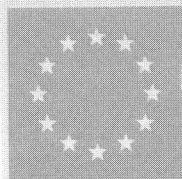
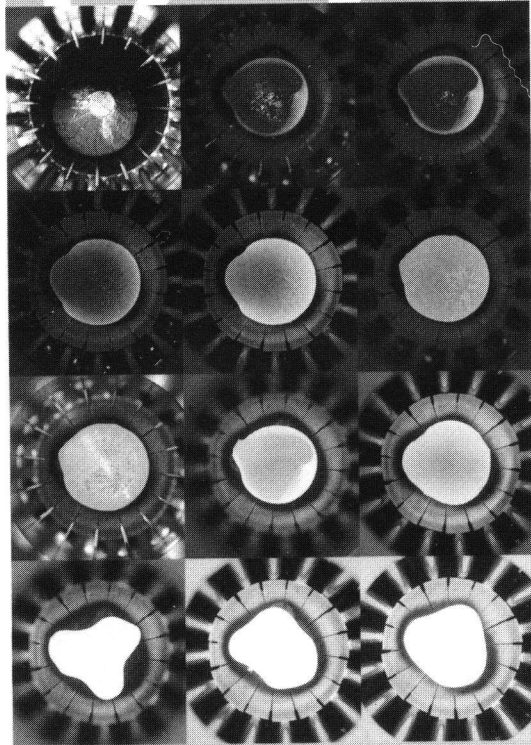


# ANNUAL REPORT

# 1991



JOINT  
RESEARCH  
CENTRE

COMMISSION OF THE EUROPEAN COMMUNITIES

Published by the

**Commission of the European Communities**

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

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### **Cover picture of the annual report**

*Different phases in the process of levitation melting within a segmented copper crucible.*

*External induction provides levitation and heating.*

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**Message  
from  
Vice-President Pandolfi**

**1991**

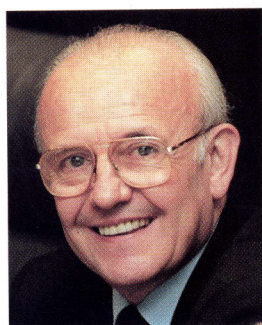
was the last year of the 1988-1991 Research Programme. An end-of-programme evaluation has reported favourably on the quality of the Centre's scientific work and the enthusiasm of its staff, and has pointed to directions which would lead to enhanced effectiveness in the future. This outcome results from the efforts of the Director General, his Directors and all of his personnel to bring success to the Joint Research Centre.

1991 has also seen the launching of a proposal for a new Multiannual Research Programme for the Joint Research Centre. By the end of the year most of the preliminary examination phase had been accomplished by the Council, the European Parliament and the Economic and Social Committee. The Programme is intended to strengthen the JRC's position in Community research, both by close alignment with Commission policies through the Framework Programme and by meeting the increasing demand for scientific and technical support from other Commission services.

On the organizational front, the Joint Research Centre is being further decentralised to attain an optimal structure in which researchers in the Institutes will obtain the maximum support from infrastructural services at a minimum cost. Devolution of the JRC has now reached a point where the Institutes have become recognisable entities with the sharing of some centralized services; strategic management is located in Brussels.

During the year, requests for scientific and technological support to other Commission services have continued to increase as the need for scientific support in implementing Community policies has become increasingly apparent and demand once again exceeds the financial resources available. 1991 has also shown a marked increase in the orders for contract research requested by outside organisations.

My gratitude is due to the Panel of high level scientists from industry and academia which evaluated the JRC under the Chairmanship of Sir Hermann Bondi. Advice and guidance in choosing the right path for the Joint Research Centre must be laid at the door of the Board of Governors and its Chairman, Sir John Kendrew; the Board's work is acknowledged with thanks.



*F. M. Pandolfi*

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

**Foreword**

1991

was the last year of the Joint Research Centre's 1988-1991 Multiannual Research Programme, a milestone on the road forward and a time for taking stock of progress and of planning the next step.

