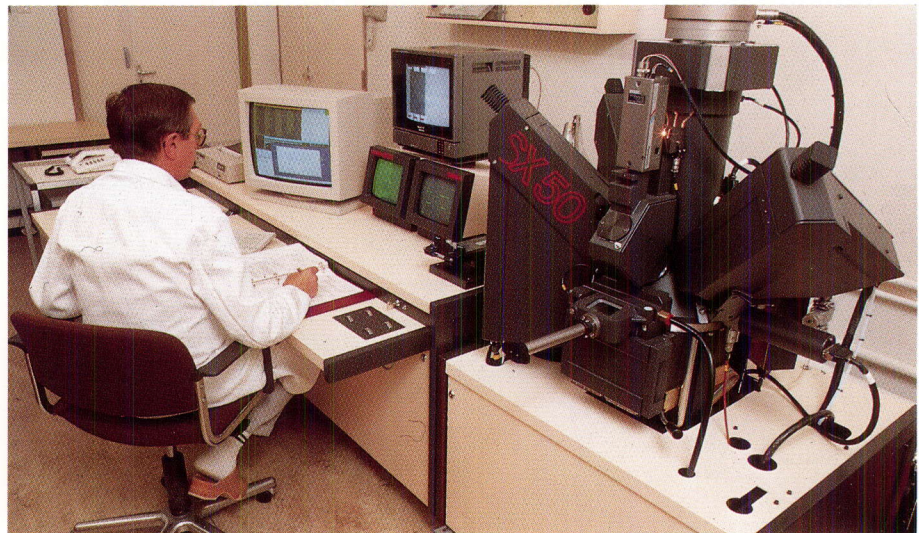
Thermobalance for hot corrosion up to 1700°C and weight change of 10 µg

Such equipment can now guide extensive long term investigations using multi-specimen autoclaves much more effectively. The Institute has also developed standard techniques involving molten salts and ash deposits to assess the behaviour of alloys and ceramics.

Corrosion-deformation synergistic effects play an important role in structural materials applications. Testing under creep and cyclic creep conditions in aggressive gaseous environment, partially with salt injection, has shown a severe influence on deformation which simulated in-service conditions, on the corrosion resistance of heat resistant steels and superalloys. The modification and development of test techniques to study intermetallic compound behaviour has started.

#### ■ Components and thermal fatigue

Progress with the components and thermal fatigue project shows that the temperature gradient and the cyclic conditions of a nuclear fusion reactor can in principle be simulated in the out-of-pile thermal fatigue rig.



Electron microscope analyser used for quantitative elemental analysis of advanced materials

In the component testing area, the Institute discovered more about the factors which determine high temperature creep behaviour of ferritic and austenitic steel under multiaxial testing conditions and were therefore able to make a significant contribution to tubular components design methodology. In close association with the Community Bureau of References, the Institute for Advanced Materials developed a European round robin testing programme for the internal pressure testing Code of Practice.

#### ■ Ceramic composite system

A ceramic composite system (silicon nitride reinforced with silicon carbide whiskers) was manufactured successfully by a low-cost, low-pressure sintering route. Strength and toughness levels are as good as high-cost Hot-Isostatic Press-material. Behaviour under mechanical loading indicated that toughening may be enhanced by a reduction in the whisker-matrix interface bonding.



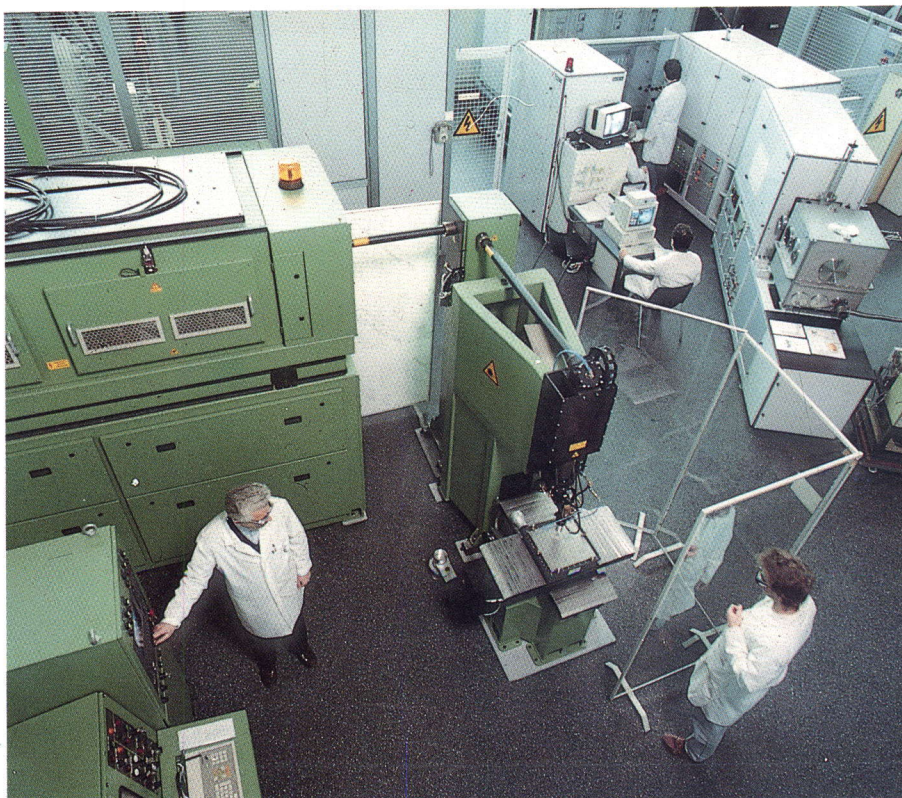
### ■ Development of NDE techniques

For the development of NDE techniques, the Institute for Advanced Materials established a methodology using X-ray diffraction to determine residual stress in surface layers of ceramic components and test pieces. The techniques have been successfully used to quantify surface stress introduced by machining and interface stresses in ceramic composites.

### ■ Surface Modification Centre

The Surface Modification Centre, in its first year of full operation, has established the parameters for the production of defined microstructure in resolidified surface layers. MoCrAlY type coatings with and without oxide phase particles have been successfully developed as well as Al/SiC composite materials by plasma spraying.

In a spin-off project the Institute has also successfully developed a prototype passive downward heat transport system. This has been tested in extreme conditions in an Alpine environment and permits the downward passage of heat collected by solar panels. This is innovative in that it does not require the use of electric pumps and apart from the initial investment, there are no running costs. A first licence for its application in solar hot water production systems has been awarded to a Portuguese firm.



A general view  
of the Laser-Ion Beam Implanter, Ispra

### ■ Cost 501

The Institute is responsible for the technical secretariat of the COST 501 action Advanced Materials for Process Engineering and has helped and contributed to the highly successful Liège Conference on High-Temperature Materials for Power Engineering 1990.

### ■ PISC (Project for the Integrity of Structural Components)

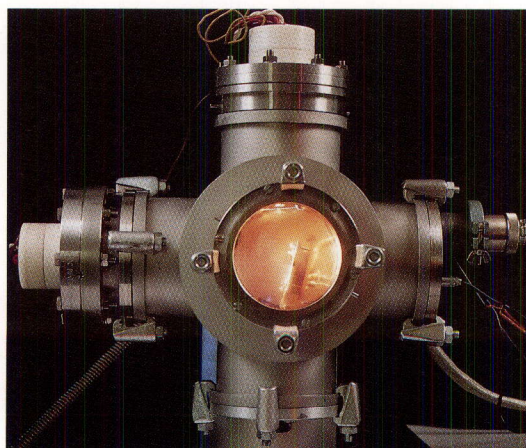
This international programme, jointly sponsored by NEA/OECD and JRC, performed by the Institute for Advanced Materials - Ispra, concerning the assessment of the effectiveness of inspection techniques and procedures and of their reliability when applied to structural steel components, is now in its third phase (PISC III project); emphasis is put on the In-Service Inspection of the primary circuit of nuclear Light Water Reactors. For most of the work, experimental activities concluded in 1990. Data collection and a preliminary evaluation of results are under way.

The main achievements are: the close coordination of this international project involving 14 countries and about 100 institutions; the manufacturing and certification of many test assemblies by the reference laboratories; the execution of round robin tests on full scale light water nuclear reactor welds, nozzle and safe-ends; the validation of mathematical models on the simulation of ultrasonic equipment failure and of the ultrasonic response on particular defects.

### ■ Contribution to the Fusion Technology and Safety Programme

The Institute for Advanced Materials contributed to this programme with the Fusion Materials project. A feature of progress was the elucidation of the effect of plasma disruptions on metallic surfaces. Results show that beyond a threshold force on the melt layer, liquid will be lost, leading to rapid erosion. For the formation of bubbles in Cr-Mn steel, a more complete understanding has been developed, considering temperatures during implantation and post-irradiation annealing.

Multi-purpose ion beam sputter device for simple ion beam sputtering from a target and/or simultaneous ion bombardment of the substrate with a second ion beam





## The Institute for Systems Engineering and Informatics (ISEI)

The ISEI at Ispra executes the Reference Methods for Non-Nuclear Energies programme and contributes to the Safeguards and Fissile Materials Management and to the Fusion Technology and Safety Programmes. Staff also contribute to various other programmes through research into structural risks and reliability, plants, socio-technical systems and artificial intelligence applied to advanced diagnostics.

### ■ Reference Methods for Non Nuclear Energies

The Reference Methods for Non Nuclear Energies programme focused on performance evaluation and implementation of certification procedures for industrial solar energy (photovoltaic/thermal) devices using European Solar Test Installation facilities at Ispra.

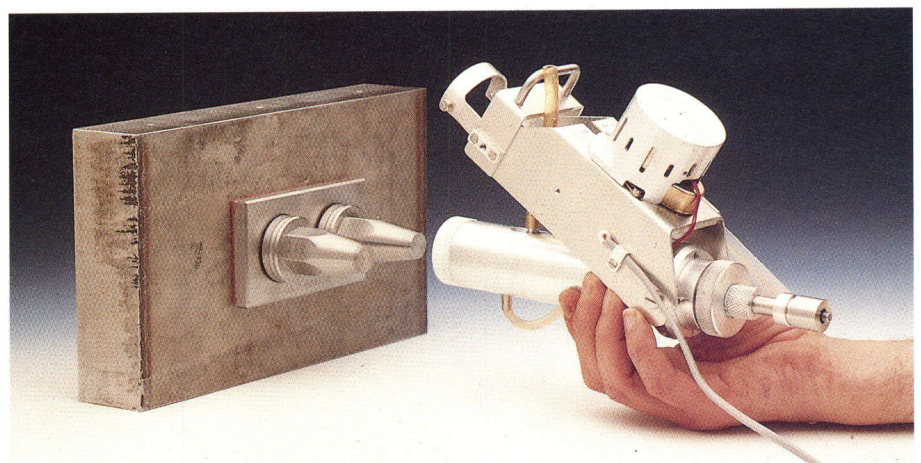
The main achievements concerning photovoltaic modules and passive solar systems are:

Based on results from the «Thin Film Qualification Task Force», the indoor degradation procedure for thin film modules was implemented (Light Soaking Test). A 300h simulated light exposure is applied to batches of commercial amorphous silicon modules which are subsequently annealed for 50h at different temperatures. The test reproduces and assesses light-induced degradation effects on advanced photovoltaic materials;

Carrier lifetime determination in the bulk and at the surfaces of commercial solar cells and of the related silicon wafers have shown that the technological cell manufacturing process does not degrade the raw material quality and that the aluminium deposition on the rear of the cell reduces drastically the «effective» carrier surface recombination;

### ■ Safeguards and Fissile Materials Management

Under the Safeguards and Fissile Materials Management programme, work on seals and identification techniques was concentrated on



Horizontal reading head for ultra acoustical tools identification developed at Ispra.

preparing and completing conclusive demonstrations of the use of ultrasonic sealing bolts on spent fuel containers for use by the Safeguards Inspectorates and in field tests.

Parallel to this, a step forward was made with Reading Techniques introducing laptop computers, new ultrasonic instruments and working on "computer controlled" software in order to get "inspector friendly" verification procedures both on site and in the office. A computer aided teleoperation system comprising a remotely guided vehicle has been designed for remote verification in storage areas.

A new laboratory for the performance assessment of containment and surveillance system (called LASCO) has been constructed and will become operational early 1991.

In 1990 an agreement was signed between the Japan Atomic Energy Research Institute and the European Atomic Energy Community, represented by the Commission of the European Communities, in the field of Nuclear Material Safeguards Research and Development. This cooperation agreement includes R&D techniques:

- to study and analyse complex systems where nuclear materials are handled and processed;
- for the containment and surveillance of nuclear materials;
- and measurement methods for nuclear materials accountancy.

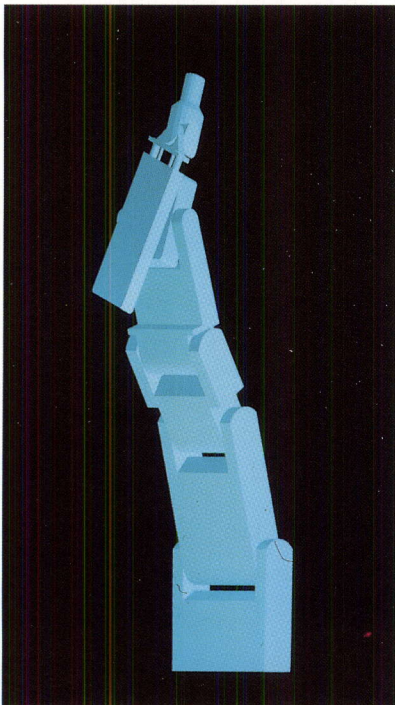
### ■ Fusion Technology and Safety.

The following steps were reached in 1990:

ISEI contributed to the design of the Next Step Machine (NET/ITER) as part of the International Thermonuclear Experimental Reactor. Staff also demonstrated remote welding and cutting of double lip vacuum seals;

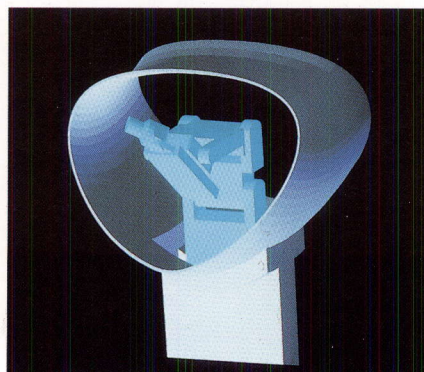
the Institute contributed to the design of NET vacuum vessel and produced a transient magneto-structural simulation of the behaviour of the blanket segment;

in the safety area, various accidents at the NET plasma facing components, namely those related to loss of coolant and loss of vacuum inside the vessel, have been analysed and their environmental impact evaluated.



Conceptual studies: simulation of robotic arm for kinematic and dynamic studies carried out in the TELEMAC Laboratory

Conceptual studies: simulation of robotic arm inside a vacuum vessel of a fusion reactor carried out in the TELEMAC Laboratory





## ■ Industrial Hazards

The main contributions and achievements are:

Risk and environmental impact assessment procedures: the results of the Benchmark Exercise on Major Hazards Analysis for an Ammonia storage plant have been evaluated and published as EUR report.

A survey of indicators and indices for environmental impact & risk assessment has been made through a Workshop organised at Ispra on May 1990. (Proceedings edited as EUR 13060 EN).

Risk management: studies on territorial risk management dealing with industrial impact were initiated and methodological results published.

Risk of Transportation of Dangerous Products on the European Scale: a study of historical accidents in relation to the transportation of hazardous materials was carried out. The results, indicate that the consequences of accidents are as severe as for fixed installations.

Human Factors in High Risk Prevention and Management: ARMA (Autoaggressive Moving Average) generator simulation package has been finished enabling ARMA processes to be simulated.

Knowledge Based Systems for risk analysis: the JRC continued to participate in two cooperative international projects: STARS (Software Tools for Analysis of Reliability and Safety) and FORMENTOR (Eureka #19).

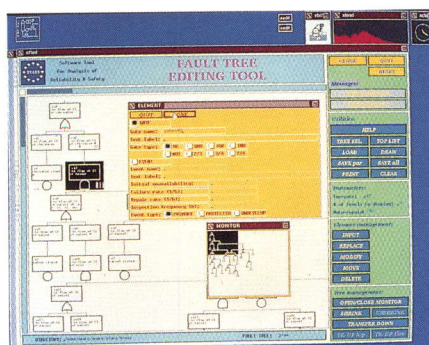
## ■ Nuclear Reactor Safety

The ISEI Institute leads JRC on Reliability and Risk Evaluation work. This work was concentrated in 1990 on two main projects: the Component Event Data Bank - CEDB and the System Response Analyser - SRA.

The CEDB component and related failure contents have been extended, notably by the inclusion of data supplied by ENRESA (Spain) from 10 nuclear power plants in operation. The software developed so far has been structured into various products which are being marketed.

System Response Analyzer: a new version of the DYLAM methodology (DYLAM-III) has been completed; in this version, which constitutes the SRA driver, a new methodology for the evaluation of the dynamic probability of sequences has been implemented.

STARS project. The Fault Tree Editing Tool is a module which allows easy modification and construction of, as well as navigation into, complex fault trees.





3D image of the deformation of a damaged specimen in carbon-epoxy composite as obtained by computer elaboration of holographic interferograms

### ■ Non-intrusive methods for materials diagnostics

ISEI carries out mainly specialised research on non-intrusive methods for materials diagnostics. Main achievements are:

- successful application of real time interferometry on composite specimens for damage mapping;

- successful application of thermal emission technique on composite material specimens (carbon epoxy specimens supplied by an aircraft manufacturer) during tensile tests to rupture: a clear evolution of the temperature has been obtained, showing the progress of damage and sequential rupture of groups of fibres;

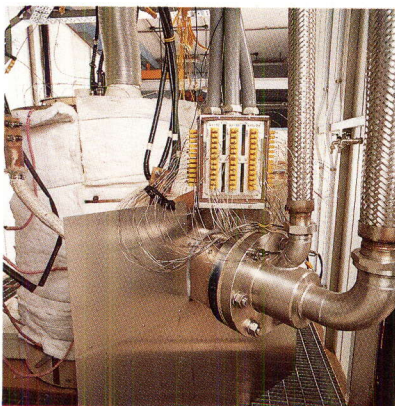
- in collaboration with IAM-Petten development of the expert system ARTIC (Assessment of Residual life time for Creep damaged components) in the frame of a Club of Utilities (CEDB, ENEL, Laborelec).

### ■ Reference Methods, Reliability of Structures

This work covers Reliability Modelling of Structures and includes both experimental and theoretical work.

Experimental work is centred on tests on 1:5 scaled vessels and fatigue tests on vessel A were completed. Results so far show both the positive effect of cladding residual stresses (slowing down of the propagation of the inner crack tip) and one validity of a superposition model for environmental fatigue.

Theoretical work head to the development of RAMINO (Reliability Assessment for Maintenance and Inspection Optimization), a new option of the COVASTOL code, and a new, more powerful, algorithm for fringe analysis in laser interferometry application.



A detailed view of the PTS (Presurised Thermal Shock) test component showing the cabling of the 144 thermocouples



## The Institute for Safety Technology (IST)

The IST at Ispra contributes to the Reference Methods, Reliability and Structures, Nuclear Reactor Safety and Industrial Hazards programmes. It also operates the PERLA and PETRA nuclear facilities and is responsible for constructing the ETHEL laboratory.

### ■ Reference methods, Reliability and Structures - Reaction Wall Project

The Institute made substantial progress in building up the reaction wall project. This programme aims to develop and validate computational mechanics calculation tools for predicting the non-linear behaviour of reinforced concrete, masonry and steel structures.

The Institute successfully launched a programme involving an association of national research organisations which both makes best use of existing competence and installations and is designed to define structures to be tested on the reaction wall. Completion of the test facility is planned for 1991 and new forms of the pseudodynamic test method will be implemented. To evaluate the potential of the pseudodynamic test methods, tests were made at various cycling frequencies incorporating hold periods to allow stress relaxation in reinforced concrete.

### ■ Nuclear Reactor Safety

In the area of nuclear reactor safety studies IST concentrated its efforts on analysing large hypothetical accidents either for light water or for sodium cooled reactors.

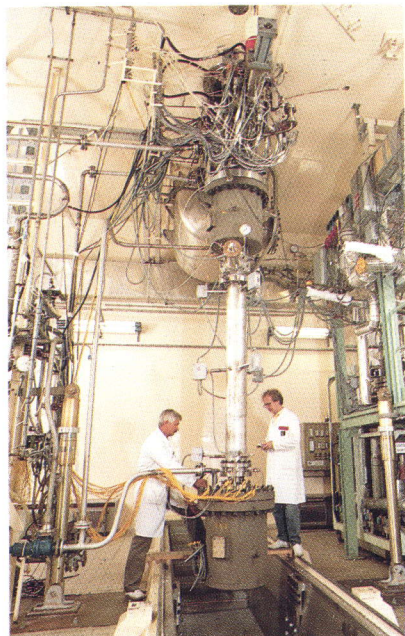
Pluriannual efforts have led in spring 1990 to the publication and distribution of a first version of the European Accident Code (EAC-2), to EC Institutions and which is expected to become the European Reference Code for predicting the early phase of whole core accidents in breeder reactors.

Equally significant was the progress made in the «Source Term» (prediction of radioactive material which could be released from a Light Water Reactor containment building during a hypothetical accident).

A new informatics structure is being developed together with organisations for a best-estimate «Source Term» calculation code which will be verified among others, against experimental data to be obtained by the Phebus fission products in-pile experiments jointly sponsored by CEA and JRC.

The FARO facility (a 150 Kg  $UO_2$  melting device connected to various test sections) provided additional results for the evaluation of possible blockage formations when molten material penetrates cold structures located beneath the reactor core.

Tests have since been stopped to allow for modifications to the facility which are needed for testing in-vessel phenomena during damage of a LWR core. This latter activity is jointly sponsored by JRC and United States Nuclear Regulatory Commission.



General view of the FARO-Blokker II test section for blockage studies



The reaction wall test facility under construction



## ■ Industrial Hazards - Runaway Reactions

IST started work on non-nuclear safety/environmental problems a few years ago. In this programme main emphasis is on the investigation of process and equipment failures in chemical and process industry.

### *Anomalies in Operation of Chemical Reactors*

A series of verification tests were conducted in FIRES, a 100 litre batch reactor, after having precalculated the results with a newly developed simulator. The most important results of this work regard the validation of scaling criteria and the prediction of critical runaway conditions for the investigated chemical reaction.

### *Emergency Fluid Discharge*

Venting experiments involving fluids in which a fast runaway reaction occurs (hydrogen peroxide decomposition) were executed in the 50 litre vessel of the MPMC facility. Computer code analyses were made of venting experiments carried out in vessels of different volumes, and with liquids of greatly differing viscosities. The development and assessment of the JRC emergency venting code RELIEF was continued.

A prototype of a new two-phase mass flow meter was built, which is based on a combination of gamma densitometry, tomography and correlation analysis.

### *Release of Hazardous Fluids*

Prediction of the Dispersion of Dense Vapour Clouds: Different turbulence models, which are a key problem in dispersion, were assessed with a three-dimensional computer program. A fast running one-dimensional prototype of a dispersion code was developed, allowing the prediction of two-dimensional wind tunnel experiments («shallow layer» model).