This step, the new multiannual research programme beginning in 1992 and finishing at the end of 1994, has been prepared during the year and is under discussion in the Council, European Parliament and the Economic and Social Committee of the Communities. The proposal is based on the forward-looking strategic plan discussed in my foreword to last year's Annual Report. The final adoption by Council is expected in Spring 1992.

The Council Decisions which established the 1988-1991 Programme requires that the Commission arranges with the Board for an evaluation of the Joint Research Centre and its activities by a team of independent external experts at the end of the Multiannual Programme.

The Panel of high-level scientists of international repute was chaired by Sir Hermann Bondi, former Master of Churchill College, Cambridge and reported to the Board in November. The Board of Governors in general, agreed with the recommendations made by the Panel and was satisfied that the tenor of the Report was positive concerning the quality of work performed and the competence and enthusiasm of the staff. Nevertheless, the Panel also felt that human resources management could be improved and attached great importance to the further development of contacts of all kinds with the outside scientific world. The Board agreed to the pertinence of these matters. At the same time, significant progress was noted as compared to the situation in 1988 before the re-organization of the Joint Research Centre into Institutes and the Board of Governors and JRC Management were gratified to find a positive appreciation of their endeavours to modernize the Centre and to set it on a prosperous course for the future.

In other sectors of activity, support to other services of the Commission and contract research for third parties, the demand shown for JRC services bears witness to the improvement in the perceived image of the JRC and is the result of a determined effort by Commission personnel to make the Joint Research Centre a recognized centre of excellence.

*John Kendrew*

**Sir John Kendrew**

Chairman  
*JRC Board of Governors*

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# JOINT RESEARCH CENTRE

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

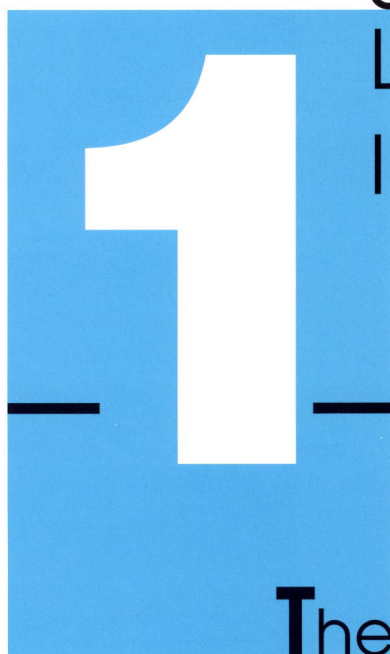
These institutes are:

CBNM	The Central Bureau for Nuclear Measurements (Geel)
ITU	The Institute for Transuranium Elements (Karlsruhe)
IAM	The Institute for Advanced Materials (Petten & Ispra)
EI	The Environment Institute (Ispra)
IRSA	The Institute for Remote Sensing Applications (Ispra)
IST	The Institute for Safety Technology (Ispra)
ISEI	The Institute for Systems Engineering and Informatics (Ispra)
IPTS	The Institute for Prospective Technological Studies (Ispra)

This Annual Report intends to give a general overview of JRC life in 1991; a companion document entitled «The JRC scientific achievements in 1991» gives a comprehensive description of significant JRC scientific achievements.

Furthermore, readers may find more details in the annual reports of the eight Institutes. Very detailed information about each project conducted at the JRC is given in the Annual Work Schedules where the name of the senior scientist leading the project is also given. Ultimately, as in the past, the JRC publishes numerous scientific reports, presents papers in conferences and organises workshops, seminars and conferences to disseminate its scientific achievements.

# JRC LIFE IN 1991



**The** eight Institutes of the JRC increased their budgetary and operational autonomy in 1991, and consolidated their role in the fulfilment of their work within the four types of activity of the Joint Research Centre. These are Specific research programmes deriving from the 2nd Framework Programme, Scientific and Technical Support to the Commission, Exploratory research, and research performed under contract for Third Parties.

The JRC is executing, within the second Framework Programme, five Specific Research Programmes aiming at three major objectives: modernisation of industrial sectors, enhancement of safety and the prevention and mitigation of accidents, and surveillance and protection of the environment. Activities of the JRC performed within the Framework Programme have been decreasing in conformity with the decisions taken in 1988.

Demand for work executed under the activities of Scientific and Technical Support to the Commission was of particular importance, and the work load has increased by 28% as compared with 1990. Sectors principally concerned were Agriculture, Environment and Energy. A large number of multiannual agreements were signed between the JRC and other Commission services in order to ensure continuity in the long term.

Third Party Work under contract has also continued to increase, and orders issued to the JRC during 1991 are totalling 22 Mioecu; over the period 1988-1991 the total volume of Third Party Work reached the level of 45 Mioecu. Sectors particularly concerned were advanced materials and actinide research.



## *Specific Research Programmes*

**JRC's** still predominant task is the implementation of the Framework Programme. It contributed to the objectives of the 2nd Framework Programme by the execution of the following specific programmes:

■ **The Technical Standards, Measurement Methods and Reference Materials programme** encompassed research projects on nuclear measurements and reference materials, executed by the Central Bureau for Nuclear Measurements (CBNM), and research projects on reference methods for non-nuclear energies

and the assessment of the reliability of structures, executed by the Institute for Systems Engineering and Informatics (ISEI) and the Institute for Safety Technology (IST).

Nuclear data measurements were executed at CBNM in 1991 as in the past. Reference materials for reac-

tor neutron dosimetry or for nuclear safeguards measurements and interlaboratory measurement campaigns on nuclear materials are in growing demand. In general, however, the scope of CBNM work is shifting from nuclear to non-nuclear fields, and from fundamental research to applications. In particular, a non-nuclear interlaboratory measurement evaluation programme was started in 1991, in collaboration with the International Union for Pure and Applied Chemistry and the National Institute for Standards and Technology (USA).

At ISEI, the European Solar Test Installation (ESTI) has furthered its international recognition as a centre of excellence for measurement and tests. In the field of preformative research, an indoor degradation test procedure for thin-film devices has been developed.

The most important achievement in the field of reliability assessment of structures is the completion of the Reaction Wall facility for structural dynamic studies and the start of a collaborative programme, developed and executed by about 20 European laboratories in this field.

■ **The Advanced Materials programme**, executed by the Institute for Advanced Materials (IAM), comprised research activities, mainly of preformative character, on advanced ceramics and on components in order to provide scientific understanding of materials behaviour.



Reaction wall facility under construction at Ispra for testing of large-scale models of structures



The characterisation of fibre-reinforced ceramic matrix composites over a range of temperatures for tensile, creep and fatigue behaviour has been the focus of prenormative research at the Institute for Advanced Materials.

Components testing have been further advanced using a unique thermal cycling rig. The growth of defects in both the inner and outer surfaces of tubular components have been measured under thermal fatigue conditions.

New hard coatings were successfully prepared in the Surface Modification Centre. These coatings exhibit a hardness approaching that of diamond, and may have potential applications in various industrial sectors.

■ **The Environment Protection programme** consisted of research projects executed by the Environment Institute (EI) on atmospheric pollution, soil, water and waste pollution and environmental chemicals. It also encompassed applications of remote sensing techniques, executed by the Institute for Remote Sensing Applications (IRSA), and research activities on industrial hazards executed by the Institute for Safety Technology (IST) and the Institute for Systems Engineering and Informatics (ISEI).

The Environment Institute has been active in the biomonitoring of trace metals in establishing «reference values» for human populations in Europe within a EUREKA project, and produced a compact disk version of the Environmental Chemicals data bank for use on personal computers.