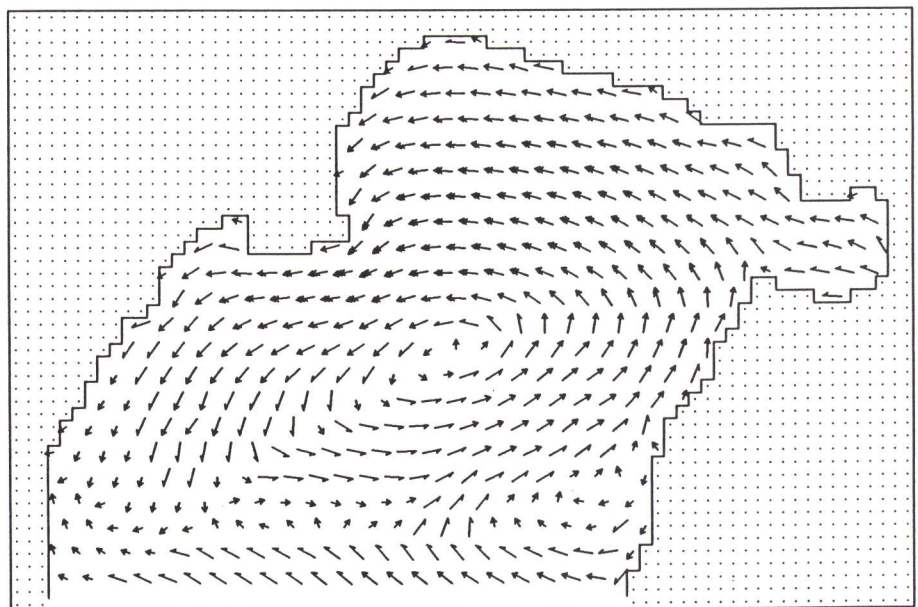
Explosion Hazards: First promising results were obtained in the numerical simulation of reactive transonic flow as it occurs during deflagration/detonation processes. A two-dimensional pilot version of the computer program allows accurate tracking of flow discontinuities (e.g. shock waves) and their interaction with obstacles.



Installation of the 100 liter chemical batch reactor within the FIRES bunker

### ■ Environmental Fluids Dynamics and Pollution

In close association with the Institute for Remote Sensing Applications the sea modelling activities succeeded in describing numerically the phytoplankton dynamics of the Adriatic Sea.



Velocity vector field for wind-driven circulation in the Northern Adriatic

### ■ Nuclear Island

In the nuclear island (the part of the Ispra site, where the nuclear facilities are concentrated) operated by the Institute for Safety Technology three new laboratories for waste, fusion and safeguards activities are near completion and have made substantial progress in their licensing procedures. More details are given in section 3.3 (Large Installations).

#### *Radioactive Waste Management*

Commissioning of the PETRA facility continued identifying the critical areas for increased performance and plant flexibility, taking into account customer requirements, in particular the specifications proposed by ENEA under the existing contract.

Both the analytical hot-box and the pneumatic link-up with the radiochemistry building were commissioned. The computerised process control system has been updated, tested and made operational.

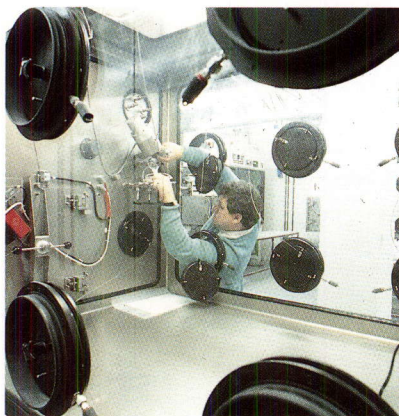
Measurement of low and very low Plutonium contents in waste drums: the neutron signal frequency distribution of cosmic radiation and its time variation were investigated and theoretical studies performed in a bid to reduce the sporadically occurring cosmic radiation when measuring the Plutonium in the mg range.

#### *Safeguards and Fissile Materials Management*

The PRE-PERLA facility was fully operational during 1990. The final operational



PETRA facility: Preparation of a sample for radiometric assay in a hot analytical box



Completing the assembly and installation of glove-boxes in ETHEL

license has been notified to JRC by the Italian Ministry of Industry and Commerce. The development of user-friendly instrument software continues. A gamma data base was completed and used in a performance exercise.

An international workshop on Plutonium isotopic composition determination through the MGA codes has been carried out with help from IAEA, EC and US laboratories in October 1990. A first assessment and intercomparison of calorimeters was carried out.

Studies were performed on neutron measurement interpretation models concerning in particular the theory for time correlation analyser dead time corrections.

#### *Fusion Technology and Safety*

The civil infrastructure systems such as the building, electrical supplies, heating and ventilation and fire detection equipment for the European tritium laboratory (ETHEL) have been installed and system testing initiated. All experimental and process glove-boxes have been installed in the laboratory and significant on-site testing fulfilled. Similarly, the small and large caissons are finished with only testing still needing to be done. The gaseous decontamination unit was installed in the building. All principal tritium services such as the tritium magazine and waste conditioning plant, together with the radiological protection and general data acquisition and control systems, are ready for installation. Finally, the commissioning organisation with the architect engineer was established and the document of proposed tests, together with initial procedures, has been agreed.



## The Environment Institute (EI)

The EI at Ispra executes for the Environmental Protection programme and partly executes the Radioactive Waste Management Programme.

### ■ Environmental Protection

#### Environmental Chemicals

##### *Environmental Chemicals Data Information Network*

In 1990 the Environmental Chemicals Data Information Network data files on the environmental fate of chemicals have been improved and extended through a link-up with Berlin's Umweltbundesamt; in 1990 ECDIN started to exchange data with an aquatic toxicity data bank developed by the University of Minnesota's Natural Resources Research Institute and the Research Laboratory at the Environmental Protection Agency of the USA.

##### *Indoor Air Quality and its Impact on Man*

Under COST action «Indoor Air Quality and its Impact on Man» the Institute published the report «Strategy for Sampling Chemical Substances in indoor air». A summary report «Indoor Pollution by Formaldehyde in European Countries» is being published whilst a summary report on «health effects of indoor air pollution» has been completely redrafted.

Indoor air pollution research activity focussed on the development of methodologies to characterise pollution sources through small test chambers, including modelling. A methodology to assess organic emissions from household products was developed and evaluated. A follow-up study of volatile organic compounds in indoor air on a sample of 13 homes, performed by passive sampling has shown much lower concentration than 1983-1984 readings from the same homes. One reason may be the decrease of Volatile Organic Compounds emission sources as solvent-based consumer products are replaced by water emulsions.

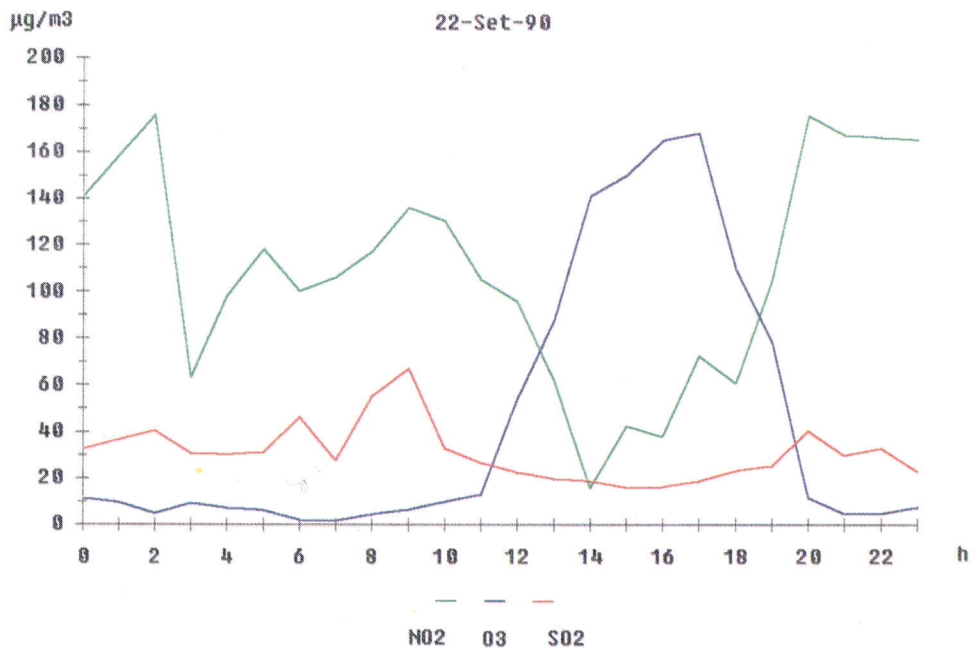
#### Air Chemistry

##### *Gas particle interaction processes in the atmosphere*

The Environment Institute is looking at gas particle interaction processes in the atmosphere in a bid to evaluate the possibilities of using a commercial

A DOAS system (OPIS) aligned to a xenon lamp for measuring air pollution in Milan city centre. The optical path is 475 m long, its elevation is 30 m above the ground. Measured parameters are SO<sub>2</sub>, NO<sub>2</sub>, ozone, HONO and formaldehyde.





Measurements of SO<sub>2</sub>, NO<sub>2</sub> and ozone by OPSIS spectrometer aligned to a xenon lamp taken in Milan city centre

differential optical absorption spectrometer to obtain simultaneous information on concentration levels of pollutants (NO<sub>2</sub>, O<sub>3</sub>, HCHO, HONO) and characteristics (total number concentration of particles, mean particle diameter) of liquid water aerosols present in air. A preliminary study on the formation of HONO in polluted air in the presence of fog, was performed in the frame of a project aiming to analyse the influence of liquid aerosol on the physical-chemistry of some pollutants.

A detailed study of the reaction of dimethylsulphide with the nitrate radical was carried out in a smog chamber and in large Teflon bags as part of the Environment Institute's research into the atmospheric oxidation and cloud forming properties of organo-sulphur compounds in the marine atmosphere. Methanesulphonic acid (MSA) and SO<sub>2</sub> have been found to be the most abundant sulphur-containing products, together with H<sub>2</sub>SO<sub>4</sub> in minor quantities. Significant differences have been found in the gas to particle conversion of MSA and H<sub>2</sub>SO<sub>4</sub>.

As part of a continuing work into night-time oxidation of biogenic unsaturated hydrocarbons, smog chamber studies on mechanism and products of the reactions between the nitrate radical and dialkenes were performed. Unsaturated carbonyl nitrates have been found as main reaction products, contrary to the case of the daytime oxidation of dialkenes by OH radicals.

#### Air Pollution - European Monitoring Network

##### *Tracer technique*

In the field of atmospheric transport and dispersion of pollutants a tracer technique has been developed that can be applied from short to very large distances. The technique is based on a mobile laboratory, consisting of a van equipped to measure perfluorocarbon compounds collected at ground level and at altitude. The measurements are backed by three dimensional acoustic radar data - providing wind profile - and by a mobile micrometeorological station.

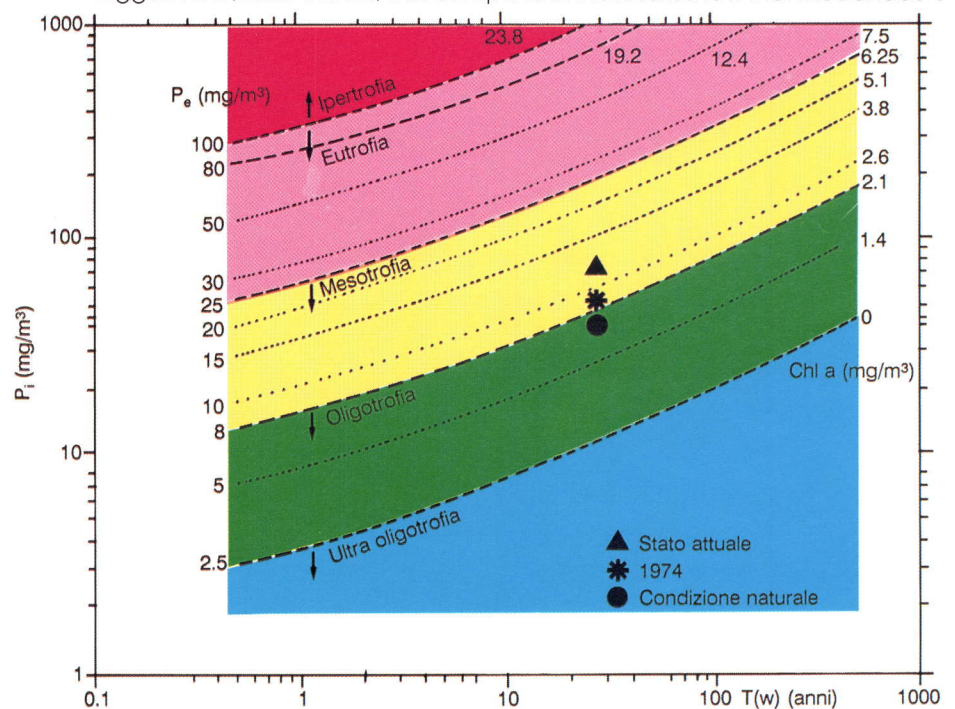


The meteorological information is then used as input data to the various atmospheric transport models, producing values of the tracer concentration which are easily compared with the measurements. The whole scheme has been successfully tested on the lake district around the Ispra site and used on larger distances such as some alpine valleys under the TRANSALP-TRACT project which is a sub-project of the EUREKA environmental project EUROTRAC.

### Water Quality

#### *Quality of the European Community's biggest lake, Lake Garda*

Research into the environmental quality of the European Community's biggest lake, Lake Garda, was completed. The results show that the Benaco's



Estimated trophic evolution in lake Garda in the last 15 years (averaged)

actual trophic state of the lake lies in the lower limit of mesotrophy. As far as the heavy nutrient levels which still affect the lake go, a further 65% reduction is needed before the lake will reach the final objective laid down by the Lombardy Region's General Water Clean-up Plan.

Heavy metal and organic micro-pollutant levels in lake water and in some fish species are considerably lower than those laid down as acceptable for human consumption. No significant heavy metals and organic micro-pollutant contamination was found in lake sediments. This investigation constitutes an important contribution to the numerous initiatives which have been launched to form a positive action plan for the restoration of the Po river basin.

### Chemical Wastes

#### *The OIL-PCB MANAGER (OPM) information system*

As part of the Chemical Emergency Management decision support system, the OIL-PCB MANAGER (OPM) information system was developed to man-



age containers and electrical devices with PCB (polychlorinated Biphenyl) contamination levels above the permitted EEC limit (EEC Directive 89/677). It is also a support system helping decision-makers to coordinate, prevent and mitigate emergencies at different complexity levels: installations, sites, containers, oils/fluids.

OPM is designed to help legally responsible agencies such as regions, provinces, health authorities and utilities which deal with containers holding PCB fluids. It is organised in a modular way and it can satisfy the users' changing requirements. OPM includes a data base management system with on-line help menus, a flexible reporting system, bibliographies on current legislation, PCB fluids, accidents involving related chemical compounds and a risk priority module. New modules are under development for the evaluation of operating apparatus status (prevention), for emergency management and for geographical data representation.

#### Environmental Studies on the Mediterranean Basin

##### *The MITO project*

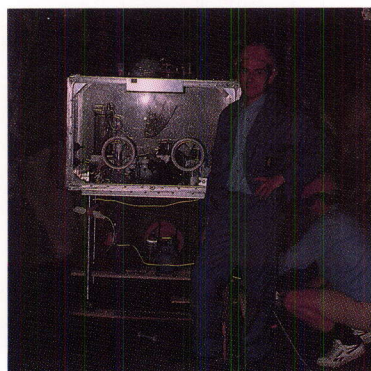
The Institute joined forces with scientists from Italy, France, Spain, Portugal and Greece for the MITO project of microphyte toxins. The MITO team have decided to concentrate on four major areas: flow cytometry, aquatic biotoxins, algal physiology and remote sensing. A Steering Committee of Mediterranean Country representatives was set up to manage a series of laboratory intercomparisons on critical environmental pollutants.

Priority will go to work on mercury, arsenic and PCBs and other persistent organochlorine compounds and the first test materials, including tuna fish muscle tissues and a macro algae material have already been prepared.

#### ■ Radioactive Waste Management

The aim of the Environment Institute activities in this field is the assessment of the long term safety of waste disposal sites. Scientists assess the safety of the different geological formations being considered for use as waste disposal sites in the European Community.

Scientists studied the migration behaviour of inorganic contaminants in ground waters, resulting from leaks from a geological repository. Special emphasis was placed on the development of non-invasive speciation methods and on the quantitative description of retention mechanisms.



Anaerobic sampling and analysis of natural waters in connection with the in-situ studies of pollutants migration in geological formations

## The Institute for Remote Sensing Applications (IRSA)

### The IRSA executes the programme on the application of remote sensing techniques

#### ■ Monitoring of Land Resources and their use.

##### The Ardèche experiment

The Ardèche experiment deals with land-use mapping and land-cover statistics over the French department of Ardèche by automatic processing methods using mainly LANDSAT THEMATIC Mapper data (30m resolution). In 1990 the Institute used multitemporal processing to map agricultural and vegetation classes automatically and the global results of this work, covering some 5600 Km<sup>2</sup> will soon be available for the whole department

#### ■ Advanced image processing

##### Image segmentation algorithm

A first version of an image segmentation algorithm combining interactive region growing and spectral spatial clustering was obtained. Moreover, the Institute made considerable progress using artificial intelligence in improving image classification.

#### ■ Global Change studies

##### Tropical vegetation burning

Being a major agent of change and a most important link between biosphere and atmosphere, tropical vegetation burning was given particular attention by the Institute in 1990. Comparison between satellite sensor data at different resolutions has begun to provide guidelines for a global biomass burning monitoring system.

#### ■ Monitoring of Marine Environment

##### Sea modelling

1990 has been a transition year for the Global Change Studies programme, Monitoring of the Marine Environment. Sea modelling at the JRC started from scratch only two years ago in 1988 and in 1990 was still largely at the test stage whereby hydrodynamic numerical exercises were done to both familiarise staff with the available models and to analyse model behaviour.

#### ■ Advanced Technology

##### Microwave Remote Sensing Activity:

the Institute concentrated on the development of all-weather remote sensing techniques in both operational and scientific work. 1990's most significant developments are summarised below :

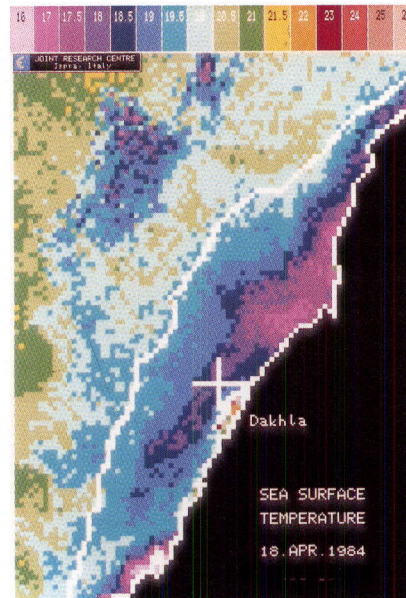
development and construction of the European Microwave Signature laboratory has continued successfully (see section 3.3.).



High spectral resolution scanner image taken over the Ardèche.



Spatially aligned satellite image of sea surface temperature of the North West African coast



The Interim Microwave laboratory was used extensively. New approaches to calibrate dispersive polarimetric signatures were investigated and tested. Two and three dimensional radar imaging techniques have been developed and successfully applied.

The Radar Signal Processing Facility was upgraded, new hardware components added and software tools integrated. The team developed a whole suite of software tools such as a package to analyse interactively multi-channel radar data sets, which enhances radar features and a package to analyse multifrequency polarimetric radar data. When the Institute put the latter in the public domain more than 50 groups from around the world responded.

The first elements of a Radar Simulation Workstation were developed, among them a radar wave forest interaction model based on different forest components.

The MAESTRO 1 airborne SAR campaign continued through the data delivery, distribution and analysis stages. The ground data were compiled, tested, verified and integrated into the data base EURACS.

#### Field Radiometry

Analysis of field data acquired during the EISAC tests was concluded and proved essential in that it showed the airborne GER spectroradiometer had been incorrectly calibrated. This was adjusted.

#### Laserfluorescence remote sensing

CISE Milan delivered the airborne laser fluorosensor to Ispra in February where it was installed in a transit van. Oil measurements show that it is possible to record the time resolved fluorescence spectrum with a laser pulse up to about 200m from the target. These preliminary results have already attracted a great deal of interest from both scientists and the major oil companies.





MAIN  
ACHIEVEMENTS  
AND  
MILESTONES

# 2 JRC

## *Exploratory Research*

**NINETEEN** projects were financed in 1990 of which ten were new and nine continued the previous year's most successful projects. The JRC's expanding environmental pollution and food and drug standards activities place increasing demands on chemical analysis techniques.

The main achievements of JRC Exploratory Research projects in 1990 were:



On-line capillary high pressure liquid chromatograph - Fandem Mass Spectrometry for the detection of trace and ultra-trace amounts in environmental and food and drug analysis

### Laboratory for Separation Science (The Environment Institute)

The activity is related to hydrophilic substances, biopolymers, biological pharmaceuticals and air pollution samples. This research involves the optimisation of separation techniques in tandem with Mass Spectrometry to determine trace and ultra-trace amounts of chemicals in different matrices.

This year the separation techniques developed were Microliquid Chromatography and Capillary Electrophoresis. Both systems have been successfully linked to Mass Spectrometers using fast atom bombardment for high yield soft ionisation. The Institute reached detection limits in the subpicomole range for peptides and continues work on other chemical classes.

### Innovative Laser Technologies for Chemical Analysis (The Environment Institute)

The goal is to develop laser induced ionisation and fluorescence methodologies coupled with mass spectrometry to obtain unprecedented sensitivity (single atom) and isotopic selectivity. An experimental fluorescence/furnace system was assembled and optimised to determine a toxic element (thallium) in biological samples such as human brain tissue, urine and other samples, with the detection power of 0.1 femtograms ( $10^{-16}$  g) in 10 microlitres of solution.

For the first time an experimental demonstration was achieved of a novel photon detector based upon the ionisation of magnesium in a flame. Photons due to spontaneous Raman scattering were observed, and allowed absorption oscillator strengths down to  $10^{-10}$  (forbidden transitions) to be detected for atomic spectral lines. Simultaneous absorption, fluorescence and ionisation measurements are underway to characterise the ionisation detector in terms of quantum efficiency and ion yield.

The fifth International Symposium on Resonance Ionisation Spectroscopy, jointly coordinated by the Institute of Resonance Ionization Spectroscopy of the University of Tennessee (USA) and the Environment Institute was held in Varese from 16 to 21 September 1990.

## Neural Network (The Institute for Systems Engineering and Informatics)

Scientists believe that computers can learn from experience to perform certain tasks in the same way in which the human brain is believed to operate; this could lead to important advances towards the integration of computers into daily life. Several projects based on this hypothesis are ongoing and have led to link-ups with other institutes involved in different aspects of computer science.

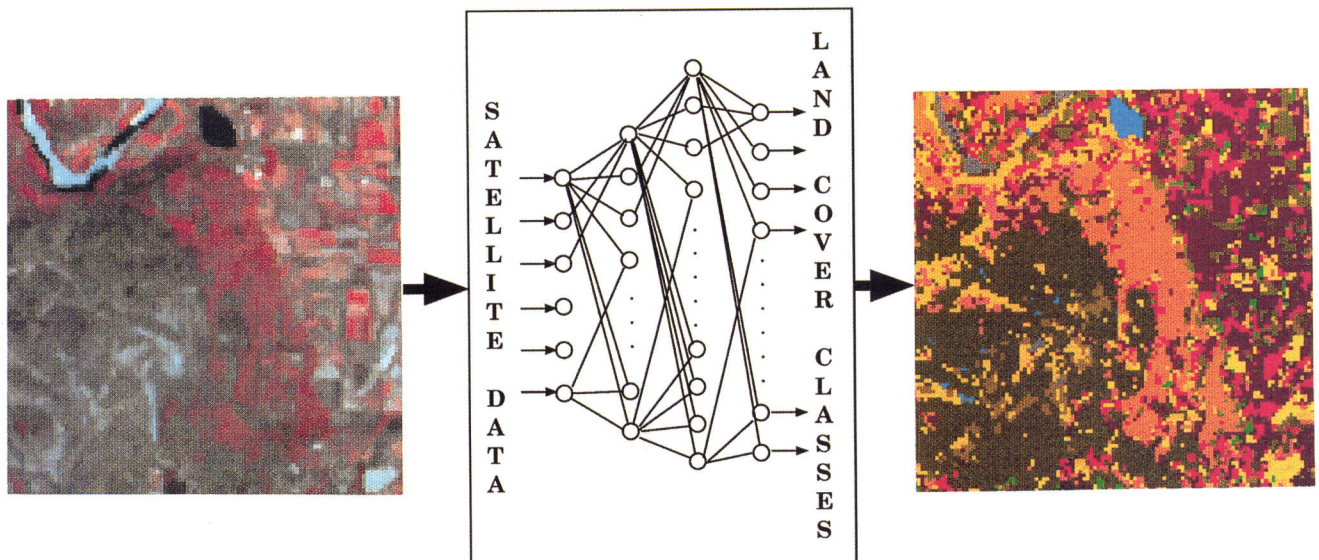
### ○ *Application to Time-Series Analysis*

The scope is that of performing uni- and multivariate time series analysis on data samples by Neural Network (NN) technique. A software package for systematic exploration of the NN-capability has been implemented. Applications to data banks on industrial conjuncture for multivariate time series forecasting have been performed.