Atmospheric pollution work focused on the reaction of nitrate oxides with biogenic emissions in order to identify reaction products and their role on the radiative properties of the atmosphere. Activities on the impact of natural and anthropogenic aerosols on climate change have merged into a project on the sulphur cycle, including both modelling and experimental activities. A new stochastic model has been developed to study the migration of pollutants in soil.

The installation of the European Microwave Signature laboratory at the Institute for Remote Sensing Applications was completed and the commissioning phase initiated. The

Institute continued its activities on land use mapping by introducing new techniques such as imaging spectrometry, neural networks and expert systems.

■ **The Nuclear Fission Safety programme** encompassed research activities in reactor safety and nuclear waste executed by the Institute for Safety Technology, research activities in nuclear safeguards and fissile materials management executed by the Institute for Safety Technology and the Institute for Systems Engineering and Informatics, and research activities on nuclear fuels and actinides executed by the Institute for Transuranium Elements (ITU).



Surface Modification Centre:  
The high current ion implanter



The reactor safety activities at IST have been centred on the operation of the FARO facility and the pursuit of the PHEBUS programme with the «Commissariat à l'Énergie Atomique» in France. The construction and the cold commissioning of PETRA, a facility to study alternative waste treatment, has been completed.

Nuclear safeguards techniques at ISEI have been improved by the development of a system of computer vision and optical surveillance of material storage. Underwater measurements by a laser system were also developed.

The Institute for Transuranium Elements contributed to the safety of nuclear

fission by investigating the behaviour of nuclear fuel under variable reactor operating conditions and further clarifying the release mechanisms of fission products from irradiated fuel.

The measurement of physical fuel properties at extremely high temperatures, of interest to reactor safety, was continued. First results of the thermal expansion of uranium dioxide above its melting temperature were obtained.

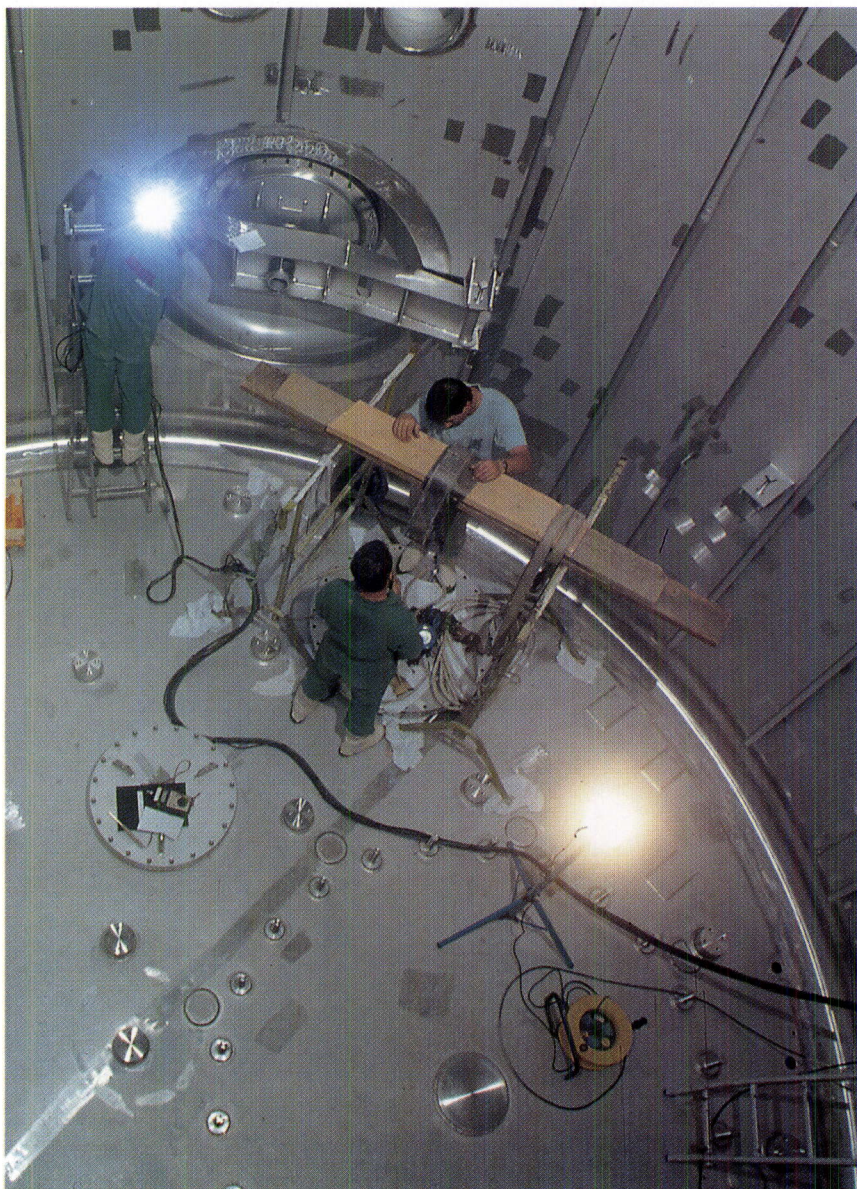
Studies were also extended on the characterisation of nuclear waste in view of its behaviour under temporary and final storage conditions.

■ **The Fusion Technology and Safety programme** is executed by the Institute for Safety Technology, the Institute for Systems Engineering and Informatics as well as the Institute for Advanced Materials.

The construction and cold commissioning of ETHEL, the European Tritium Laboratory which will be dedicated to safety and construction problems of fusion reactors, was completed.

In 1991 the JRC activities related to the accomplishment of the Specific Programmes accounted for 70% of the JRC budget, in comparison with 74% in 1990. Progress made in the execution of these programmes is reported in more detail in Chapter 2, dedicated to the activities of the JRC Institutes.

PHEBUS Project, presently the largest programme in nuclear reactor safety research. A view into the containment vessel which will enclose the major part of the experimental equipment.





## 2 JRC

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

**JRC scientific and technical expertise is available to other Directorates-General of the Commission for support in the formulation and implementation of Community policies.**

JRC support can take several different forms:

- theoretical studies or laboratory work;
- assistance in management of projects or contracts;
- scientific and technical help in drafting EC legislation.

In 1991, JRC scientific and technical support accounted for 19% of the JRC budget, compared with 15% in 1990, 13% in 1989 and 10% the year before. Figure 1 shows how this support was divided amongst the various Community policies.

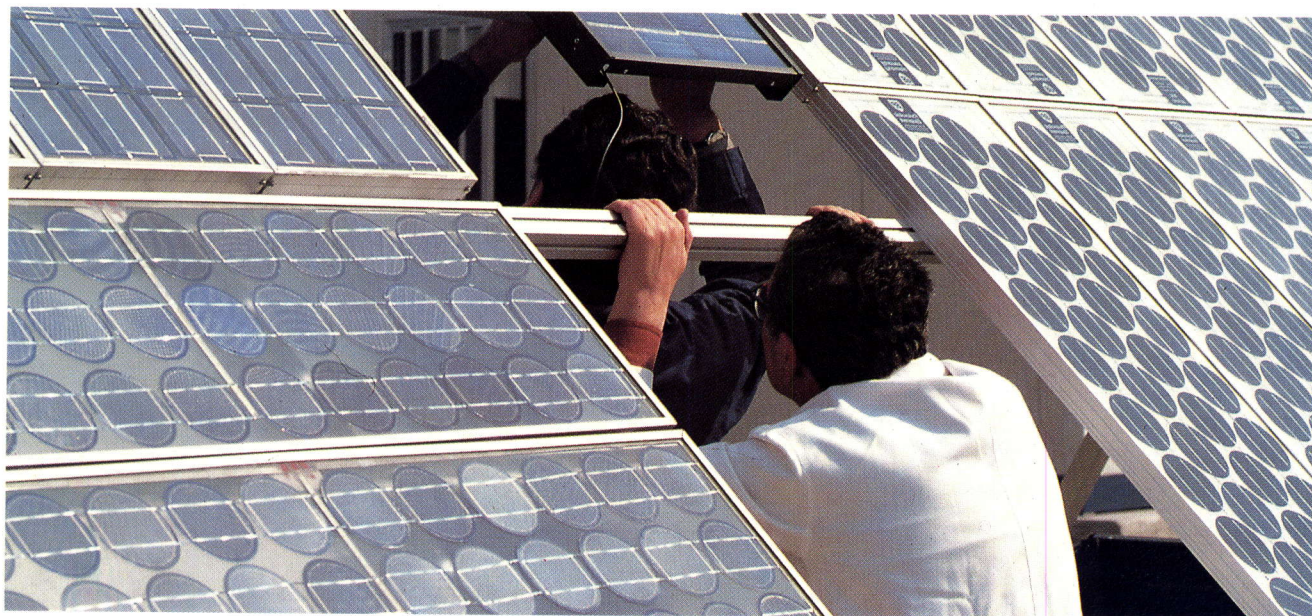
During the year a number of multiannual agreements have been