### ○ *Applications to Remote Sensing Images (in collaboration with the Institute for Remote Sensing Applications)*

Remote sensing images contain information not directly accessible to normal statistical analysis but often appreciable by the human brain «at sight». Data sets also include spatial, temporal and spectral patterns recognisable only after extensive data handling and in future the data sets will become even more complicated and extensive.

Image classification using neural network techniques





Two application studies are underway with very encouraging results. One depends on a time series of the upwelling phenomena off Northwest Africa (wind field and sea surface temperature), and the second uses spectral data from Landsat and Spot for classification purposes.

○ ***Exploitation of Biological Adaptive Systems for Process Control  
(Institute for Systems Engineering and Informatics)***

The objective is to perform a comparative study of three adaptive techniques of a «biological» nature for the control of dynamic processes. The three adaptive techniques which have been studied on a number of benchmark exercise are the Genetic Algorithm, the Neural Networks and the Immune Network.

A working group on Biological Adaptive Systems has four members: JRC - ISEI; Brussels Free University; Ecole Polytechnique, Paris; Università degli Studi di Siena. The benchmark exercise undertaken consists of four case studies of increasing complexity, namely, a simple tank, a cart-pole, a simulated robot and a pumping system of a nuclear plant. Each exhibits at least one of the following characteristics; non-linearity, instability, inverse stability, unmodelled dynamics and unstructured perturbations.

## **Boron Neutron Capture Therapy (Institute for Advanced Materials, Petten/Institute for Safety Technology)**

The clinicians sub-group of the concerted Action of the European collaboration group on Boron Neutron Capture Therapy specified the parameters of the neutron beam, namely:

- a neutron fluence  $\geq 10^9$  n/cm<sup>2</sup> sec;
- a mean neutron energy  $\leq 8.1$  keV;
- an incident gamma dose  $< 0.5$  Gy per treatment of  $3 \times 10^{12}$  n/cm<sup>2</sup>.

This epithermal neutron beam was commissioned on time in August, and immediately the following programme was launched:

- design, construction and installation of the shielding walls of the irradiation room;
- characterisation of the epithermal neutron beam;
- start of radiobiological experiments with cell cultures and instrumented phantoms;
- design of the target for Selenium production intended for PET (diagnostic) work.

The principal goal now of this project is to produce sufficient data within two years to determine the healthy tissue tolerance in a patient during the planned treatment.



Aerosol particle agglomeration in a sound field.

## Acoustic Aerosol Scavenging (Institute for Transuranium Elements)

Encouraged by the successes of the previous year with the application of a high intensity sound field to particle agglomeration and elimination from static atmospheres, the Institute made new in-roads in 1990.

- continuation of studies under static conditions with higher sound intensities ( $\leq 1$  kW)
- initiation of experiments under dynamic conditions
- experiments at frequencies  $< 21$  kHz and employment of seed aerosols to accelerate coagulation
- theoretical and practical preparation of particle drift experiments using Oseen Forces.

Throughout this research the ITU considered industrial applications. Acoustic aerosol scavenging can be used to purify flue and off-gases under dynamic conditions to improve industrial filters by pre-treatment of aerosols. It can also aid fire fighting in confined spaces and improve visibility in tunnel fires and smouldering, underground rubbish dumps.

The ITU has now applied for a patent for its unique «acoustic chamber for aerosol pre-conditioning of industrial off-gases».



MAIN  
ACHIEVEMENTS  
AND  
MILESTONES

# 2

## 3 JRC

### *S/T Support to Community Policies*

#### JRC AT WORK FOR OTHER COMMUNITY POLICIES

**BESIDES** contributing to the Community research policy through the specific research programmes, the JRC is called on by other Directorates General to carry out studies or provide advice and services necessary to further the policies for which they are responsible.

This work is commissioned by establishing contracts between the customer Directorate General and the JRC. It represents a very small but important part of the Commission's technical support needs; important in view of the JRC's particular range of expertise and its independent and objective point of view.

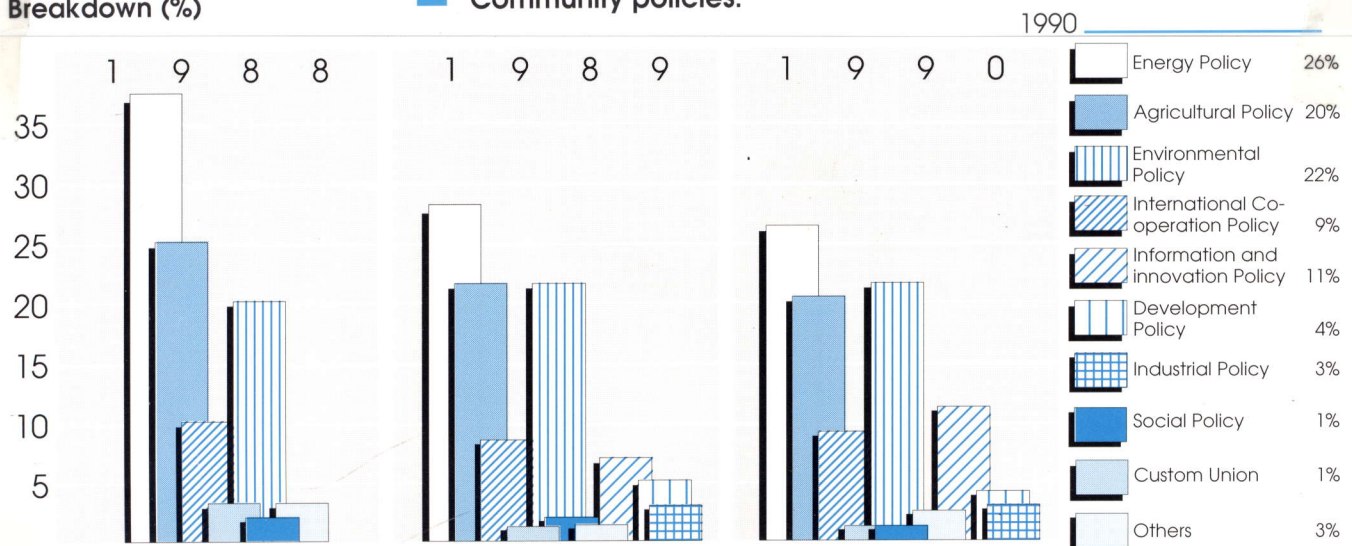
The most important JRC contributions concern the following fields:

- the development and testing of instruments and data evaluation methods (of interest to IAEA and the EURATOM Safeguards Directorate) for verification activities in EC nuclear facilities,
- the development of methodologies which integrate remote sensing data in the elaboration of statistics for crop acreage and agricultural production in the EC,
- the development of monitoring techniques to protect the health of workers in industry and the assessment of the industrial risk to the Public,
- the protection of the environment in several of its aspects such as atmospheric pollution, water quality, dangerous and toxic waste and chemical control,
- the work of the laboratory for food analysis with special reference to wine and the rational use of energy and the demonstration of new energies.

Some of these actions are long-term, while others involve quite rapid responses to specific policy questions.

In 1990 JRC scientific and technical work accounted for 15% of the JRC budget, compared with 13% in 1989 and 10% the year before; Figure 1 shows how this support was divided amongst the various Community policies.

Figure 1  
JRC Support  
to EC Policies  
Breakdown (%)



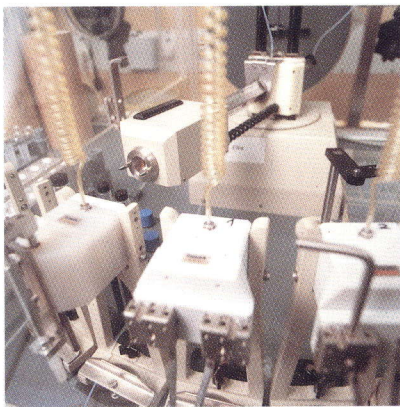
## International Cooperation

### ■ IAEA Safeguards (CBNM, Environment, Safety Technology, Systems Engineering and Informatics, Transuranium Elements and Administration Directorate)

The IAEA Safeguards inspectors receive technical support in a large variety of disciplines such as nuclear measurement, sealing and surveillance techniques and accountancy methods. In 1990 the JRC and the IAEA carried out a major review of the support work in order to concentrate efforts on a more limited number of tasks.

The main achievements are as follows:

- a robot for the preparation of samples in view of their mass spectrometric analysis is being installed at the Gatchina reprocessing plant (USSR) for long-term field testing;
- a two week physical inventory verification exercise on highly enriched uranium material has been organised at the PERLA facility in Ispra;
- several Non Destructive Analysis calibration campaigns were performed jointly with IAEA staff on Plutonium measurements by high-resolution Gamma spectrometry;
- a laser prototype scanning system developed at the JRC has been installed at a spent fuel storage pond in Saluggia, Italy for field testing. Furthermore, a TV camera and a time lapse recorder were connected to the system and may be triggered by an alarm coming from the laser system;
- the image processing system for reviewing aid, installed at IAEA headquarters which is now being tested by IAEA staff;
- sealing systems for Mixed uranium plutonium oxide fuel assemblies have been studied and two laboratory prototypes were constructed;
- support was provided to the improvement of the IAEA safeguards information systems and more particularly for the transit matching of declarations;
- the study of the solid spike technique for reprocessing input analysis has been completed and is to be tested in hot conditions.



Sample preparation by robots for subsequent safeguards analysis by mass spectrometry

### ■ Programme of Assistance and Technical Cooperation in favour of Developing Countries (PACT)

Under an agreement with the IAEA around 10 scientists, from different developing countries, have spent up to 12 months at Ispra on a DG I grant, training in advanced analytical techniques such as atomic absorption spectrometry, X-ray fluorescence spectrometry and instrumental analytical chemistry.



### ■ Application of remote sensing to marine productivity (Remote Sensing Applications)

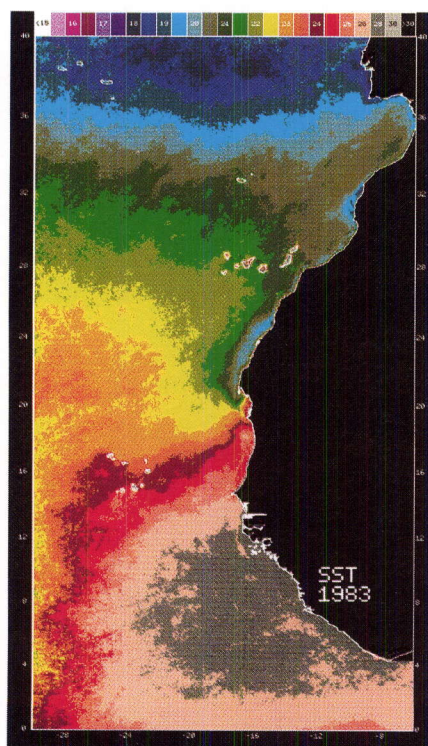
Application of satellite images has been concentrated on Global Area Coverage (GAC) images from NOAA satellites. All available GAC images from January 1981 to December 1984 have been processed into monthly composites of Sea Surface Temperature maps. Together with the wind data which have been processed for the same period they constitute a unique data source for meso- and large scale studies of oceanographic conditions in the area. This data set is examined within the collaboration agreement with Morocco and simultaneously used for network applications at the JRC.

The software for processing AVHRR data has improved and is now in a state that should allow for wider distribution. Negotiations with software distributors were due to be finalised.

A joint project with the University of Las Palmas lead to the first systematic assessment of the oceanographic conditions in the waters surrounding the Canary Islands. Separate studies are carried out on the wake effect in the lee of the islands and on the characterisation of the turbulent «giant filament» in the Cap Blanc area.

Work with Morocco has been stepped up. In 1990 the Institute and Moroccan scientists jointly researched the production and analysis of GAC data and meteorological data, drew up pilot projects to study aquiculture and macro algae, and set up numerous oceanographic campaigns for 1991.

Yearly average temperature of the Central East Atlantic Ocean for 1983. Such Data is a clear indicator for the coastal upwelling phenomena off the N.W. African coast, currently under study



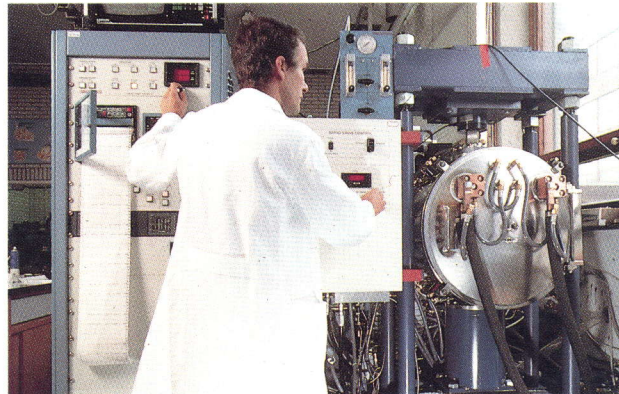
## Industrial Policy

### ■ World Shipbuilding Data Bank (Systems Engineering and Informatics)

The object of the project is to establish an easily accessible and independent register of world shipping tonnages.

### ■ Standards for ceramics (Advanced Materials)

The availability of standards and pre-standards at an early stage of technological development is vital in order to promote innovation, the application of the technology, market diffusion and acceptance. In 1990 the Commission mandated the Institute for Advanced Materials to carry out a standardization programme for advanced ceramics. Some forty standards and pre-standards for test methods, for powders, coatings, monolithic and composite ceramics are under preparation.



Vacuum and inert gas hot press (max. temp. 1800°C, pressure 22 tons) used for ceramic processing and ceramic joining

During 1990 the Institute's work has helped the Commission through:

- the leadership of/and participation in CEN working groups,
- participation in standards drafting and round robin exercises,
- the organisation of a workshop on the Classification System for Advanced Ceramics,
- stimulation of pre-normative R & D actions in cooperation with Community Bureau of Reference,
- initiation of an interlaboratory test concerning tensile testing,
- development and improvement of test methodologies for mechanical properties and non destructive testing.

### ■ Pharmaceutical Data Bank (Environment)

Work continued on the prototype data bank with staff from the Environment Institute giving several presentations about the data bank to representatives of other Directorates General, Member States and the pharmaceutical industry. A feasibility study which should form the basis of an agreement to construct the system has been prepared and distributed.



## Social Policy

### ■ Biological Monitoring and Occupational Exposure to Chemicals(Environment)

Five monographs on biological monitoring have been published in the last year. Staff have edited the second volume on the toxicology of chemicals (EUR 12029 EN) containing the scientific conclusions on 21 substances.

### ■ Renal Insufficiencies and Trace Metals (Environment)

A report on the trace metal contamination of patients by dialysis equipment «Trace metals in dialysis fluids and assessment of trace metal exposure of patients on regular dialytic treatment» was finalised and presented to the XVII Congress of the European Society for Artificial Organs. Other studies concerned the trace metal level in autopic tissue as well as in potential indicators of exposure (skin, hair, nails), the trace metal exposure of uremic patients during the treatment of the patients with  $\text{CaCO}_3$  drugs from different origin, and the effect of Al toxicity on superoxide dismutase in vitro.



Ultra clean laboratory used for sample preparation in trace metal studies

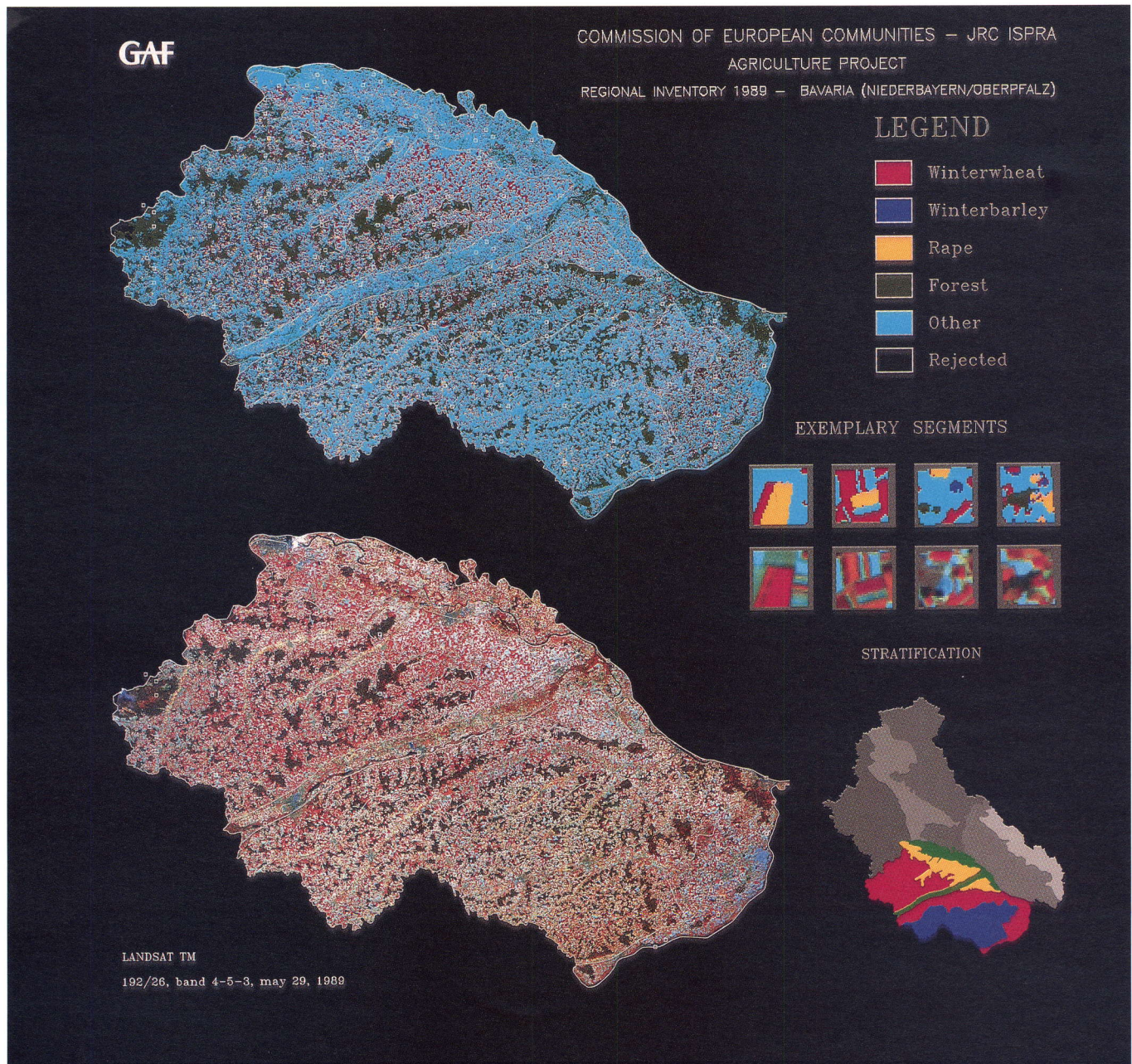


## Common Agricultural Policy

### ■ Application of remote sensing to agricultural statistics (Remote Sensing Applications)

One of the 5 regions (Bayern, Germany) covered by the Regional Inventories study. Image (Landsat TM) and classification results are shown for an area near Niederbayern (courtesy of GAF)

The methods of remote sensing control have been applied in three regions of the South of Italy and two in the North of Greece. They have allowed the FEOGA to have a much more objective knowledge of the real surfaces planted with durum wheat. In October 1990 a complete review of the methods and results was undertaken. A very efficient and





economic method is now available to control the global data provided by the local regional or national bodies in a completely independent way. It uses coverage of satellite images and some limited ground observations. The success of these inventories induced the FEOGA to launch more in depth analysis for the next two years where not only global data at the regional level would be checked but also individual statements from farmers will be investigated.

### ■ Registers and Control of Surfaces through remote sensing

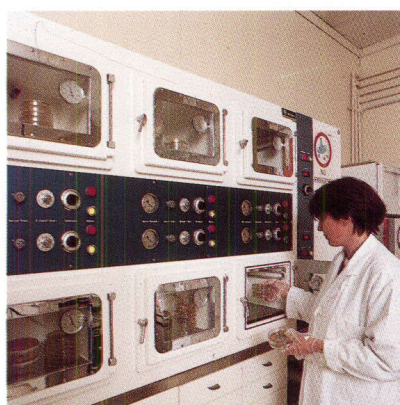
The Institute for Remote Sensing Applications uses either aerial or satellite observation techniques to set up registers to monitor agricultural surfaces. Topics include:

- Olive tree register: the Institute offered continuous support in this field and has almost completed its work in Italy.
- vineyard register: as this was a new activity in 1990 the Institute studied the different methods used in various countries through documents, technical visits and workshops.
- citrus register: support in this area is just beginning and the complete method is being studied.

### ■ Laboratory for food analysis (Environment)

A first batch of 150 wines from the area of Franconia (Germany), 1989 vintage, was analyzed to evaluate the influence of geographical parameters, grape variety, grape ripening, fermentation parameters etc., on the deuterium concentration and a data bank of these samples was installed. Staff investigated the reliability and reproducibility of the Nuclear Magnetic Resonance (NMR) method and organised a European round robin experiment applying the NMR-method for 1991.

To define the main practical procedures for the creation of a European Data bank, a collaboration with the «Centre Européen d'Analyse Isotopiques Spécifiques» in Nantes, has been established. A cooperation with national wine experts, and national NMR wine laboratories has been established.



Multiple incubator for anaerobic bacterial cultures in the laboratory for microbiological food and drug analysis

## Transport Policy

### ■ Aircraft Incident Data Base (Systems Engineering and Informatics)

The Institute for Systems Engineering and Informatics submitted a final report on the state of the art for cabin's material flammability to DG VII. Staff also analysed existing documents and carried out a first investigation on standards for distributed data base systems query methods.

### ■ Air Transport

At the request of DGs III and VII, the Institute for Prospective Technological Studies examined future trends for air transport in twenty to thirty years from now and in September published a first report «Pre-Lotos Study - Long Term Outlook of Air Transport».

## Development Policy

### ■ Application of remote sensing to the monitoring of tropical vegetation

#### (Remote Sensing Applications)

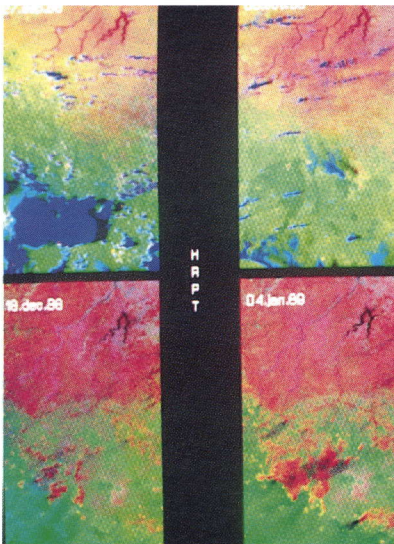
The Institute for Remote Sensing Applications monitors food crop production in West Africa as well as forecasting future crop yields.

In 1990 the Institute carried out an analysis of the relationship between official crop yield figures and vegetation readings derived from satellite data. Scientists also plan a detailed campaign for measuring planted acreages in 1991.

Work into the impact of vegetation condition on water resources in West African river basins was also advanced. The Institute has nearly finished preparing a low resolution satellite sensor data (AVHRR) time series for 15 major West African watersheds and is making good progress with the establishment of an interface between remote sensing data and existing hydrological models.

The Institute continued compiling the tropical forest inventory. Scientists developed a classification procedures for the identification of tropical forest stands on AVHRR data and various techniques for regional or continental scale monitoring which are to be used in Africa and South East Asia.

A detailed study into the role of fire as an indicator of active deforestation is under way. Staff have started to design a global forest inventory strategy, including the development of the first ERS-1 SAR data workstation dedicated to forestry application.



An example of the use of AVHRR images for bush fire monitoring. The image is of the border between Guinea and Liberia, West Africa.



## Environmental Policy

JRC provides DG XI with technical assistance in the drafting and implementation of legislation on Chemicals, Atmospheric Pollution, Water Quality, Chemical Waste, Industrial risk and Major Accidents.

### ■ Chemicals (Environment)

The EINECS inventory was published in the Official Journal of the EC in June. The Ispra team worked on updating annex 1 of the dangerous substances directive which lists substances subject to classification, packaging and labelling rules. With a view of harmonizing procedures for the risk evaluation of new chemicals, a workshop was held in Ispra with representatives of the competent authorities and the chemical industry.

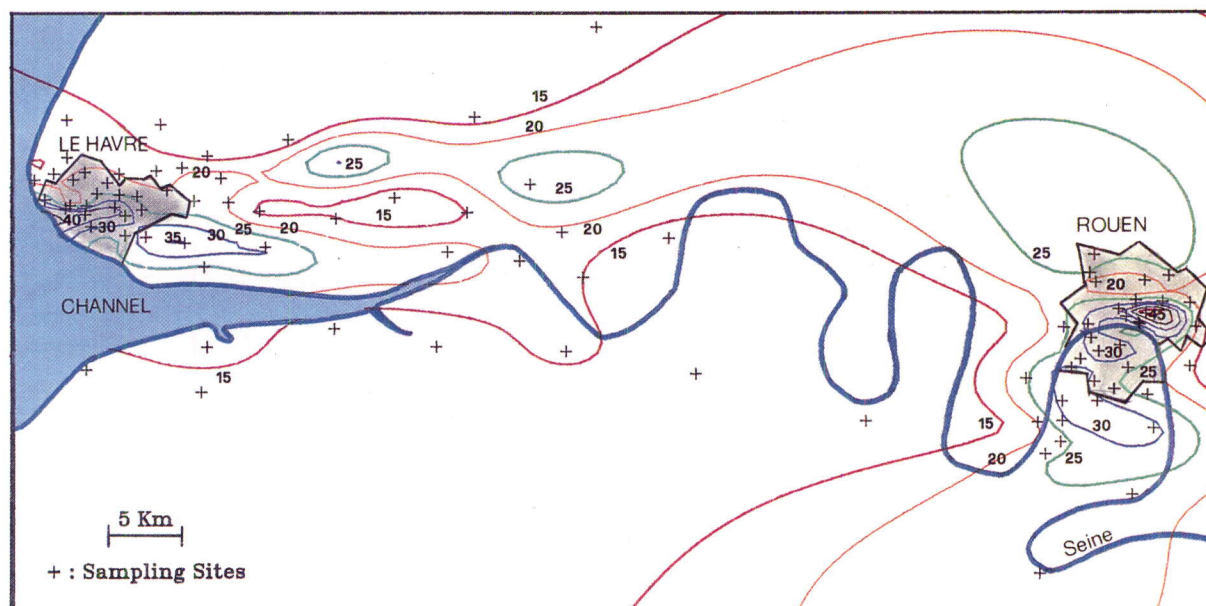
To encourage the application of Directive 79/831/EC on testing requirements and testing guidelines for chemicals the Institute and DG XI co-hosted a workshop attended by representatives of industry, research institutions and the Member States (development of European reference soils).

Development work and validation efforts for promoting the application of quantitative structure-activity-relationship in screening chemical risks was stepped up significantly and staff evaluated models for the estimation of physico-chemical properties, environmental distributions and acute toxicity.

### ■ Atmospheric Pollution (Environment)

Distribution of  $\text{NO}_2$  in the Rouen-Le Havre region of France (Average concentration values in  $\mu\text{g}/\text{m}^3$  from 1.4.90 to 30.6.90)

The Central Laboratory for Air Pollution put forward an instruction manual for  $\text{SO}_2$  and Black Smoke monitoring procedures at use of EC networks. Staff drew out a programme to compare the performance of different



NO<sub>2</sub> calibration methods. A test atmosphere generator was set up to test air, the sampling manifolds of monitoring stations and the diffusion tubes used in the new design of the Paris and Rouen NO<sub>2</sub> networks.

#### ■ Water Quality (Environment)

Work on standard pattern and reference methods of analyses set out in Annexes II and III of the EC drinking water Directive 80/778/EEC was completed, as was preliminary research into new substitutes for STTP in detergents. Preparatory Work concerning the proposal for a new directive on ecological quality of Community waters has been completed.

Work on the non-point sources of molybdenum and boron has been completed, while the results on the point sources of zinc, nickel and copper are close to completion. Studies on non-point sources of Be, Tl, Sb and point sources of As, B, Mo have been started.

#### ■ Waste (Environment)

A laboratory study on fast screening methods for in-field determination of PCBs in waste oil has been completed and an article submitted to «Chemosphere».

#### ■ Biotechnology Hazards (Systems Engineering and Informatics)

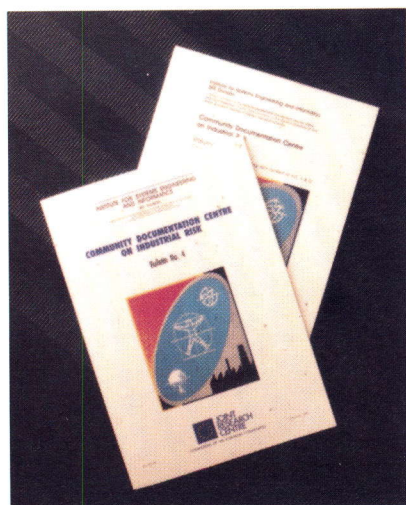
Advice has been given on a number of scientific and technical issues raised during the finalisation procedure of two directives on genetically modified organisms which appeared on 23 April 1990. This work included participation in intergovernmental meetings within the EC and OECD.

Preliminary needs for guidelines on good practices for microbiological work and industrial large scale work have been identified.

#### ■ Major Accident Reporting System (Systems Engineering and Informatics)

Operation of the Major Accident Reporting System has continued as in previous years through analysis of accident topologies, causes and preventive measures. A total of 95 accidents are now on file and, using the lessons learnt from them, an EC report on preventive policy is being finalised.

The Community Documentation Centre on Industrial Risk has collected around 1500 documents and publishes information in a regular series of documents. Staff have finished a comprehensive report comparing national approaches with the safety report which will be available from the Centre. A meeting with national safety inspectors at Ispra in October looked at the comparison of safety reports on LPC storage.

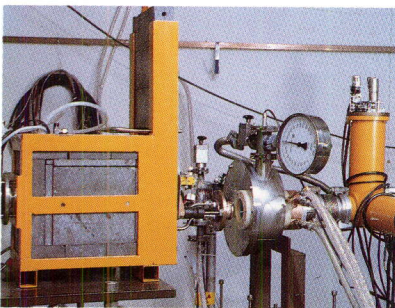


Examples of the publication series «Community Documentation Centre on Industrial Risk»



A study on emergency preparation and the response to major accidents in the UK and Germany was completed as a first step to the improved exchange of national experiences between the Member States.

The results of the Varese conference in 1989 have been published in a book «Communicating with the public about major accident hazards» and have been the subject of a subsequent workshop in which even field experience from pilot studies was discussed as the basis for guidelines. A pilot study has been performed on two Italian Seveso sites and the results published in «Risk information needs of communities near Seveso sites». A larger study covering sites situated in four European countries and aiming at a cross national comparison has been completed and the results are being assessed.



Irradiation facility for the production of the radioisotope  $^{68}\text{Ge}$  with (from right to left) x-y-scanner, beam diaphragm, irradiation chamber, sample holder and lead shielding

#### ■ Standardisation of Quality Control Protocols for Cyclotron Produced Radiopharmaceutics (Advanced Materials)

Production of radioisotopes for medical use with a Cyclotron could be hampered by insufficient radiochemical and chemical purity, which could be a health hazard to both patients and medical staff. For this reason:

- the precise cyclotron energy used to produce the appropriate nuclear reactions must be known to avoid the presence of other radionuclides;
- the production yield must be known;
- radiochemical and chemical quality control must be defined.

The Institute for Advanced Materials is working to provide DG XI with protocol pre-normative proposals for all three points in different isotope productions.

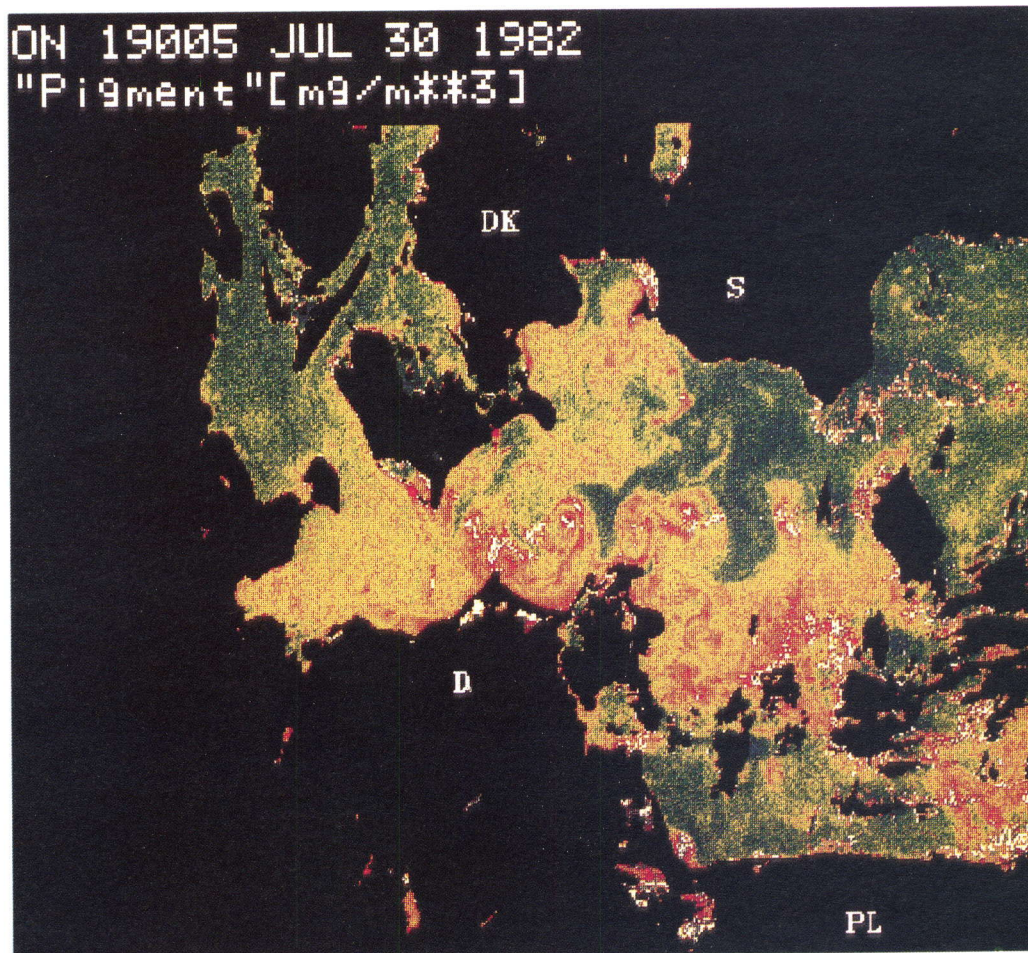
In 1990 the first isotopes of interest have been chosen and work has been initiated. The Cyclotron energy is being defined accurately, with a newly developed procedure. Work on Ga-67 and Ga-68 is already off the ground.

#### ■ Ocean Colour European Archive Network (Remote Sensing Applications)

Ocean colour data are of invaluable help in monitoring the marine environment and its bio-geo-chemical processes, such as algae, blooms eutrophication events and sediment transport. The task of ensuring diffusion and use of such data has been approached in the OCEAN project initial phase, in collaboration with the European Space Agency.

Work carried out so far includes the generation of a European CZCS data catalogue, as well as the definition of improved data processing algorithms and of new data archiving formats. The definition of the hardware/software environment for carrying out OCEAN activities has been completed and suitable workstation systems have been installed at Ispra and the European Space Agency. Implementation of this software system to produce image data (integrated with geometric and atmospheric parameters from those in station), has allowed data processing and archiving to start.





A CZCS image of the Southern extent of the Baltic Sea, taken in the summer when the water temperature is high (17-20°C), shows a great concentration of pigments covering a large area

Work on the software needed to derive marine environmental parameters from the image data was also started. Following the establishment of an OCEAN project expert group, a first core sample of application demonstration projects was selected to provide requirements and guidelines for the mass production of such value added data. The diffusion of information on the OCEAN project has continued with presentations at a number of conferences and seminars.

#### ■ Corine Land Cover: Methodologies for Land Cover Mapping and Revision by Remote Sensing

The Corine project has established a methodology for a Land Cover data base which has provided land cover classification for selected areas in Europe. The Institute for Remote Sensing Applications is currently updating both its information and its data gathering methods. In 1990 in particular the Institute issued computerised visual interpretation methods to update the Corine Land Cover data base of Portugal.



### ■ Radioactivity Environmental Monitoring (Environment)

The Radioactivity Environmental Monitoring Data bank was used to produce the monitoring report on environmental radioactivity 1984-1986 and establish guidelines for the 1987-1989 report.

About 3000 pieces of source data are now available on-line in the REM Data bank and a pilot PC version working on more limited sets of data has been distributed.

Data on radioactive discharges from nuclear installations for the 1977-1987 period have been assembled in a PC-based data bank. An inventory of the monitoring networks of Member Countries has been presented to national experts and a critical analysis is under way.

### ■ Community Bureau of Reference

The Central Bureau for Nuclear Measurements continued its support through storage, control and distribution of BCR reference materials. It produced reference materials for two sediments, two soils and milk (trace elements) as well as studies on fly ash (dioxin), liver (vitamins), orange juice (sugars, aminoacids), grape juice (sugars, aminoacids), port-wine (numerous component) and milks (dioxin).



Non-nuclear reference materials:  
handled in support to the "Bureau  
Communautaire de Référence "(BCR)

## ■ Telecommunications, Information and Innovation Policy

The Institute for Advanced Materials (IAM) has been mainly concerned with the conclusion and evaluation of the materials database demonstrator programme. In this context a new framework for pre-normative work has been developed to support the Commission and provides a new approach to scientific and technological information. Dubbed Information Engineering, the new approach means that information can be integrated into modern computer systems and used to exchange data between them. Proposals for cooperation between DG XIII and the Institute have been developed from these new ideas. The results of the demonstrator programme were presented at several international conferences.

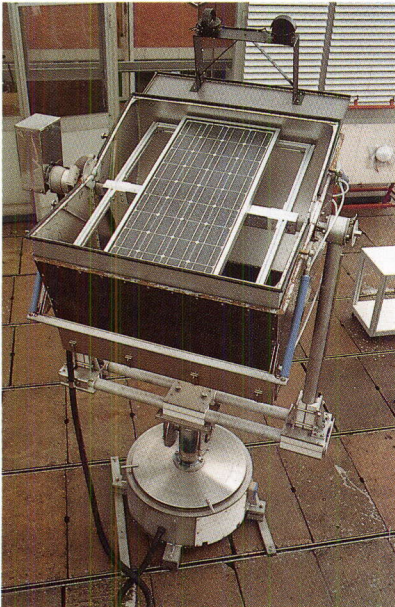
The Institute for Systems Engineering and Informatics (ISEI) has continued its scientific and promotional assistance to various international network projects, namely:

- I X I pan-European back-bone network
- ERCOFTAC (European Research Community on Flow, Turbulence and Combustion) pilot centres
- high speed networks for corporate and public use (ESPRIT-2).

In the area of Applications of Software and Knowledge Engineering, contribution was given to two projects, namely:

- KWICK, an Intelligent Agents System for the integration of multimedia engines operating system functions, for which acquisition of data for the first phase of prototyping and functional definition of the envisaged Supervisor and software environment were made.
- ARCHON, an architecture for cooperative expert systems in a series of industrial process control applications. Development was started on the Man-machine Interface Layer of ARCHON Virtual Machine. In particular, a prototype of the User Interface Agents of the Machine was set-up.





Climatized calibration of photovoltaic reference modules

## Energy Policy

### ■ Rational use of energy and new energies (Systems Engineering and Informatics)

The Institute for Systems Engineering and Informatics continued its work into energy conservation and the rational use of energy in small and medium size enterprises. Three data bases have been created to contain the data of the energy bus programme. Appropriate coding systems have been developed to be used on a European basis.

In the building sector, in relation to DG XVII's THERMIE programme, 34 project proposals have been evaluated. Reports on problems related to «the replication of demonstration projects» and «Population weighted Degree-Days for Member States» have been prepared.

Scientific and technical assistance is provided to the management of DG XVII's photovoltaic and solar thermal demonstration projects, including monitoring installation performance, data entries into the SESAME Data bank and the evaluation of new proposals.

Under the VALUE programme the Institute is currently transferring technology on the monitoring and telemonitoring of solar systems to Greece using technology from Ispra (see page 98).

### ■ Nuclear Safeguards (Systems Engineering and Informatics, Safety Technology, Transuranium Elements, CBNM, Administration Directorate, Environment)

The main analytical support activities in support to the EURATOM Safeguards Directorate are as follows:

- A K-edge densitometer was set up and put into operation at La Hague; the performance of other US-built models is being tested. Plans for an on-site laboratory were agreed and various prototype equipment was built and tested;
- a large number of Uranium, Plutonium and spent fuel solutions were analysed;
- the CBNM continued its ECSAM quality control programme which aims to maintain a high level of Safeguards measurement reliability. Results were obtained for UO<sub>2</sub> powder, UO<sub>2</sub> pellets and uranium nitrate solution;

In the field of instrumentation development and data evaluation methods the main achievements are the following:

- Two Phoid instruments for the assay of large uranium samples and a gamma spectrometric system for the assay of MTR fuel assemblies have been delivered to the Safeguards Directorate (DG XVII) including a new data evaluation system.
- Software for the evaluation of measurement data coming from neutron coincidence instruments has been delivered. This is used for the assay of Pu samples and for the establishment of a measurement data base for non destructive neutron/gamma measurements combined with analytical data.
- Detailed neutron flux calculations were performed to study the feasibility of measuring spent fuel in casks at reprocessing plants.

- 8 training courses for the use of non destructive instruments and application of radioprotection rules were provided. A new physical inventory verification exercise on Pu material being prepared.
- General support is provided to the Safeguards Directorate in the field of radioprotection and regulations of safety at work, by performing frequent visits to nuclear installations within EC and for in-field potentiometric analysis of U samples in fuel fabrication plants.
- Ultrasonic sealing bolts for spent fuel casks were designed and field tested at two reprocessing sites and one reactor.
- A new system for automatic verification of E-metal seals has been constructed.
- A new computer aided surveillance system has been designed and video multiplexers and optical disks for image storage were tested.
- Several data bases are being prepared for the management by the Safeguards Directory of the transport of materials or instruments and for maintenance of video systems or components.
- A material accountancy system MADES has been studied and is now being tested at the Safeguards Directorate.

## Customs Union

### ■ Enabling Import Regulation (Environment, Safety Technology)

Under this heading scientists help check imports so that the right customs tariff can be imposed.

In 1990 the Environment Institute at Ispra helped identify various undefined imports of organic and inorganic material and offered technical back-up to enable implementation of EC Regulation 2340/86 on chemical and biological substances. Staff also helped with the quest to find a reliable test for starch purity.

The Safety Technology Institute makes available technical support and participates in meetings of the Custom Duty Free Committee, in which controversial cases are reviewed, about the scientific instruments imported from non-Community countries, which are exempt from custom duty when they are used for scientific research and have high scientific value, provided there is no equivalent instrument with the same characteristics made in the Community.

The dossiers analysed are those for which the Customs of the Community countries refused the exemption of duty. In addition a continuous support was provided for the Legal Service in connection with last development of jurisprudence in the field of UNESCO exemptions.



## ■ Forward Studies Unit

The Institute for Prospective Technological Studies assesses current perceptions of the greenhouse effect, looking at both scientific consensus on it and the role of energy in the production of greenhouse gases. Two reports «Science and the Greenhouse Effect» and «Technological Response Options to the CO<sub>2</sub> Issue» were prepared.

## ■ Other Support activities by the Institute for Prospective Technological Studies

The Institute for Prospective Technological Studies has also contributed to the formulation of the DG XII and JRC science policy in other ways:

- the Institute started a study on cross interaction of horizontal and vertical technologies. First results of a report written under contract with the «Ecole des Mines» were presented to the Director General of DG XII: «Concept of technological interfaces and their role in competition, contribution to European Science and Technology policy»;
- in preparation for discussions on Strategic Planning for the JRC (JRC 2000) the Institute assessed the expected state of technology in ten years time. Three documents were drafted namely: «This World Around us», «Science and Technology Issues» and «S/T Assessments».

The Institute organised numerous seminars and workshops for several Commission departments: on Aeronautic Research, the Long Term Outlook of Air Transport, on Energy Conservation and on Forecasting Technological Innovation.

MAIN  
ACHIEVEMENTS  
AND  
MILESTONES

## 4 JRC *Work for Third Parties*

**WORK** for third parties bring a closer contact with the «real» world, provide a measure of the JRC's competitiveness and a valorisation of existing potential additional income.

Figure 2 shows the JRC order book as well as amounts invoiced and payments received. Further details are provided in Table 1 below.