signed by the Director-General of the JRC with other Directors-General in order to provide an effective customer/contractor relationship, as well as a degree of continuity and long-term planning. This is a clear reflection of the increasing confidence in the JRC's reputation within the customer/contractor framework, which has been reinforced, and a recognition of the efficiency of its services in solving current problems. The main sectors concerned were Energy, Agriculture and Environment.

■ **JRC support for Energy policy** (DG XVII) accounts for above 25% of the scientific and technical support budget.

Most of the work undertaken deals with the following tasks:

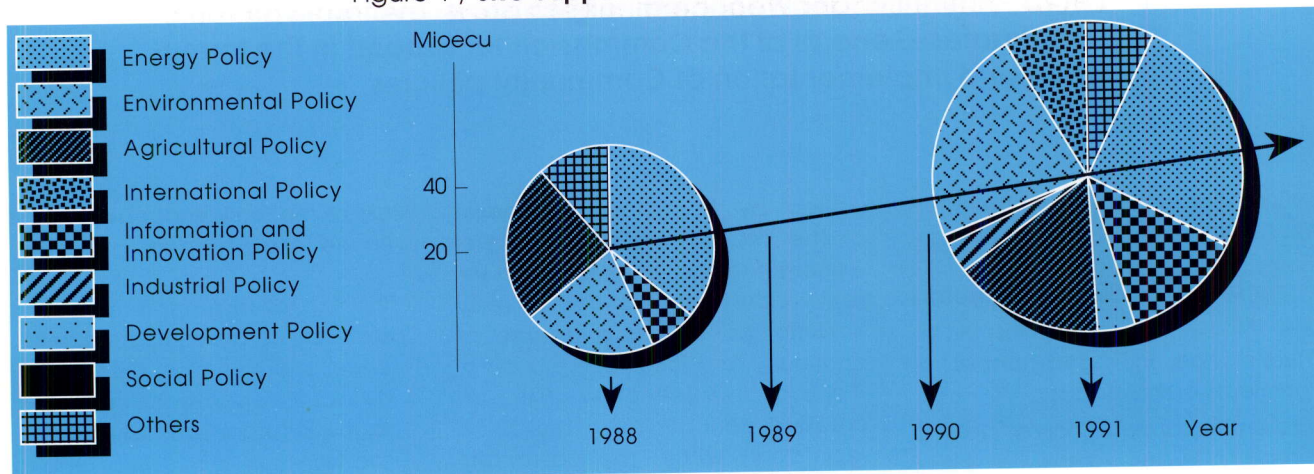
- training of inspectors, providing state of the art equipment, reference analyses of nuclear materials samples and technical support to the Euratom Safeguards Directorate;
- in the field of non-nuclear energies, contributions were predominantly on energy conservation and its rational use in small and medium size industries, buildings and transport systems, and in the monitoring of photovoltaic and solar thermal demonstration projects.