Figure 2

JRC Work for Third Parties 1988-1990

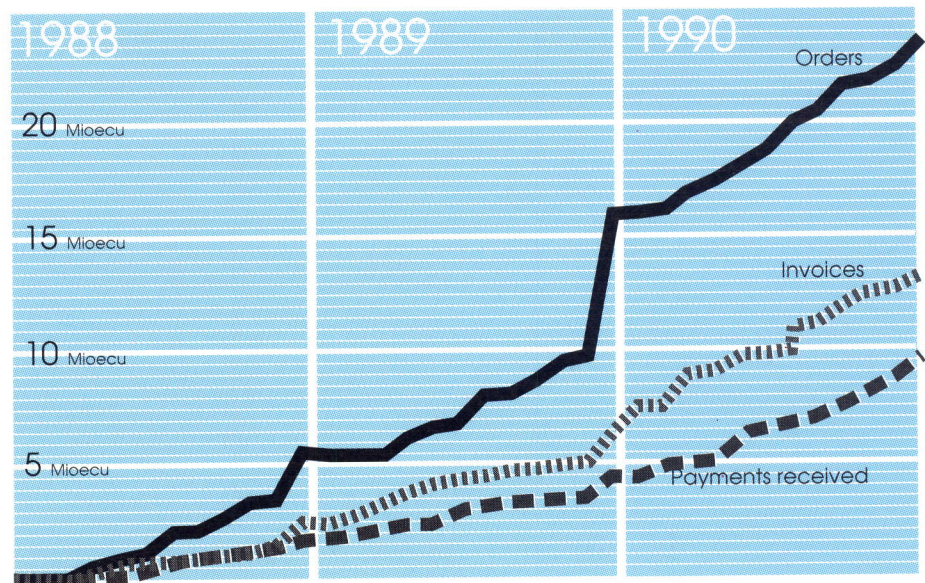


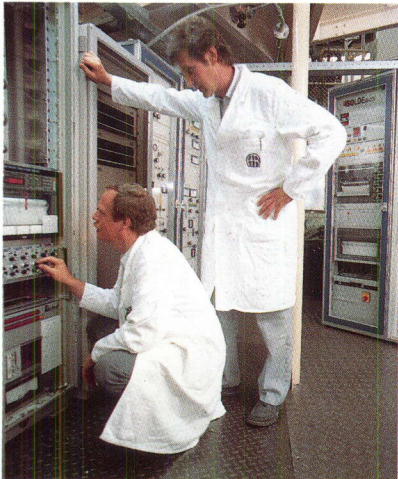
TABLE 1

### Work for Third Parties (MioEcu)

Year	1988	1988-1989	1988-1990	1988-1991
<b>1 Exploitation of HFR</b>	17.2	36.6	56.7	78.0
<b>2 Other third party work</b>				
2.1 Target value	2.9	17.5	33.4	58.0
2.2 Order book actual	5.79	15.71 <sup>(1)</sup>	23.53	-
2.3 Amounts invoiced	2.67	6.67	12.97	-
2.4 Payments received	1.93	4.74	10.03	-

(1) including 3 Mioecus for a contract signed early in 1990 (a letter of intent was signed in 1989 for this sum)





Instrumentation of the ISOLDE experiment (Iodine SOLubility and Degassing Experiment) on pre-irradiated PWR fuel rods

## Exploitation of the High Flux Reactor (The Institute for Advanced Materials, Petten)

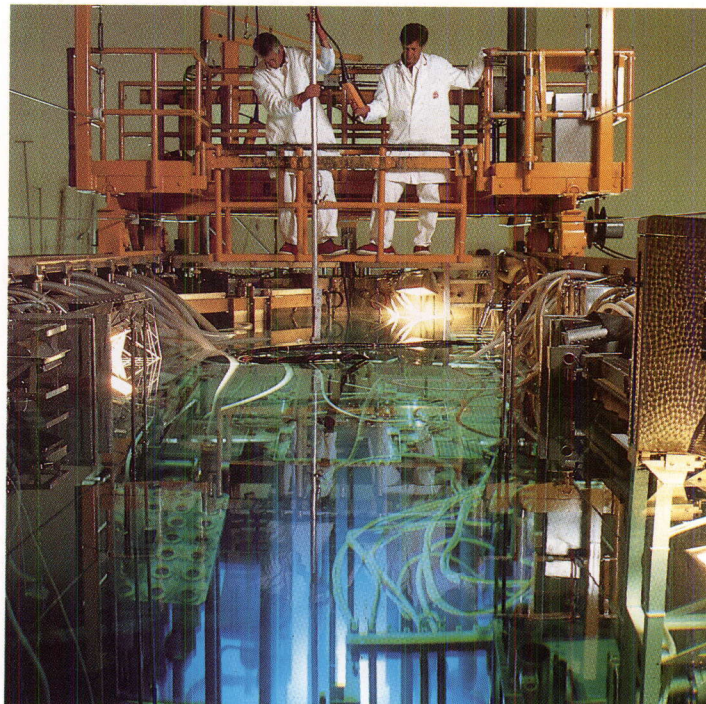
In 1990 the reactor operated well - close to 100% of scheduled operating time. Occupation of irradiation positions was between 70 and 80%.

As in previous years the reactor was largely used to irradiate fuel and structural materials under steady-state as well as transient and specified load conditions for LWRs, HTRs and LMFBRs and for radiation damage investigations for prospective first wall materials and tritium behaviour in prospective breeder materials for fusion reactors.

For these projects, the Institute operates irradiation facilities, comprising water supply and conditioning systems, sweep gas facilities with the option of on-line determining of fission product and tritium release and sophisticated in-pile creep devices. The beam tubes are used extensively for nuclear physics and materials research. Neutron radiography and activation analysis services have been provided for external clients.

The following achievements stand out:

- first in-pile test to investigate iodine release from PWR fuel under loss of coolant accident conditions;
- increase of radioisotope production for medical and industrial applications;
- in-pile irradiation of Pb-17 Li eutectic alloy to investigate on-site tritium production, recovery and permeation in breeder and structure of a fusion blanket;
- assessment of feasibility of building a large silicon doping facility;
- contract signed with the European Space Agency to study the application of neutral radiography to space components technology.



View of the pool side facility of the High Flux Reactor (HFR), Petten



## The Institute for Prospective Technological Studies

The Institute reviewed the state of the art of thermonuclear fusion for the German Federal Ministry for Research and Technology.

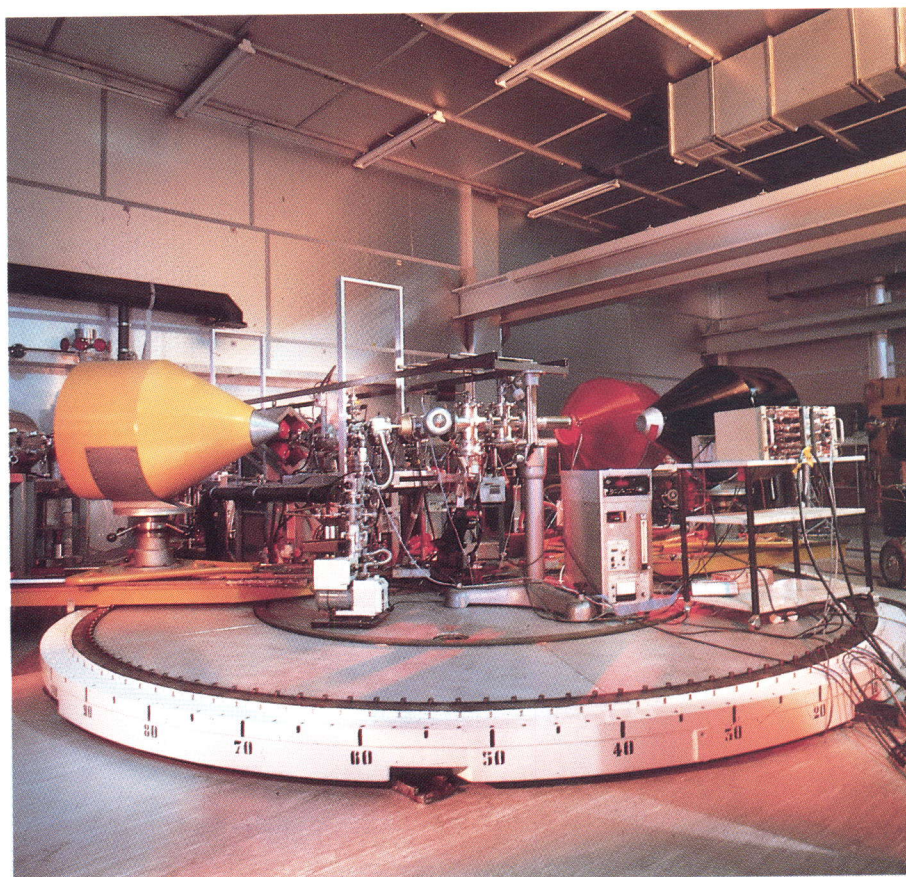
The final report entitled «A critical literature Survey on the prospects for thermonuclear fusion energy» was delivered in August 1990.

## The Central Bureau for Nuclear Measurements

The  $^{137}\text{Cs}$  and  $^{60}\text{Co}$  contents of conditioned radioactive waste barrels from Belgian nuclear power plants were assayed using the segmented gamma-ray scanning method for NIRAS/ONDRAF. Software automation to reduce the number of staff needed to analyse routine measurements, started.

Low energy X-ray reference sources with different exchangeable fluorescer foils were prepared and are now on sale.

For the Radiobiological Department of SCK/CEN the CBNM performed two neutron irradiations of blood samples using the CN-7 MV Van de Graaff.



Experimental arrangement for angular correlation experiments at the 7 MV Van de Graaff accelerator



Plans to irradiate mice are being discussed. An irradiation position at the 7 MV Van de Graaff was prepared for neutron irradiations of silicon samples from the University of Rome, which are to be used as detectors in an experiment at CERN. Irradiations started at the end of 1990.

The Regular European Interlaboratory Measurement Evaluation Programme on analytical quality control, which the CBNM performs for laboratories within and outside the EC, continued.

Results from  $UO_2$  powder,  $UO_2$  pellet and uranium nitrate solution were evaluated. The preparation and characterization of MOX, spent fuel and synthetic input solutions, and plutonium nitrate solutions for further exercises started.

For external customers the CBNM carried out a number of analytical and other services. 42 orders for special samples, targets, and 26 for reference materials from various industries and research laboratories were completed.

In particular the Bureau prepared about 4000 reference samples (plastics with four different levels of Cd traces) for the German «Verband der Automobilindustrie, e.V.». Certification using isotope dilution mass spectrometry is in progress.

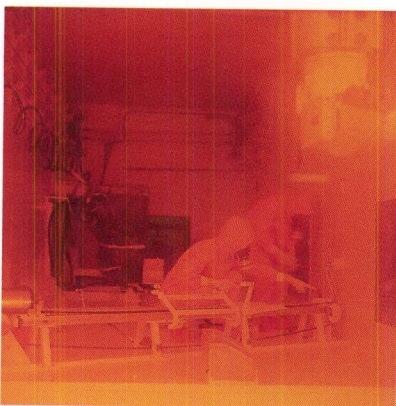
## The Institute for Transuranium Elements

In 1990 the Institute for Transuranium Elements worked on contracts for 13 clients, 7 contracts were under negotiation or have been signed with work to be started in 1991. The total value of contracts signed in 1990 amount to 3.8 Mioecu.

Major contracts under way deal with:

- the preparation and characterisation of alloys which contain minor actinides (Np, Am, Cm) as part of a multiannual contract to look into the possibilities of nuclear incineration of long-lived nuclear waste constituents;
- the analysis of oxide fuel residues from reprocessing solutions;
- the post-irradiation analysis of  $UO_2$ ,  $UO_2/Gb_2O_3$ , and mixed uranium plutonium fuel rods from commercial pressurised and boiling water reactors;
- the post-irradiation examination and characterisation of fuel rods under an international fission product release research project;
- the purification, conditioning and analysis of carbon containing mixed uranium plutonium fuel.

In addition, the Institute was paid to perform electron microscopic studies and measurements of oxygen potential on irradiated fuel samples. Contracts to analyse non-irradiated nuclear fuel samples and to provide ultrasonic sensors for in-pile fuel temperature measurements are being negotiated.



Post-irradiation examination of fuel rods. Decontamination operations inside a hot cell

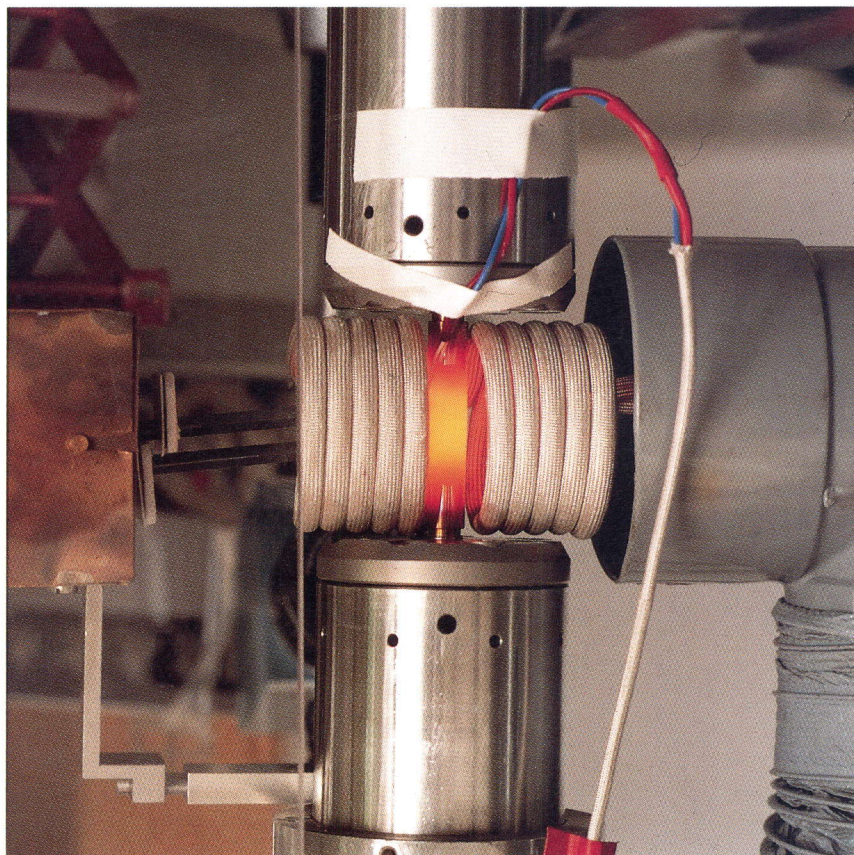


## ■ The Institute for Advanced Materials

The introduction of third party or contract research into the Institute for Advanced Materials has required deliberate efforts to change attitudes and the approach at all levels of the Institutes scientific and administrative work force. A changing attitude to the culture of science and technology and the recognition of the importance of the market place can now be discerned even among those who have long been committed to academic research.

Advanced materials research revenues amounted to 1.0 Mioecu in 1990 and a further volume of 14 agreements amounting to 0.35 Mioecu were contracted.

Contracts covered a variety of industrial sectors, for example aeronautics, automobiles, energy, chemicals and materials. Similarly, in addition to the supplementary Programme budget, the HFR netted revenues of 1.1 Mioecu for irradiation services such as isotope production, mineral irradiations and aeronautics applications. The total volume of an additional 7 contracts signed in 1990 amounts to 0.970 Mioecu, bringing the Institute's total number of contracts to 40. The order portfolio for 1991, for both sectors of the Institute, shows an increase in revenues in 1991, on 1990.

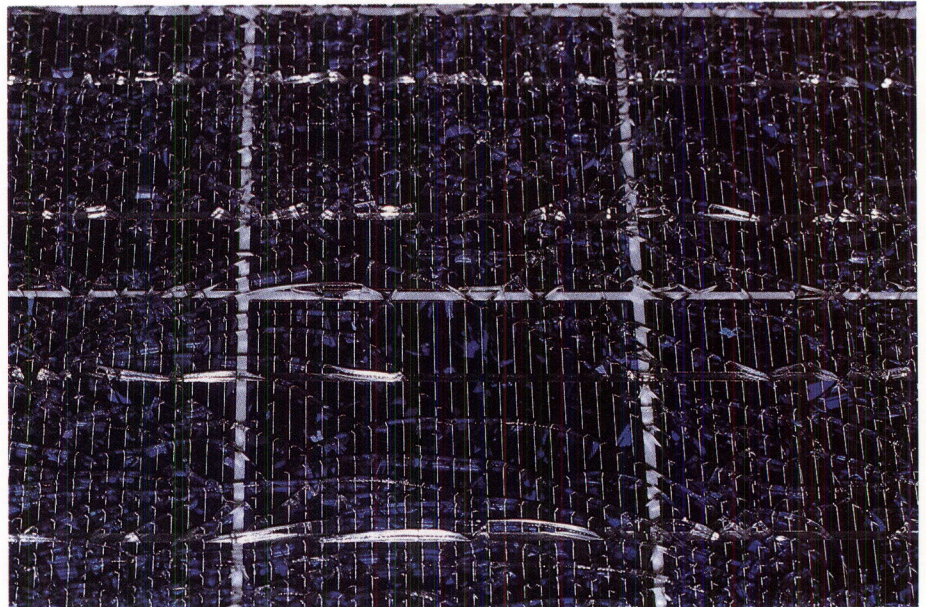


Experimental set-up for the thermo-mechanical fatigue testing of advanced gas turbine blade alloys



## ■ The Institute for Systems Engineering and Informatics

In 1990 the Institute tested photovoltaic devices at its European Solar Test Installation for clients from Italy, Germany, Spain, United Kingdom, Switzerland, the US and Japan.



Photovoltaic modules damaged during CEC Specification 503 qualification tests

Under a contract with the Italian Ministry for the Environment, the Institute worked on a definition of the functional requirements of information systems, for the management of the Po River Master Plan and industrial toxic waste.

Considerable progress was made on a contract to analyse ENEL component data for reliability; ISEI carried out an exploratory analysis of the data supplied by ENEL and stored in the Component Event Data Bank.

Staff identified and investigated outliers. Reliability parameters for a first set of components were inferred and compared with analogous parameters that had been assessed for other European plants.

Furthermore, the Institute implemented a cognitive model of a signal decision maker on a blackboard architecture (ESPRIT 2 Basic Research Action 3105 MOHAWC); it implemented the RAMINO prototype expert system for the enhancement of inspection (BRITE Project P2124-87) and developed a unique identification system for spent fuel storage casks.

## The Institute for Safety Technology

The Institute has made substantial efforts to identify its market and to improve its internal organisation to better satisfy the needs of clients. One of the major characteristics of the Institute is its responsibility to design, construct and operate almost unique facilities. Consequently potential customers were addressed and positive results achieved for the use of hot cells in the nuclear isle and for the execution of reactor safety related tests in the FARO facility.

However, so far marketing has been less successful with the chemical industry. 200 medium size industries were contacted in Northern Italy but detailed discussions started with only 12 of them.

Another area of IST expertise which was exploited is the development of calculation codes. Contracts were signed under which the Institute provides practical assistance to national organisations in improving their models and codes.

## The Environment Institute

The Environment Institute was engaged in a number of varied contracts in 1990.

For the Spanish Agency for Radioactive Waste (ENRESA), the Environment Institute characterised groundwater and inspected boreholes at the El Berrocal site. Laboratory research into actinide transport through rock matrix and fractures continued.

Work on the Atmospheric Transport Models Evaluation Study, a contract held jointly with the International Atomic Energy Agency and the World Meteorological Organisation progressed significantly.

A draft report was submitted to the ATMES Steering Committee at the end of the year, with the final report expected during the first half of 1991.

Under contract with the Umweltbundesamt, Berlin, the Institute collected and processed ecotoxicity data on 1500 chemicals from its Environmental Chemical Data Information Network files, as well as information on other chemicals from external sources.

In June the Institute started work under a contract with Italy's Lombardy Region. A base document concerning the procedures for operation and calibration of air pollution monitoring stations and networks and for data acquisition and analysis has been prepared and 5 monitoring stations have been surveyed.

Another contract with the Lombardy Region, to run the first Higher Civil Protection School course, finished in June.

Forty five students ranging from coordinators of civil protection operation centres to safety managers from the public and private sector followed the course.



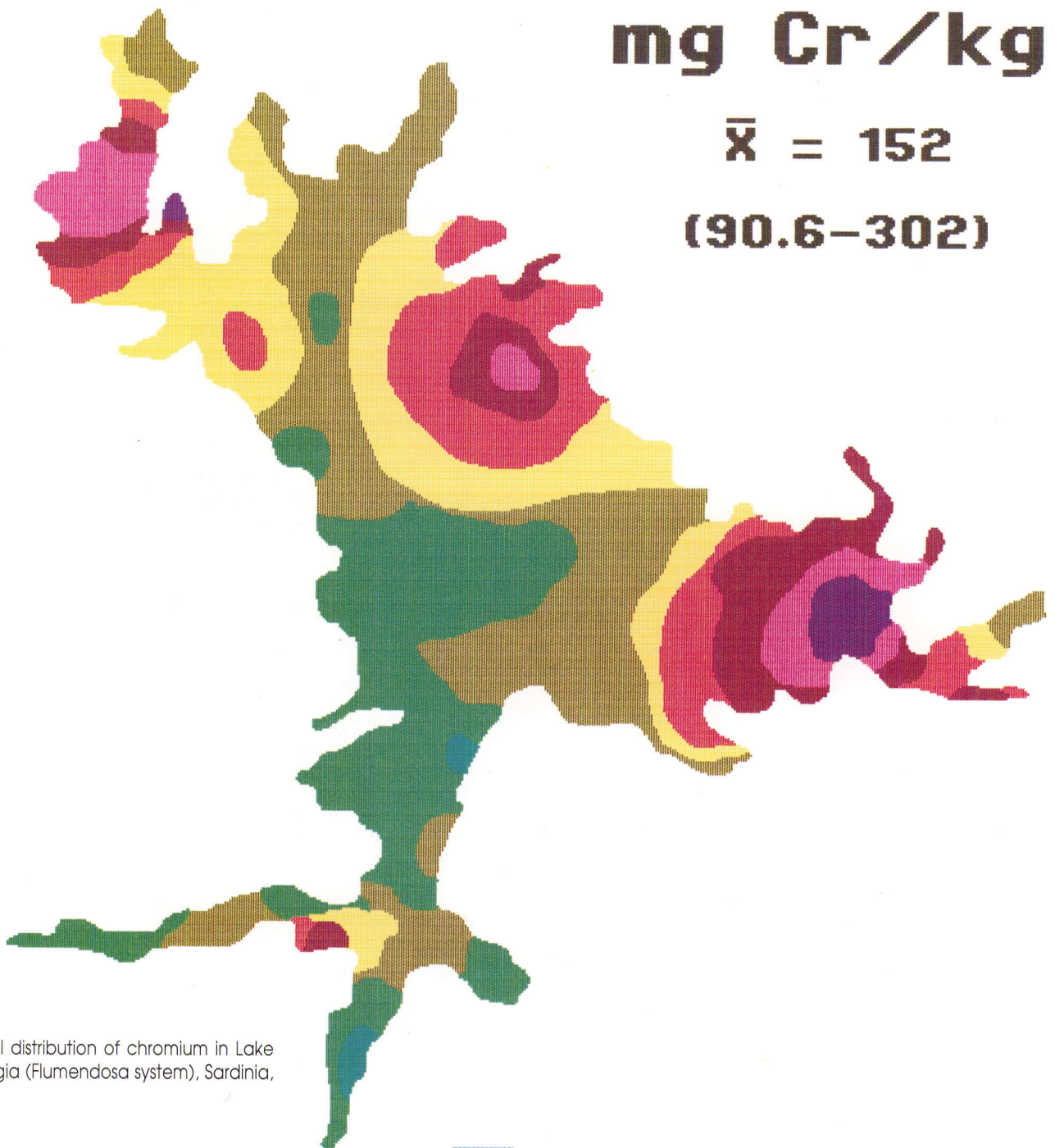
Under a contract with Ente Flumendosa, the Institute found a number of trace metals in the sediments of Flumendosa, Mulagaria and Simbirizzi lakes, which could prove hazardous if the lakes were used as reservoirs for drinking water.

The Institute measured volatile organic compound levels in the European Parliament's Brussels and Strasbourg buildings as part of a 4-year project to control indoor air quality.

**mg Cr/kg**

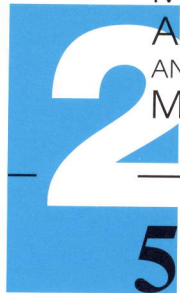
**$\bar{x} = 152$**

**(90.6–302)**



Spatial distribution of chromium in Lake Mulargia (Flumendosa system), Sardinia, Italy

MAIN  
ACHIEVEMENTS  
AND  
MILESTONES



**5 JRC**

## *Participation in EUREKA Projects*

**THE EUREKA Initiative is a light framework which supports and encourages autonomous international partnerships to develop innovative products and services. It involves companies and research institutes from 19 countries plus the Commission of the European Communities. Since 1985, nearly 400 projects worth over 7.6 billion ECU have been launched by almost 2,000 partners.**

JRC participation in EUREKA projects increased in 1990. Today the JRC is involved in EUROTRAC, FORMENTOR, VISIMAR and LASFLEUR and plans to participate in ALPSOLAR, Vibration Measurements using Laser Technology and EUROENVIRON.

### **Systems Engineering and Informatics**

The Institute for Systems Engineering and Informatics is involved in FORMENTOR which was originally launched by French and Norwegian partners. The Institute entered as a full member of the Consortium at the beginning of 1989, at the onset of the development phase.

This EUREKA project aims to develop an on-line expert system to provide advice to operators of complex man-made systems in potentially hazardous situations. Several work packages have been initiated especially concerning the so-called methodological stream. Two pilot applications have been started: one concerning a chemical process plant and one in the aerospace field.

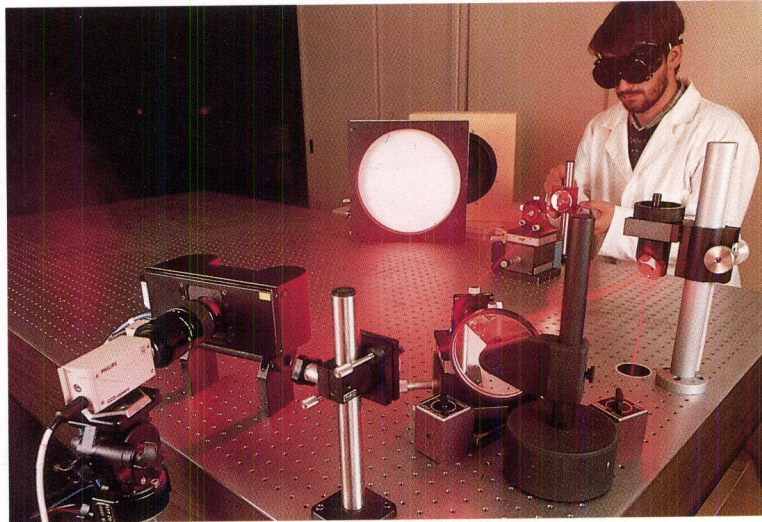
The Institute is exploring the possibility of participating in the Austrian-German ALPSOLAR project (EU 333) which aims to develop electric generators using photovoltaic solar captors specially designed to function in the meteorological conditions of the Alpine environment.

Participation in the EUREKA No. 383 «Vibration Measurement using Laser Technology» is being negotiated and work is expected to start at the beginning of 1991.

The project's aim is to develop instruments to measure vibration in situations where a transducer cannot be mounted on the vibrating object - for instance the shaft of an engine or the diaphragm of a loudspeaker.



Set-up for vibration measurement by holographic interferometry



## Environment Institute

The Environment Institute is involved in two EUREKA environmental projects, EUROTRAC (EU 7) and EUROENVIRON (EU 330). These are both "umbrella projects", which function as long-term ideas-factories, developing ideas for specific "daughter" projects.

EUROTRAC deals with the way pollutants are transported and transformed in the upper atmosphere, while EUROENVIRON tackles the more down-to earth issues of waste, pollution and clean technologies at ground level.

Within EUROTRAC the Institute contributes to the sub-projects TRACT, BIATEX, JETDLAG and LACTOZ.

- TRACT was focussed on a tracer field experiment in the Ticino area to assess the transport of atmospheric pollutants in the Alpine region. Italian, Swiss and German laboratories and the JRC were involved in the measuring campaign.
- Under BIATEX, the Institute contributes to a study on the emission and concentration measurements of biogenic hydrocarbons (monoterpenes) and carbonyl compounds in forest areas.
- LACTOZ looked at various aspects of atmospheric night-time chemistry particularly the reaction of the nitrate radical with biogenic emissions from vegetation (isoprene) and the study of the  $\text{NO}_3/\text{N}_2\text{O}_5/\text{O}_3$  equilibrium in air.
- JETDLAG, concentrated on the evaluation of spectral parameters of atmospheric trace gases methyl chloride and formic acid. For the latter, the measurement of absolute infrared band intensities and the pressure broadening coefficient has been supplemented by a feasibility study on the applicability of a tunable diode laser technique to the detection of this species in the gas phase.
- In April 1990, at Garmisch-Partenkirchen, the Institute took part in the EUROTRAC Symposium 1990 on «Transformation and Transport in the Troposphere».

Under EUROENVIRON, along with Italian, Danish and English groups, the Institute has finalised its proposal on the «Development and evaluation of a mobile laboratory» which, in mid 1991, will be submitted to the EUREKA Ministerial Conference for approval as a full EUREKA project.

The team intends to develop a mobile analytical laboratory to perform «in field» sampling and analysis of waste, water and soil contaminants.

## Remote Sensing Applications

The Institute for Remote Sensing Applications is a partner in the LASFLEUR project (EU 380), which also involves scientists from Italy, France and Germany. It is investigating the use of several fluorescence parameters for the remote detection of vegetation stress.

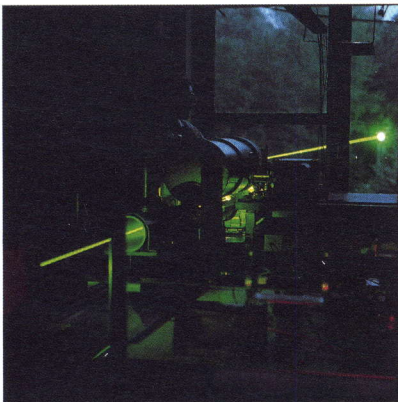
The final goal of the LASFLEUR project is to develop a system based on an airborne laser to collect information on the state of plant health across large areas of vegetation. By using laser induced fluorescence signals of vegetation, conclusions may be drawn on the state of plant vitality. Thus, such measurements may be valuable for the development of a monitoring system for environmental damage forecasting and recovery assessment.

For its part the Institute is investigating energy transfer processes in photosynthetic systems by time-resolved chlorophyll fluorescence with regard to remote characterisation of the vegetation by fluorescence techniques.

From the results obtained to date it would appear that time decay measurements made in the laboratory are able to detect and analyse fluorescence decay after excitation with very short laser pulses. These data taken with the plant physiological work completed this year shows the potential of this technique for the detection of plant stress.

The Institute has given a new impetus to its programme «Monitoring of the Marine Environment» by participating in the VISIMAR project.

The objective of this EUREKA project is the development of a video animation system for the production of video scenes and films of marine environmental processes, based upon observational data and applying empirical and deterministic model concepts. Members of VISIMAR include Germany (coordinator), Finland, France, Greece, Italy, The Netherlands, Norway, Spain and Sweden.



Field measurements made in support of the LASFLEUR activity, using laser spectroscopy



# 2 MAIN ACHIEVEMENTS AND MILESTONES

## 6 JRC *and Associated Laboratories*

**THE JRC has a federating role, regrouping scientific resources according to schemes such as Associated Laboratories.**

**New cooperation agreements signed include one with the Spanish CIEMAT (Centre for Energy, Environmental and Technological Research) calling for collaboration in a broad spectrum of research themes and another with CERFACS (Centre Européen de Recherche et Formation Avancée en Calcul Scientifique), Toulouse, France, on advanced applications of informatics.**

### **Nuclear Measurements**

The Central Bureau for Nuclear Measurements works closely with a number of research establishments on nuclear measurements, including SCK/CEN at Mol (B), and the University of Gent (B) and ILL Grenoble (F). The CBNM has also linked up with the PTB Braunschweig (FRG) for a silicon study.

Furthermore, the Central Bureau for Nuclear Measurements continued regular interlaboratory comparison exercises on nuclear fuel under the Regular European Interlaboratory Measurement Evaluation Programme.

### **Transuranium Elements**

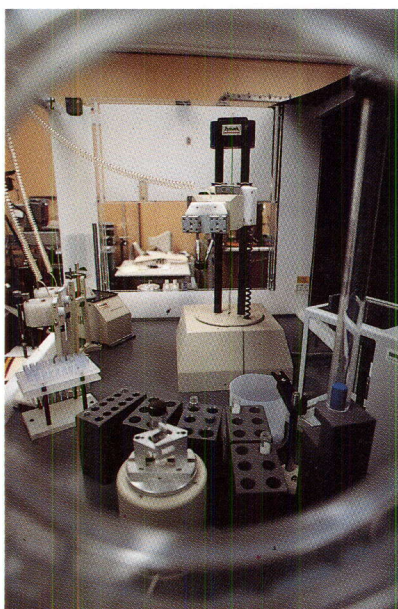
The Institute for Transuranium Elements works with the Gatchina Laboratory of the Khlopin Institute, Leningrad, in the safeguards field by installing and testing robotized equipment for the automatic input analysis at a reprocessing plant.

The installation was developed at JRC Karlsruhe, set up at the Gatchina Laboratory in October and undergoes field testing over a ten months period. The results will be evaluated jointly by the Leningrad and the Karlsruhe laboratories.

Some 40 laboratory associations exist in the field of actinide research.

Examples are the development of equipment for optical measurements on heavy elements and compounds under extreme pressures with the «Max-Planck-Institut für Festkörper Forschung» in Stuttgart and the search for new heavy fermion compounds on the basis of actinides with AERE Harwell, where well characterized samples of high purity prepared at the Institute undergo low temperature specific heat measurements.

Polarized neutron diffraction experiments and inelastic neutron scattering measurements are performed by a mixed team of French and ITU researchers at the Institute Laue-Langevin in Grenoble.



Safeguards analysis. Robot for the preparation of samples for isotope analysis installed in a glove box

The leaching properties of power reactor fuel with simulated burn-ups have been investigated jointly with the Whiteshell Laboratories of Atomic Energy of Canada, Ltd.

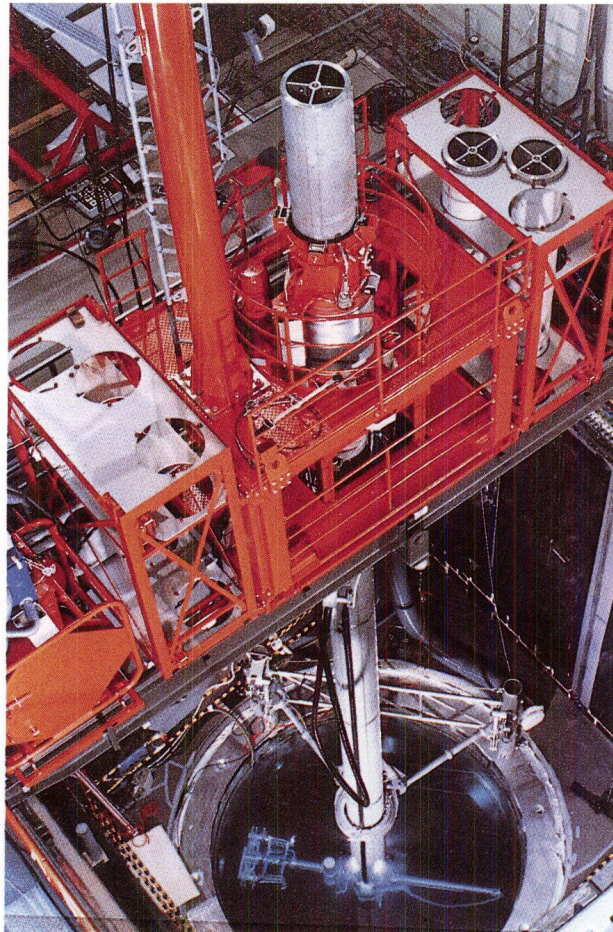
Experiments to conjugate certain alpha-emitting radio-nuclides (prepared at the Institute) with specific mono-clonal antibodies are performed in collaboration with the «Institute für Genetik und Toxikologie» of the Kernforschungszentrum Karlsruhe.

Irradiation experiments with advanced fuels are prepared and carried out under a collaborative agreement with the French CEA's Cadarache laboratories.



## Advanced Materials

The PISC project, which started fifteen years ago, is one of the best examples of a JRC initiative to link laboratories and industries on a specific research topic (see 2.1.). This project now looks set to be finished in 1992/1993.



RWE/MAN (Germany) central mast manipulator used with UT electronics and crew of MAN and SIEMENS, on the full scale components at MPA (University of Stuttgart, FRG) for the PISC III exercise

Two new cooperative projects have to be mentioned :

- E-MARC: The Institute for Advanced Materials set up a European consortium of major European research organisations involved in materials research and development in the Netherlands, the United Kingdom and Italy. E-MARC represents in total about 1000 researchers and technicians in the materials field and a wide range of advanced equipment for research, development and characterisation of advanced materials.

- Joint Venture on Advanced Coatings Centre: A Joint Venture to build and exploit an advanced coatings centre was established by the Petten-based Institute for Advanced Materials, and the Netherlands Energy Research Foundation. The centre will provide R&D support on coatings technology to industry.

The Institute also initiated the build up of research networks involved in advanced materials R&D.

## Systems Engineering and Informatics

The Institute for Systems Engineering and Informatics has set up and now provides the General Secretariat for three scientific associations.

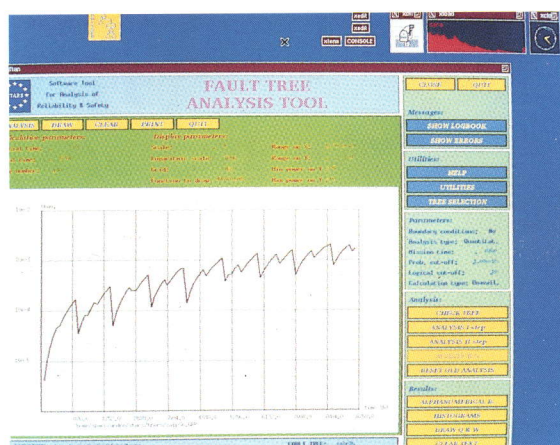
The European Safeguards Research and Development Association (ESARDA), founded in 1969, is presently composed of eleven parties, covering all the R&D laboratories of EC countries involved in safeguards R&D. In seven working groups information on R&D activities is exchanged and joint projects are managed. At the ESARDA general meeting in Como in May 1990, the association discussed technology transfer in the nuclear safeguards field.

The European Reliability Data Bank Association (EuReData), founded in 1979, has around 50 members, involved in Reliability Data and Collection from governments, industry and research from both the EC and EFTA. Activities are divided into project groups.

ESRRDA: The Association founded in 1986, is actually composed of 36 research laboratories and universities. The aims are to encourage and harmonise research and development for safety and reliability of technological systems.

Moreover the Institute has organised two consortia of laboratories and industry:

- The «Institute Club» is for scientists involved in the field of expert system technology applied to life extension of power generation plant components.



STARS project. The Fault Tree Analysis Tool performs the logical and probabilistic analysis of a fault tree. It is an enhanced version of the SALP-PC code.

- The consortium «STARS» is a group of research and industrial laboratories which started a joint venture to develop a homogeneous set of software tools to help with the various phases of safety and reliability analysis.

CERFACS (Centre Européen de Recherche et Formation Avancée en Calcul Scientifique): an Agreement has been made and the areas of collaboration between CERFACS, Toulouse (France) and JRC have been defined. The first areas of interest regard:

- holographic synthesis
  - realistic visualization in continuum mechanics
- All systems have to be developed on SUPERNODE parallel computers.



## ■ Remote Sensing Applications

The Institute for Remote Sensing Applications participates in the EC cooperation agreement with the European Space Agency (ESA).

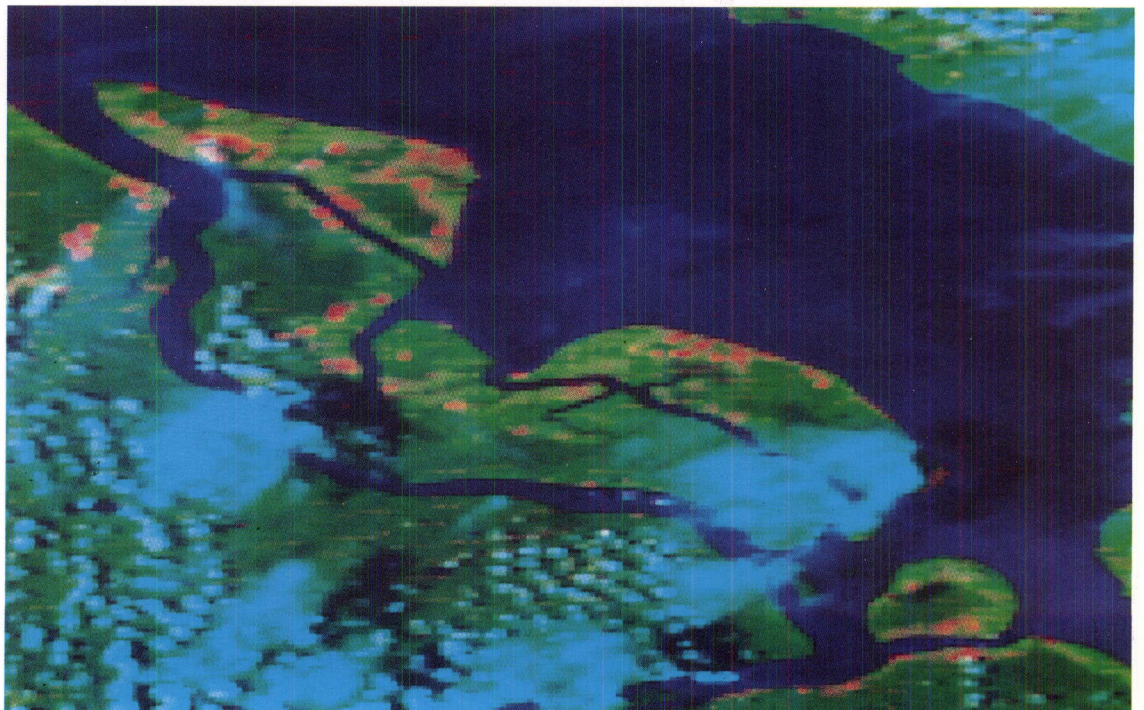
The ESA/European Commission Environment and Earth Observation Working Group, which was set up last year, has prepared joint projects covering a range of subjects related to environmental research and earth observations.

- Multi-satellite observations are used to assess spatial distribution and temporal evolution of tropical ecosystems under the Tropical Ecosystem Environment observation by Satellites (TREES) programme;
- the European airborne remote sensing capability programme was set up to provide a series of sensors for aircraft which can be used by the research Community.

At its fifth meeting in October 1990 the Working Group also discussed the possible use of satellite observations to study desertification in Mediterranean countries and in order to prepare joint initiatives for the European Environment Agency.

Together with ESA and many national teams, work to set up a European airborne remote sensing capability continued and a European Economic Interest Grouping was founded. The ERS 1 pilot projects to be started with the launch of ERS 1 in 1991 have been prepared.

Tropical forest inventory can be achieved globally using low resolution AVHRR data. Shown here is the coast of Sumatra with the original rain forest in dark green, the disturbed forest in light green and agricultural areas in red.



## ■ Safety Technology

The Institute for Safety Technology has set up and coordinates a European Association of Structural Mechanics Laboratories regrouping the main laboratories in this field in the Member States. By improving the scientific and technical basis needed to analyse the behaviour of large structures subject to severe dynamic loading, the association hopes to contribute to the validation of improved construction codes and standards.

A detailed collaborative research programme is under development which will make use of existing scientific resources and high performance testing facilities within the associated laboratories.



# RESOURCES

**T**his chapter outlines the three major resources of the JRC:

- Human: Both statutory and visiting staff
- Financial: The JRC Budget
- Large Installations

# 1 HUMAN RESOURCES: *Restructuring and Staff Policy*

## Staff Policy

The JRC authorized statutory staff amounts to 2180, including both the scientific-technical and the administrative categories. The detailed Organisation Chart is given in Annex D.

Statutory employees are governed by the EC staff regulations. For many years the JRC has only recruited staff as temporary agents and no more as officials; at present 59% of the total staff are temporary agents and 41% are officials in the scientific-technical and administrative categories. During 1990, 178 people left the JRC and 147 people were recruited.

The Table 2 gives the distribution of the JRC statutory staff by Scientific-Technical and Administrative categories and by Institutes.

**TABLE 2**

**Distribution of statutory staff \***

Location	Administrative	Scientific-Technical	Total
Directorate-General	16	7	23
Programmes Directorate	7	11	18
Administration Directorate	190	226	416
Central Bureau for Nuclear Measurements	21	147	168
Institute for Transuranium Elements	21	174	195
Institute for Advanced Materials	37	232	269
Institute for Systems Engineering and Informatics	26	221	247
Environment Institute	19	158	177
Institute for Remote Sensing Applications	11	69	80
Institute for Safety Technology	36	289	325
Institute for Prospective Technological Studies	3	11	14
<b>Total</b>	<b>387</b>	<b>1,545</b>	<b>1,932</b>

(\*) End December 1990



## Visiting Scientists and Scientific Fellows

The JRC trains high-level specialists through a programme of fellowships, which are granted to two main types of scientists:

- post-doctoral fellows.
- postgraduate students preparing a master's degree or a doctorate

Fellows are given a grant for one to three years. Besides this type of fellowship, the JRC hosts visiting scientists, mostly professors on sabbatical leave and senior scientists for one or sometimes two years. Furthermore, experts from national organisations may be seconded to the JRC to participate in selected scientific work. Finally, people from third countries may work at the JRC on a grant agreed under a Commission accord with their countries.

Table 3 shows where these people worked in the various JRC Institutes.

**TABLE 3**  
Visiting Scientists, Seconded Experts and Grant Holders  
*By Institute and by categories on 1 December 1990  
(EC and non EC citizens)*

Institutes	Visiting scientists	Seconded experts	Post-doctoral sectorial grants	Graduate sectorial grants	Under-graduate sectorial grants	Non-EC Grant Holders	Total
Central Bureau for Nuclear Measurements	4	1	0	11	0	0	16
Institute for Transuranium Elements	1	7	2	14	0	0	24
Institute for Advanced Materials	10	1	5	24	1	1	42
Institute for Systems Engineering and Informatics	5	3	2	20	2	3	35
Environment Institute	5	1	3	12	1	4	26
Institute for Remote Sensing Applications	2	3	1	9	0	0	15
Institute for Safety Technology	6	4	1	11	0	2	24
Institute for Prospective Technological Studies	0	0	1	0	0	0	1
<b>Total</b>	<b>33</b>	<b>20</b>	<b>15</b>	<b>101</b>	<b>4</b>	<b>10</b>	<b>183</b>

Furthermore the Administration Directorate has a senior national official as a seconded expert

**THE JRC is moving towards a market orientation. Whilst the amount allocated to specific and exploratory research remains stable, services to other Commission departments and outside contracts continue to grow. In 1990 they reached 14% and 15% of budget respectively.**

### Expenditures Committed in 1990

The commitment credits fixed by the Budgetary Authority for the execution by the JRC of the Specific Research Programmes and of the S/T Support Activities to the Commission, are as follows :

- Specific Research Programmes	174.46 Mioecu
- S/T Support to the Commission	34.62 Mioecu
	Total 209.08 Mioecu

Other resources for HFR operation and third party work are :

- HFR Reactor (Supplementary programme)	20.71 Mioecu
- Work for Third Parties (Budgetary advance)	16.08 Mioecu
	Total 36.79 Mioecu

The total amount of the available credits is therefore 245.87 Mioecu.

Details about 1990 commitments are given in the following two tables covering Specific Research Programmes, Exploratory Research, S/T Support to the Commission and Work for Third Parties (HFR Reactor and others).

During the budgetary exercise, an amount of 2.5 Mioecu was transferred from specific credits to reinforce personnel credits.

This transfer was necessary because :

- There has been an unforeseen correction in the salaries of 0.6 % with effect from 1st July 1989.
- Inflation in Belgium and Italy rose more than anticipated.
- The exchange rate between the Ecu and the currencies in which the salaries are paid became less favourable.



TABLE 4

Commitments for programme execution 1990  
(Rounded figures, Mioecu)

	Personnel	Other Expenditures	Total	1990 Budget
Specific research programmes	104.59	61.71	166.30	174.46
Exploratory Research	4.86	2.81	7.67	pm
<b>Subtotal</b>	<b>109.45</b>	<b>64.52</b>	<b>173.97</b>	<b>174.46</b>
S/T Support to the Commission	19.91	15.85	35.76	34.62
<b>Subtotal</b>	<b>19.91</b>	<b>15.85</b>	<b>35.76</b>	<b>34.62</b>
OTHERS				
HFR Reactor	4.90	14.97	19.87	20.71
Work for Third parties	3.63	2.88	6.51	16.08
<b>Subtotal</b>	<b>8.53</b>	<b>17.85</b>	<b>26.38</b>	<b>36.79</b>
<b>Total</b>	<b>137.89</b>	<b>98.22</b>	<b>236.11</b>	<b>245.87</b>

TABLE 5

Annual expenditures 1988-1991  
(Rounded figures, Mioecu)

	Commitments 1988	Commitments 1989	Commitments 1990	Budget 1991
Personnel	124.8	131.4	137.89	143.0
<b>Subtotal</b>	<b>124.8</b>	<b>131.4</b>	<b>137.89</b>	<b>143.0</b>
Specific research programmes	66.1	70.4	61.71	65.9
Exploratory Research	2.3	2.4	2.81	pm
<b>Subtotal</b>	<b>68.4</b>	<b>72.8</b>	<b>64.52</b>	<b>65.9</b>
S/T Support to the Commission	12.2	14.8	15.85	22.5
<b>Subtotal</b>	<b>12.2</b>	<b>14.8</b>	<b>15.85</b>	<b>22.5</b>
OTHERS				
HFR Reactor	10.8	14.6	14.97	12.1*
Work for Third parties	2.5	2.9	2.88	5.6
<b>Subtotal</b>	<b>13.3</b>	<b>17.5</b>	<b>17.85</b>	<b>17.7</b>
<b>Total</b>	<b>218.7</b>	<b>236.5</b>	<b>236.11</b>	<b>249.1</b>

\* Of which 2.75 Mioecu contribution in kind from ECN



**This Chapter deals with the operation and construction of Large Installations at the JRC sites.**

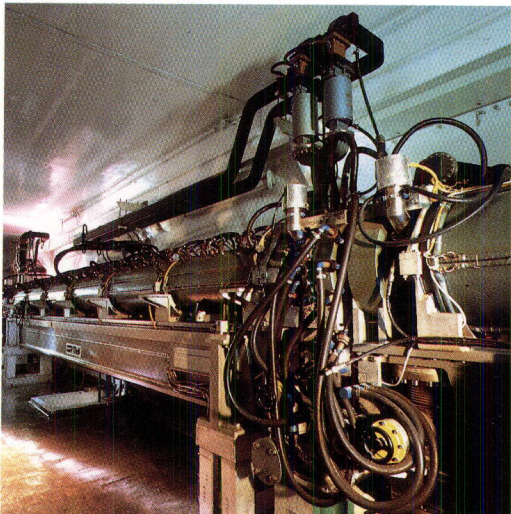
### **Utilisation of Large Installations**

#### **GEEL (CBNM)**

- **ACCELERATORS:**

In the reporting period

- the Linac electron beam was available for 3157 h for physical experiments; 65% of this time was devoted to short pulse measurements (< 1 ns). Combined neutron filters have been developed to produce beams of intense monoenergetic neutrons at the Linac.
- the 7 MV Van de Graaff machine ran for 2096 h and
- the 3.7 MV Van de Graaff machine was used for 967 h.



Accelerating sections of the Electron Linear Accelerator

#### **ISPRA**

- **LOBI:**

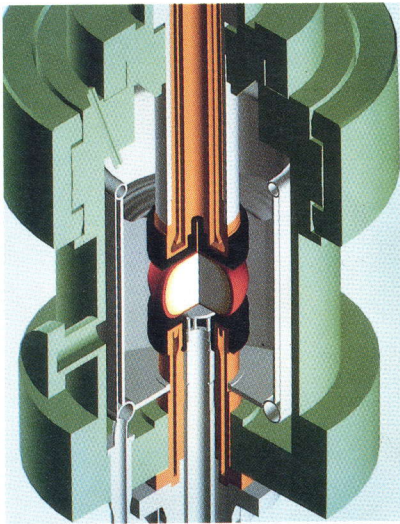
LOBI is a large test loop for the study of abnormal behaviour in light water primary cooling circuits.

In 1990, four tests agreed with the European partners were executed, including the related analysis and document work.

- **FARO:**

FARO is a multipurpose facility to investigate interactions between fuel and coolant in nuclear reactors during severe accidents. Up to 125 kg of uranium dioxide can be melted, to simulate a wide range of possible reactor accidents. During 1990:





Cut-away view of the FARO furnace showing the  $UO_2$  melt between the two electrodes

- two tests of the BLOKKER II series (related to LMFBs) were carried out for the study of melt penetration and freezing in rectangular cavities;
- modifications of the facility for the LWR programme started;
- a technical information exchange arrangement with US NRC and EPRI for the execution of FARO tests was signed.

- LDTF (Large Dynamic Test Facility):

The Large Dynamic Test Facility (LDTF) has unique features for testing the influence of weldings and defects in materials on the dynamic behaviour of structures under realistic geometrical and loading conditions. The facility is available to external customers and there have been preliminary contacts with representatives of the automobile industry.

- ESTI (European Solar Test Installation):

The European Solar Test Installation includes a complex of test facilities supported by a team of specialists and technicians principally from the photovoltaics field.

The combination of purpose-built facilities, specialist staff and an extensive data base constitute a unique resource which can now be used not only for research and prenormative work but also for commercial activities for the benefit of manufacturers, research organisations, buyers and users.

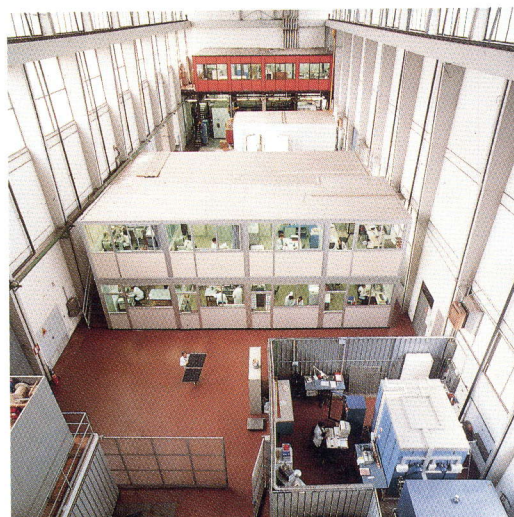
In 1990 ESTI :

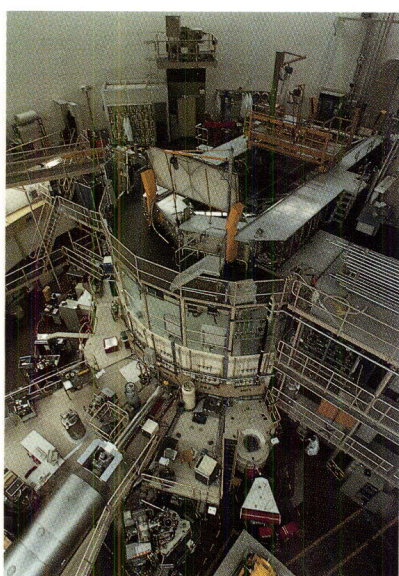
- implemented the new Specification No 503 «Qualification Test Procedures for Crystalline Silicon Photovoltaic Modules»;
- delivered Qualification Certificates for modules from various manufacturers (European, American, Japanese) for the three MW plant to be installed in Italy by the Italian Electricity Power Utility (ENEL);
- carried out various single qualification tests on prototype modules including specific hail-tests for glass, mirrors and car roofs;
- installed new test facilities (solar simulator, climatic chamber, UV radiation unit).



The Large Dynamic Test Facility (LDTF) in preparation for testing reinforced concrete beams

An overall view of the European Solar Testing Installations (ESTI)





Overall view of the HFR hall, Petten

● MAINFRAME COMPUTER:

The centre is equipped with a mainframe computer backed up by extensive auxiliary equipment and highly developed networks linking computers and terminals at the centre, with access to public data transmission networks. Computer use in 1990 has been very similar to that of 1989 i.e. around 26.000 machine units.

● CYCLOTRON:

In 1990 the Cyclotron achieved a net effective time for experimental irradiations of 1.700 hrs. The breakdown between activities was as follows:

Specific Programmes:	
Fusion	70%
Environment	5%
Advanced Materials	8%
Standardization of Radiopharmaceuticals (DG XI)	10%
Internal use:	7%

**PETTEN**

● HIGH FLUX REACTOR:

In 1990 the High Flux Reactor operated for 278 days, with 75% average occupation of irradiation positions. The break-down by category of irradiation experiment is as follows:

LWR	4%	Solid State Physics	7%
FBR	10%	Radioisotope production	13%
HTR	12%	Miscellaneous	11%
Fusion	28%	Internal Utilisation	6%
Nuclear Physics	9%		



## Construction of New Installations

### PETRA

Construction of the PETRA facility at Ispra terminated in 1989. The Ministry of Industry has authorized the facility up to the start-up of the hot operation. During 1990 a series of improvements in the layout were introduced after components and systems tests; cold commissioning tests were continued and are scheduled to be completed by mid 1991.

### PERLA

The building for the Safeguards Performance Laboratory PERLA is finished. The installation of the ventilation and electrical equipment were initiated in 1990; The authorization by the Ministry of Industry is given up to the termination of the installation. The procedure for licensing hot operation is expected to start mid 1991.



Overall view of the PETRA facility showing the three main hot cells and the Process Control System (PCS)



### ETHEL

The ETHEL project made significant progress. The construction of the building was completed and the installation of most of the infrastructure systems was terminated in 1990. Individual subsystems are expected to be tested during the first semester of 1991.



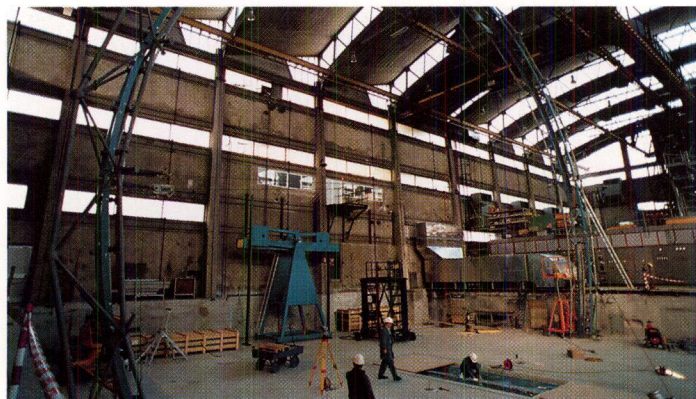
A partial view of one of the principal areas for performing tritium experiments in ETHEL

### REACTION WALL

The construction of this facility started in 1990; the laboratory, including the equipment, is expected to be completed by the end of 1991.

### THE MICROWAVE SIGNATURE LABORATORY

The development and construction of the European Microwave Signature Laboratory, contracted to a German firm, passed successfully the Critical Design Review (CDR) in April this year. As a result, the production of the individual components has started. In parallel, the host building for the laboratory has been prepared. The installation phase was started at Ispra in November 1990. All electronic components are ready for installation and the operation software for the whole laboratory is under development.



Construction work in progress on the European Microwave Signature Laboratory within the host building



# ANNEXES

**T**his

part contains further details of the various activities and administration of the Joint Research centre, as well as a guide to the tables, figures and terms used in this Report:

- Financial Accounts
- Publications, Eurocourses and Application of Results
- External Relations
- Board of Governors and Organisation Chart
- Index and Glossary



## Annex A: Financial Accounts

Two tables are provided in order to show in more details the commitments made in 1990:

Table 6: this table compares the commitments made by each objective with the budget, the personnel expenses being kept apart.

Year Reference	1990 Amounts committed		1990 Commitment credits in Budget	
<b>1. Personnel</b>	137.89		138.00*	
- Framework Programme		109.45		104.92
- out of Framework Programme		28.44		33.08
<b>2. Quality of life</b>				
2.1. Radiation Protection				
- Evaluation and Monitoring of Radioactivity				
2.2. Environment	12.09		13.92	
- Environmental Protection		5.69		7.04
- Application of Remote Sensing Techniques		3.82		4.11
- Industrial Hazards		2.58		2.77
<b>3. Modernisation of industrial sectors</b>				
3.1. Science and technology of Advanced Materials	4.11		4.64	
- Advanced Materials		4.11		4.64
3.2. Technical Standards, Measurement Methods and Reference Materials	12.04		13.03	
- Nuclear Measurements and Reference Materials		7.36		7.93
- Reference Methods, reliability of structures		4.15		4.48
- Reference Methods for Non-Nuclear Energies		0.53		0.62
<b>4. Energy</b>				
4.1 Fission : Nuclear Safety	28.75		32.86	
- Reactor Safety		14.75		16.71
- Radioactive Waste Management		3.93		4.33
- Safeguards and Fissile Materials Management		3.11		3.44
- Nuclear Fuels and Actinide Research		6.96		8.38
4.2. Controlled Thermonuclear Fusion	4.72		5.10	
- Fusion Technology safety		4.72		5.10
<b>5. Exploratory research</b>	2.81	2.81	p.m.	p.m.
<i>SUB-TOTAL FRAMEWORK PROGRAMME (incl. Expl. Res.) (2 to 5)</i>	64.52		69.55	
<b>6. S/T Support to Commission</b>	15.85		17.15	
<b>7. Work for third parties (outside HFR supplementary programme) budgetted credits</b>	2.88		5.77	
<i>TOTAL GENERAL BUDGET (1 to 7)</i>	221.14		230.47	
<b>8. HFR</b>				
- funding contributions	11.46		11.70	
- in kind contribution	2.60		2.6	
- transfers from previous years	0.91		1.1	
<b>9. Work for third parties (outside HFR supplementary programme) additional direct commitments</b>	3.7		0	
<i>GRAND TOTAL (1 to 9)</i>	239.81		245.87	

\* Including transfer of 2.5 Mio from the specific credits to personnel credits



TABLE 7

Detailed breakdown Commitments 1990, Budget 1990 (Mioecus)  
(Rounded Figures)

Year Reference	1990 Amounts committed		1990 Commitment credits in Budget *	
<b>1. Quality of life</b>				
1.1. Radiation Protection				
- Evaluation and Monitoring of Radioactivity				
1.2. Environment	36.88		38.34	
- Environmental Protection		18.12		19.09
- Application of Remote Sensing Techniques		10.60		10.73
- Industrial Hazards		8.16		8.52
<b>2. Modernisation of industrial sectors</b>				
2.1. Science and technology of Advanced Materials	13.46		13.80	
- Advanced Materials		13.46		13.80
2.2. Technical Standards, Measurement Methods and Reference Materials	30.39		31.58	
- Nuclear Measurements and Reference Materials		18.51		19.74
- Reference Methods, reliability of structures		9.91		10.07
- Reference Methods for Non-Nuclear Energies		1.97		1.77
<b>3. Energy</b>				
3.1 Fission : Nuclear Safety	72.00		77.68	
- Reactor Safety		34.68		37.18
- Radioactive Waste Management		12.29		12.83
- Safeguards and Fissile Materials Management		10.63		10.36
- Nuclear Fuels and Actinide Research		14.40		17.31
3.2. Controlled Thermonuclear Fusion	13.57		13.06	
- Fusion Technology safety		13.57		13.06
<b>4. Exploratory research</b>	7.67	7.67	p.m.	p.m.
<i>SUB-TOTAL FRAMEWORK PROGRAMME (incl. Expl. Res.) (1 to 4)</i>	173.97		174.46	
<b>5. S/T Support to Commission</b>	35.76		34.62	
<b>6. Work for third parties (outside HFR supplementary programme) budgetted credits</b>	6.51		16.08	
<b>7. HFR</b>				
- funding contributions	16.36		17.00	
- in kind contribution	2.60		2.60	
- transfers from previous years	0.91		1.11	
<b>8. Work for third parties (outside HFR supplementary programme) additional direct commitments</b>	3.70		0	
<b>GRAND TOTAL (1 to 8)</b>	239.81		245.87	

\*) Figures computed for each programme objective, by adding personnel credits to specific credits;

Table 7: this table is similar to table 6 but the personnel cost has been added to the cost of each objective.



## Annex B: Publications, Eurocourses and Application of Results

### Publications

In 1990 the JRC published 821 papers, more than in previous years. The most prolific fields were nuclear fuels and actinide research, followed by environmental protection. The following Table gives the distribution of these publications among research programmes.

Publication trends over the last six years are illustrated in Fig. 3.

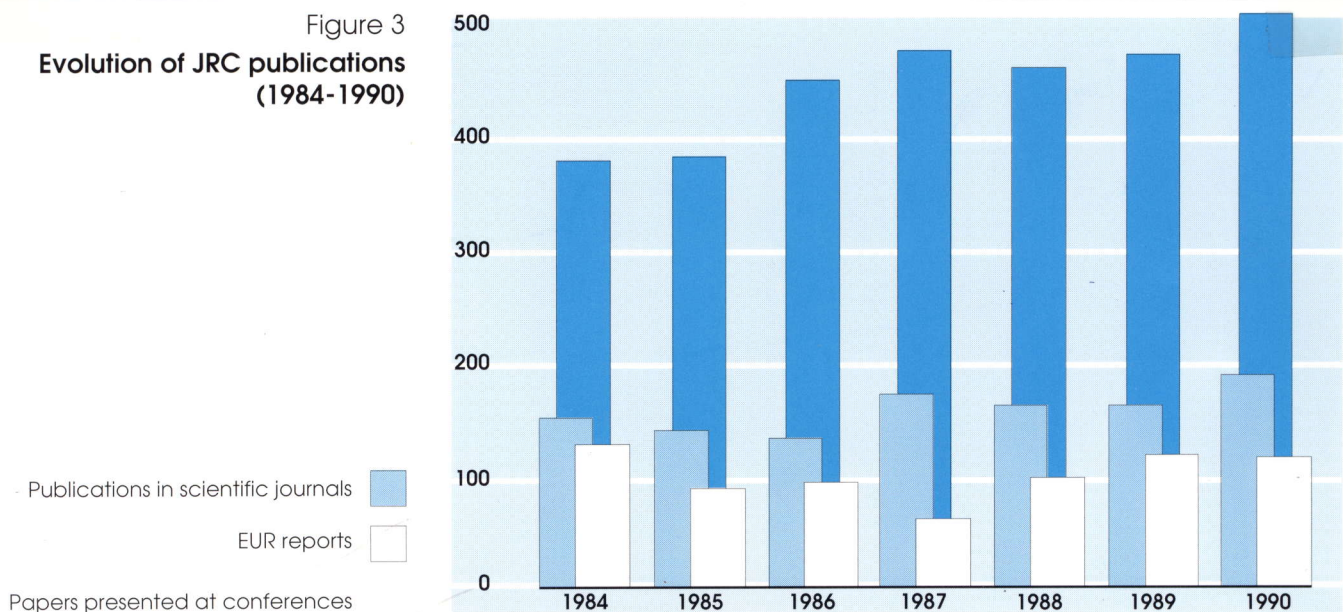
A detailed list of JRC publications is published each year, in the «Publications Bulletin». Publications in 1989 are listed in issue No 10 (ISSN-0254-3133), which was published in October 1990.

TABLE 8

Distribution of JRC publications among research programmes in 1990

	EUR Reports	Conference papers	Public. in scientific journals	Total
Nuclear Measurements and Reference Materials	7	39	24	70
Advanced Materials	9	58	30	97
Fusion Technology and Safety	8	46	9	63
Reactor Safety	20	44	10	74
Radioactive Waste Management	12	7	11	30
Safeguards and Fissile Materials Management	3	9	3	15
Nuclear Fuels and Actinide Research	4	90	34	128
Reference Methods for Structural Reliability	1	13	1	15
Environmental Protection	11	73	34	118
Application of Remote Sensing Techniques	6	36	10	52
Industrial Hazards	6	30	9	45
Radioactivity Environmental Monitoring	3	6	3	12
Reference Methods for Non-Nuclear Energies	7	2	1	10
Other publications	19	61	12	92
<b>TOTAL</b>	<b>116</b>	<b>514</b>	<b>191</b>	<b>821</b>

Figure 3  
Evolution of JRC publications (1984-1990)





## Eurocourses

Since 1974, Eurocourses at the Ispra Site have helped build up an increasingly integrated scientific community throughout the EC. They attract researchers, industrial staff, administrators and students who want to gain a European perspective in their fields.

In 1990, the JRC organized eight Eurocourses, with that on remote sensing techniques attracting the greatest interest. Two-thirds of the lecturing staff were well-known guest lecturers from Europe and the USA, and one-third were experts from both the Institutes and various Directorates General of the Commission.

The courses covered the following subjects:

### Health Physics and Radiation Protection

- Fundamentals of radiation protection.

### Remote sensing applications

- Remote sensing and geographical information systems for management of natural resources in developing countries;

- Application of remote sensing to agricultural statistics crop inventories and area frame sampling.

### Chemical and environmental science

- Practical applications of quantitative structure-activity relationships in environmental chemistry and toxicology;
- Sulphur dioxide and nitrogen oxides in industrial waste gases; emission, legislation and abatement.

### Computer science

- Computing with parallel architectures;
- Industrial application of electromagnetic computer codes.

### Technological innovation

- Forecasting technological innovation.

All courses were residential. They were attended by 176 participants from industry, public administration, universities and research organisations, as shown in Figure 4 which also lists the countries represented.

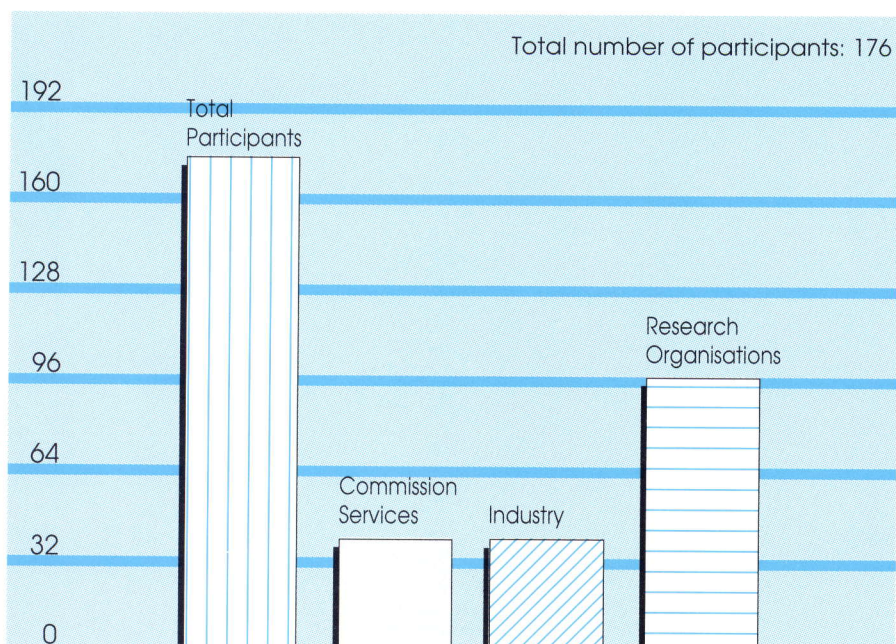
The courses material is being published in various volumes which each describe the state of the art in a specific field.

The «Remote sensing and geographical information systems for management of natural resources in developing countries» course was financed by the Directorate General for Science, Research and Development (DG XII), the Directorate General for Development (DG VIII), and the Directorate General for External Relations (DG I). The course lasted two weeks and included theoretical lectures as well as practical laboratory training. The International Institute for Aerospace and Earth Science of Enschede (NL) provided lecturing and training on «Geographical Information Systems»

Attendance on the courses dealing with application of remote sensing techniques was remarkably high. Participants from various Commission Services, including JRC Institutes, made up about 12% of the total. Among all the countries represented, Spain had the highest number of participants.

Participants and countries represented in 1990 Eurocourses

Figure 4



#### EC Member Countries represented:

Belgium, Denmark, France, Germany, United Kingdom, Greece, Italy, Netherlands, Portugal and Spain.

#### Non EC Member Countries represented:

Argentina, Equador, Guinea, Madagascar, Nigeria, Norway, Poland, Senegal, Sweden, Switzerland, Thailand, Uganda, Yugoslavia and Zimbabwe.



## Applications of Results

A growing use of JRC laboratories has been in the promotion of innovation transfer to industry and other potential users; in particular for the exploitation of new patents, the development of inventions and the construction of prototypes.

As with other research organisations, it is difficult to quantify the use of results stemming from research work. Indeed, there is no way to measure the flow of knowledge from the JRC to other organisations and European industry precisely. Nevertheless Chapter 2.2 and 2.3. give an idea of how JRC scientific capabilities are used as a basis for the further development of codes and standards (advanced materials, photovoltaic, mechanical structures, nuclear materials) and for the establishment of Community policies, in particular for the regulations in the environmental protection field. Furthermore Chapter 2.4. highlights how Industry can also benefit from the JRC scientific resources.

A growing use of JRC laboratories has been in the promotion of innovation transfer to industry and other potential users; in particular for the exploitation of new patents, the development of inventions and the construction of prototypes.

15 projects from Energy, Environment, Materials and Remote Sensing fields

have been selected by DG XIII and are receiving a funding from the Innovation Programme, as well as a JRC contribution of 14 staff-years including a financial allocation of 0.500 Mioecu. The fields of application are:

1. Electronic speed controller
2. Passive downward heat transport
3. Heat pipe furnace
4. Object identification by surface texture
5. Ispra MARK 13A process for the flue gas desulfuration
6. Oxygen sensors
7. Gas encapsulation in Zeolites
8. Antioxidant for plastics
9. Mass Spectrometer
10. Ultrasonic sealing and identification techniques
11. TITUS ultrasonic seals - Reference transducers
12. Six colours pyrometer
13. Transfer of solar technology
14. Aerosol treatment with ultrasounds
15. Aspects of image processing

The following achievements are worth mentioning:

- a first heat pipe furnace was ordered by a German firm and manufactured according to the specification of the firm, in the JRC laboratory. Other orders are expected;
- for the oxygen sensor an additional patent was taken to improve the stability of the measurements; licences can now increase the product quality and so could mean a large potential market (process CERMAT);

- the six colour pyrometers are still being developed by a German licensee, along with the Institute for Transuranium Elements. The licensee is now carrying out a market study;
- the transfer of solar equipment monitoring techniques, from the JRC laboratory (Institute for Systems Engineering and Informatics) to CRES in Greece is progressing well. The monitoring techniques will have to be adapted to the specific needs of the Greek building industry;
- a prototype installation for aerosol treatment by ultrasound is being built at the Institute for Transuranium Elements, according to specific requirements of a German firm; a testing programme using this firm's special instrumentation is planned.
- the fundamental optical phenomena related to the Processing and Synthesis Techniques applied to synthesis of holograms have been patented and the image and holographic processing software has been implemented on T-NODE computer. The coordination with the other partners of the VALUE programme on Image Processing and Synthesis, namely CRN-Strasbourg, University of Milano and Limoges, has been undertaken.

Relations with DG XIII were strengthened by the organisation of «information days» at the JRC sites and a seminar at DG XIII in Luxembourg.



## Annex C: External Relations

### Exhibitions and fairs

In 1990 the JRC was involved in various events, including multisectorial fairs and specialized exhibitions; Table 9 gives an overview of the JRC participation in such activities.

EXHIBITION	INSTITUTE	DATE
<b>INOVA '90</b> Paris	Advanced Materials, Transuranium Elements, Safety Technology, Environment	<b>3-6 April</b>
<b>HANNOVER MESSE</b> Hannover	Advanced Materials, Environment, Remote Sensing Applications	<b>2-9 May</b>
<b>EUROPA RICERCA</b> Rome	Remote Sensing Applications and Project EUREKA	<b>31 May-10 June</b>
<b>HYDROGEN EXHIBITIONS</b> Strasbourg	Systems Engineering and Informatics	<b>12-15 June</b>
<b>TECHTRANSCENTRE</b> Herning	Advanced Materials, Environment, Systems Engineering and Informatics	<b>11-15 September</b>
<b>ELETTRONICA, SPAZIO, ENERGIA</b> Rome	Systems Engineering and Informatics	<b>5-9 November</b>
<b>TECHNOSPACE</b> Brussels	Remote Sensing Applications	<b>6-10 November</b>
<b>ALONE INTERNAZIONALE NUOVE TECNOLOGIE</b> Torino	Transuranium Elements, Advanced Materials, Environment, Safety Technology	<b>7-11 November</b>
<b>FORUM SCIENCE, TECHNOLOGY AND SOCIETY</b> Strasbourg	The Joint Research Centre	<b>8-10 November</b>
<b>FORMAZIONE DOMANI</b> Bologne	The Joint Research Centre (Eurocourses)	<b>19-21 November</b>
<b>SICUREZZA '90</b> Milan	Environment	<b>24-28 November</b>
<b>RICH '90</b> Milan	Environment, Safety Technology	<b>27 November - 1 December</b>

### Press and public relations

During the year the JRC received important visitors from the EC Member States, the European Parliament, the Council and from the Commission including a visit by the President of the Commission. Furthermore from several countries worldwide including Japan and the USA.

The JRC hosts numerous visitors and meetings at its sites; an overview is given in Table 10

The most significant events included the following visits:

- Visit of the directors from Risø National Laboratory, Denmark, headed by Dr. H. Bjerrum Møller, Managing Director. (23 January) - Ispra
- Visit of a delegation of Japanese Experts headed by Mr N. Kubota, Nuclear Safety Technology Centre, Tokyo, Japan (24 January) - Ispra
- Visit of Messrs W. Lion and P. Lagendijk, respectively Consuls General of Belgium and the Netherlands in Milan (7 February) - Ispra
- Visit of members of the United Nations Institute for Training and Research (UNITAR European Office in Geneva)

- headed by Mrs De Rham-Azimi (26 February) - Ispra
- Visit of Dr A. Lindgren, Scientific and Industrial Secretary of Finland in Milan (1 March) - Ispra
- Visit of Mr P. Romita, Italian Minister for Community Politics (19 March) - Ispra
- Report of journalists from the «Radiotelevisione della Svizzera Italiana» (26 March) - Ispra
- Visit of Mr F.M. Pandolfi, Vice-President of the Commission of the European Communities (17 April) - Ispra
- Visit of the ISPM Institute, Rabat, Morocco (19-20 April) - Ispra



- Visit of Mr J. Sucena Paiva, Secretary of State for Science and Technology of Portugal (27 April) - Ispra
- Visit of Mr E. Sødahl, Director in the Foundation for Industrial Research of the Norwegian Technical University of Trondheim (7-8 June) - Ispra
- Visit of a Japanese Delegation representing the University of Tokyo, the Nuclear Power Engineering Test Centre, Toshiba Corporation, Hitachi Ltd., Mitsubishi Heavy Industries Ltd., Nippon Nuclear Fuel Development Co. Ltd. and Nuclear Fuel Industries Ltd. (13 June) - Karlsruhe
- Visit of the Budgetary Committee of the Council (15 June) - Ispra
- Visit of Mr. A. Liénard, Minister for Environmental Planning, Research, Technology, and External Relations of the Wallonian Region, (June 20) - ITU Karlsruhe
- Visit of Mr T. Regge, Member of the Commission on Energy, Research and Technology of the European Parliament (25 June) - Ispra
- Visit of Mr Robles Piquer, Member of the European Parliament (28 June) - Ispra
- Visit of Mr L. Vertemati, Member of the Committee on the Environment, Public Health and Consumer Protection of the European Parliament, (2 July) - Ispra
- Visit of Mrs J. Larive and Messrs G.J. Adam and M. Chiabrando of the European Parliament's Committee on Energy, Research, and Technology (July 12) - ITU Karlsruhe
- Visit of Ambassador U. Vattani, «Consigliere Diplomatico del Presidente del Consiglio del Governo Italiano» and Mr R. Nigido «Ministro Plenipotenziario, Coordinatore delle Questioni Comunitarie» (25 September) - Ispra
- Visit of Mr P. Wetton, Consul General of Great Britain in Milan and Mr D. Hollamby, Scientific Adviser at the British Embassy in Rome (1 October) - Ispra
- Visit of Mr J. Macário Correia, Under Secretary of State for the Environment and Consumer Protection of Portugal (12 October) - Ispra
- Visit of a delegation from EXXON Company, USA headed by Mr B.P. Zarinis (30-31 October) - Ispra
- Visit of Mr P. Schmidhuber, Member of the Commission of the European Communities in charge of Budget and Finance (8 November) - Ispra
- Visit of Mr J. Delors, President of the

Commission of the European Communities (26 November) - Ispra  
 - Visit of Mr P. Biarnes, Member of the French Senate (27 November) - Ispra

#### Workshops, seminars and conferences:

- Nuclear Certification Group Meeting (31 January-1 February) - Geel
- Prenormative R&D for Advanced Ceramics Ad-Hoc Committee (12 February) - Petten
- Ceramic Meeting Task Group Meeting (European Group of Fracture) (13-14 February) - Petten
- Standards for Advanced Ceramics CEN Technical Committee (22-23 February) - Petten
- European Safety Reliability Research and Development Association (ESRRDA) and European Reliability Data (EUREDATA) Assembly Meeting and Workshop (3-6 April) - Ispra
- Designing with Structural Ceramics Workshop (3-6 April) - Petten
- Meeting of «L'Académie Nationale de l'Air et de l'Espace de Toulouse» (26-27 April) - Ispra
- 30th Anniversary of the Central Bureau for Nuclear Measurements (10-13 May) - Geel
- 12th European Safeguards Research and Development Association

- (ESARDA) Meeting (15-17 May) - Ispra
- 25th European Two-Phase Flow Group Meeting (21-23 May) - Ispra
- Meeting of the Yugoslavia-EC Joint Committee on Science and Technology (28-30 May) - Ispra
- High Temperature Fibre Technology Workshop (31 May) - Petten
- Intermetallics Workshop (6 June) - Brussels
- COST 501 Working Party (19-21 June) - Petten
- Classification of Advanced Ceramics Vamas Workshop (21-22 June) - Ispra
- User Aspects of Phase Diagrams Conference (25-27 June) - Petten
- 7th ASTM-Euratom Symposium on Reactor Dosimetry (27-31 August) - Strasbourg
- 5th International Symposium on Resonance Ionization Spectroscopy and its Application (16-21 September) - Ispra
- Meeting of the Environment Assessors of the 4 European Regions (28 September) - Ispra
- Architecture for Cooperating Heterogeneous On-Line Systems (ARCHON) PCC-8 Meeting and 3rd Project Review for the ESPRIT Programme (2-5 October) - Ispra
- High Temperature Mechanical Testing Colloquium (18-19 October) - Ispra

TABLE 10

### Visits and meetings

	No	No. of days	No. of persons
Visits	107	111	1160
Meetings	79	140	1935



## Annex D: Board of Governors and Organisation Chart

### Board of Governors in 1990

#### Sir John KENDREW

Chairman  
The Old Guildhall  
4 Church Lane  
Linton  
GB-CAMBRIDGE CB1 6JX

#### M. Jean-Pol PONCELET

Cabinet de Madame Miet Smet  
Secrétaire d'Etat à l'Environnement  
rue de la Loi, 56  
B-1040 BRUXELLES

#### Prof. Flemming WOLDBYE

Danish Research Administration  
H.C. Andersens Boulevard 40  
DK-1553 COPENHAGEN V

#### Dr. Werner GRIES

Bundesministerium für Forschung und  
Technologie Heinemannstrasse 2  
D-5300 BONN 2

#### Prof. A.J. KARABELAS

Department of Chemical  
Engineering  
School of Engineering  
University of Thessaloniki  
GR-THESSALONIKI

#### Dr. Manuel MONTES PONCE DE LEON

Director de Tecnología Nuclear  
CIEMAT  
Avda Complutense 22  
E-28044 MADRID

#### Dr. Jules HOROWITZ

Conseiller Scientifique du CEA  
31-33, rue de la Fédération  
F-75752 PARIS CEDEX 15

#### Prof. Gerard T. WRIXON

Director  
National Micro Electronics Research  
Centre  
Lee Maltings  
University College Cork IRL-CORK

#### Ing. Carlo MANCINI

Direttore  
ENEA  
Viale Regina Margherita 125  
I-00198 ROMA

#### M. Jean HOFFMANN

Commissaire du Gouvernement à  
l'Energie  
Ministère de l'Energie  
19-21 Bd. Royal  
L-2449 LUXEMBOURG

#### Drs. J.J. DE JONG

Deputy Director of Electricity and  
Nuclear Energy  
Ministerie van Economische Zaken  
Bezuidenhoutseweg 6  
Postbus 20101  
NL-2500 EC DEN HAAG

#### Prof. Fernando Manuel RAMÔA RIBEIRO

Vice-Presidente JNICT  
Junta Nacional de Investigaçao  
Cientifica e Technologica  
Av. D. Carlos I, 126 - 2o  
P-1200 LISBOA

#### Sir John FAIRCLOUGH

Chief Scientific Adviser (outgoing  
member in June 1990)  
substituted by

#### Prof. W. STEWART

Chief Scientific Adviser  
Cabinet Office  
70 Whitehall  
GB-LONDON SW 1A 2AS

### Organisation chart

(May 1991)

#### Directorate-General

Director-General  
Adviser hors classe  
Adviser

Adviser (in charge of Board  
of Governors)  
Budget Coordination  
Assistant to Director-General

#### Programmes Directorate

Director  
Safety engineer  
- Coordination  
of scientific activities  
- Interinstitutional relations  
- General planning  
- Marketing  
and exploitation of results  
- Space Applications

#### Brussels

Jean-Pierre CONTZEN  
George Robert BISHOP  
Piedad GARCIA DE LA  
RASILLA Y PINEDA

Samuel LLOYD  
Michel GRIN  
Gisèle VANWERT

#### Brussels

Hans Jørgen HELMS  
Marcello BRESESTI

François LAFONTAINE  
Reinhold HACK  
Roberto CUNIBERTI

Ettore CARUSO  
.....

#### Administration Directorate for the JRC

Director  
Adviser  
- Human resources  
- Analytical accountancy  
and management  
of central services  
- Contracts  
- Infrastructure, Ispra site  
- Radiation Protection,  
Ispra site  
- Public relations, Ispra  
- Central workshop, Ispra  
- Vocation training school,  
Ispra  
- Documentation  
and Publications  
- Security

#### Ispra

Henri HANNAERT  
Gilles NULLENS  
Bernard CHAMBAUD

.....  
Michele ACTIS-DATO  
Alberto AGAZZI

Argeo BENCO  
Emanuela ROSSI  
Learco DI PIAZZA

Michel LE DET

Mary CONNOLLY  
Domenico SEVI

**Central Bureau  
for Nuclear Measurements**

Institute Director

- Nuclear physics and measurements
- Reference materials
- Personnel, administration and infrastructure

**Geel**

Werner MÜLLER

Achiel DE RUYTTER  
Richard LESSER

Michel FOUCAULT

**Institute  
for Transuranium Elements**

Institute Director

Adviser acting as

Institute Deputy Director

Adviser (Programmes)

- Technological physics
- Applied physics
- Nuclear technology
- Nuclear chemistry
- Actinides
- Personnel and Administration
- Radiation protection
- Technical services

**Karlsruhe**

Jacobus VAN GEEL

Jean FUGER  
Hans Eberhard SCHMIDT  
Michel COQUERELLE  
Hans Joachim MATZKE  
Karl Ernst RICHTER  
Lothar KOCH  
Ulrich G. BENEDICTPaul BLAES  
Klaas BUIJS  
G rard SAMSEL**Institute  
for Advanced Materials**

Institute Director

Adviser

- High-flux Reactor
- Characterization of materials
- Materials engineering
- Materials reliability and performance
- Non-destructive testing and instrumentation
- Functional materials and Cyclotron
- Personnel and administration of the Institute, and infrastructure of the Petten site

**Petten et Ispra**Ernest Demetrios  
HONDROSWalter KLEY  
J rgen AHLFMarcel VAN DE VOORDE  
Hermann KR CKEL  
(acting)

Peter SCHILLER

Pierre JEHENSON

Livio MANES

Abraham BAHBOUT

**Institute for Systems  
Engineering and Informatics**

Institute Director

Head of unit acting

as Institute Deputy Director

Adviser (Thermonuclear fusion)

Adviser

**Ispra**

Robert W. WITTY

Giuseppe VOLTA  
Giampaolo CASINI  
Jean-Pierre AUBINEAU

- Systems Engineering and reliability
- Reference methods and measurements for non-nuclear energy sources
- Control of fissile materials
- Informatics services
- Advanced energy systems

Giuseppe VOLTA

Eric ARANOVITCH

Marc CUYPERS

.....

.....

**Environment Institute**

Institute Director

Head of unit acting

as Deputy Director

- Administration and Technical Services
- Atmospheric Physics
- Atmospheric Chemistry
- Atmosphere Biosphere Interactions
- Environmental Informatics
- Environmental Chemicals: Waste, Soil, Water
- Environmental Chemicals: Life Sciences
- Environmental Chemicals: Indoor Pollution
- Food and Drug Analysis, Consumer Protection

**Ispra**

Friedrich GEISS

Bruno VERSINO

.....

Francesco GIRARDI

.....

Bruno VERSINO

.....

Sergio FACCHETTI

.....

.....

.....

**Institute for Remote  
Sensing Applications**

Institute Director

- Environmental Mapping and Modelling
- Agriculture Information Systems
- Monitoring of Tropical Vegetation
- Marine Environment
- Advanced Techniques

**Ispra**

Raymond KLERSY

Jacques MEGIER

Jean MEYER-ROUX

Jean-Paul MALINGREAU

.....

A. SIEBER

**Institute for Safety Technology**

Institute Director

- Thermodynamics
- Process engineering
- Applied mechanics
- In-pile experiments
- Nuclear fuel cycle
- Nuclear experiments

**Ispra**

Helmut HOLTBECKER

Paola FASOLI

Claus BUSSE

Jean Michel DONEA

Peter VON DER HARDT

Heinz DWORSCHAK

Giuseppe BARBERA

**Institute for Prospective  
Technological Studies**

Institute Director

- Studies and reviews, network coordination

**Ispra**

Pierre BONNAURE

Carlo RINALDINI



## Annex E: Glossary and Index

### Glossary of acronyms and abbreviations

ALPSOLAR	EUREKA Project to develop photovoltaic solar devices	EUROTRAC	European Experiment on Transport and Transformation of Environmentally Relevant Trace Constituents in the Troposphere (EUREKA project)
ATMES	Atmospheric Transport Models Evaluation Study	FARO	Experimental Facility for Fuel Melting
AVHRR	Advanced Very High Resolution Radiometer	FIRES	Facility for Investigating Runaway Events Safety
BIPM	Bureau International des Poids et Mesures	FORMENTOR	EUREKA project to develop expert system to help decision in hazardous situations (complex man made systems)
CBNM	Central Bureau for Nuclear Measurement	HFR	High Flux Reactor
CEA	Commissariat à l'Énergie Atomique	HTR	Hochtemperaturreaktor
CEC	Commission of the European Communities	IAEA	International Atomic Energy Agency
CENELEC	Comité Européen de Normalisation Electrotechnique	JAERI	Japan Atomic Energy Research Institute
CEN	Comité Européen de Normalisation	LASFLEUR	Laser Induced Chlorophyll-Fluorescence
CISE	Centro Informazioni Studi Esperienze	LMFBR	Liquid Metal Fast Breeder Reactor
COST	Scientific and Technical Cooperation	LWR	Light Water Reactor
CRIEPI	Central Research Institute of Electric Power Industry (Japan)	NEA	Nuclear Energy Agency (of the OECD)
CZCS	Coastal Zone Color Scanner	NOAA	National Oceanic and Atmospheric Administration (US)
E-MARC	European Materials Research Consortium	PERLA	Performance and Training Laboratory (Nuclear Safeguards)
EAEC	European Atomic Energy Community	PETRA	Facility for Treatment of Radioactive Waste
ECSAM	European Commission's Safeguards Analytical Measurements	PISC	Programme for Inspection of Steel Components
ECN	Energie Centrum Nederland (Dutch national energy research centre)	RAMINO	Reliability Assessment for Maintenance of Inspective Optimization
ETHEL	European Tritium Handling Experimental Laboratory	SESAME	Databank on European Community's Energy Research and Development Projects
EURACS	European Radar Cross Section Database	TRANSALP	Transalpine Transport of Air Pollution
EURATOM	European Atomic Energy Community	UNCTAD	UN Conference on Trade and Development
EUREKA	European co-operation on advanced technology	VISIMAR	Visualisation and Simulation of Marine Environmental Processes
EUROENVIRON	EUREKA Environmental Umbrella Project		
EUROSTAT	Statistical Office of the Commission of the European Communities		

### List of tables and figures

Tables	Page		
1. Work for Third Parties	65	8. Distribution of JRC publications among research programmes in 1990	96
2. Distribution of statutory staff	84	9. Exhibitions and fairs	99
3. Visiting Scientists, Seconded Experts and Grant Holders	85	10. Visits and Meetings	100
4. Commitments for programme execution 1990	87	<b>Figures</b>	
5. Annual expenditures 1988-1991	87	1. JRC S/T Support to Community Policies	48
6. Detailed breakdown Commitments 1990, Budget 1990	94	2. Work for Third Parties - Orders, invoices, payments received in 1988-1990	65
7. Detailed breakdown Commitments 1990, Budget 1990	95	3. Evolution of JRC publications (1984-1990)	96
		4. Participants and countries represented in 1990 Eurocourses	97

Commission of the European Communities

**Joint Research Centre**

Directorate-General  
200, rue de la Loi, B-1049 Brussels  
Phone : +32 2 235 85 27  
Telex : 21877 COMEU B  
Fax : +32 2 235 01 46

**Central Bureau of Nuclear Measurements**

Steenweg op Retie  
B-2240 GEEL  
Phone: +32 14 571 292  
Telex: 33 589 EURAT B  
Fax: +32 14 584 273

**Institute for Transuranium Elements**

Postfach 2340  
D-7500 KARLSRUHE  
Phone: +49 7247 84 350  
Telex: 7825483 EU  
Fax: +49 7247 4046

**Environment Institute**

I-21020 ISPRA (VA)  
Phone: +39 332 78 96 01  
Telex: 380042 or 380058 EUR I  
Fax: +39 332 78 92 22

**Institute for Remote Sensing Applications**

I-21020 ISPRA (VA)  
Phone: +39 332 78 97 65  
Telex: 380042 or 380058 EUR I  
Fax: +39 332 78 95 36

**Institute for Safety Technology**

I-21020 ISPRA (VA)  
Phone: +39 332 78 97 43  
Telex: 380042 or 380058 EUR I  
Fax: + 39 332 78 99 03

**Institute for Systems Engineering and Informatics**

I-21020 ISPRA (VA)  
Phone: +39 332 78 99 47  
Telex: 380042 or 380058 EUR I  
Fax: +39 332 78 99 23

**Institute for Advanced Materials**

P.O. Box 2  
NL-1755 ZG PETTEN  
Phone: +31 2246 5401  
Telex: 5721 REACP  
Fax: +31 2246 33 93

**Institute for Prospective Technological Studies**

I-21020 ISPRA (VA)  
Phone: +39 332 78 99 41  
Telex: 380042 or 380058 EUR I  
Fax: +39 332 78 90 65



Conception and Production:

**JRC Ispra Publications Service**

Graphic Design and Editing:

**European Service Network/Graphèmes**, Brussels

Photographic Research: **P. De Hoe**

Graphic Design of the cover: **J. Wells/M. Magermans**

Photographs: **E. Gorts**

Printing: **Arte Print**, Brussels