Photovoltaic modules deployed in the EARS (European Array Reference System) field for long-term performance monitoring



Figure 1 / JRC Support to EC Policies Breakdown



■ **JRC Support for the Environmental policy**, which accounts for 22% of the total budget, provides DG XI with technical assistance in the drafting and implementation of legislation on chemical pollutants, atmospheric pollution, water quality, chemical waste, industrial risks and major accidents.

- Work for chemical pollutants deals mainly with S/T support to EC programmes and regulations in the field of chemicals control for two Council directives, 67/548/EEC and 79/831/EEC.
- Atmospheric pollution support concerns the implementation of Council directives 80/779/EEC and 85/203/EEC on air quality (SO<sub>2</sub>, NO<sub>2</sub>, photochemical oxidants).
- Work on major accidents supports the implementation of Council directive 82/501/EEC, and the investigation of hazards of certain industrial activities, such as processing and storage installations for hazardous chemicals.

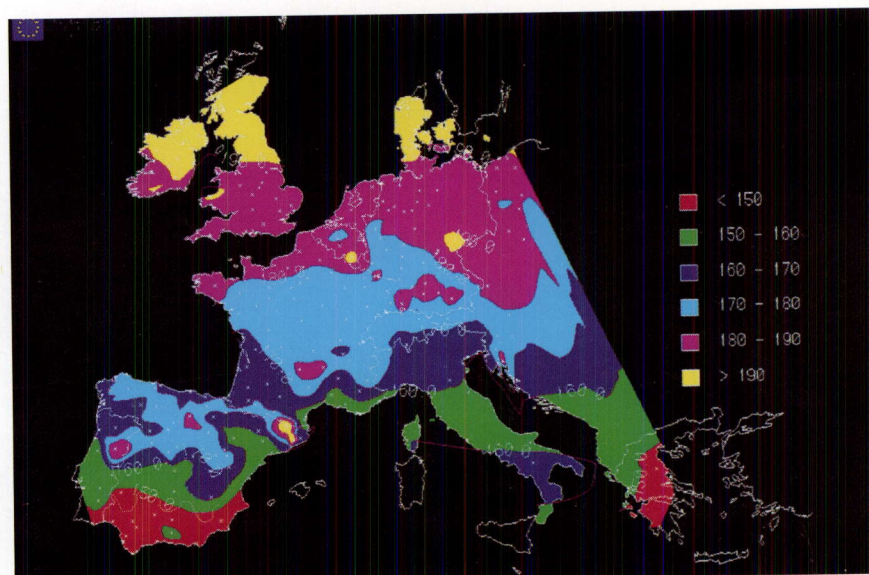
■ **JRC support for the Common Agricultural Policy**, which accounts for over 15% of the total budget, covers mainly three research areas, such as:

- application of remote sensing to agricultural statistics, where the aim is to develop and demonstrate, up to semi-operational scale, methodologies which integrate remote sensing data into the collection of statistics for the monitoring of crop acreage and agricultural production in the EC (Council Decision 88/503/EEC);
- support in operational applications to set up registers of inventory control systems in agriculture, us-

ing either aerial or spatial remote sensing techniques;

- the use of the Nuclear Magnetic Resonance technique for the analysis of wines and the creation of a data bank of European wines (Council Regulation No 2048/89 - Art. 16).

Further information on JRC Scientific and Technical support activities to the Commission's services may be found in Chapter 2.



Modelisation of the flowering date of grapevine agrometeorological models  
Number of days after the 1st of January.



**1** JRC  
LIFE  
IN 1991

**3** JRC

*Work for Third Parties*

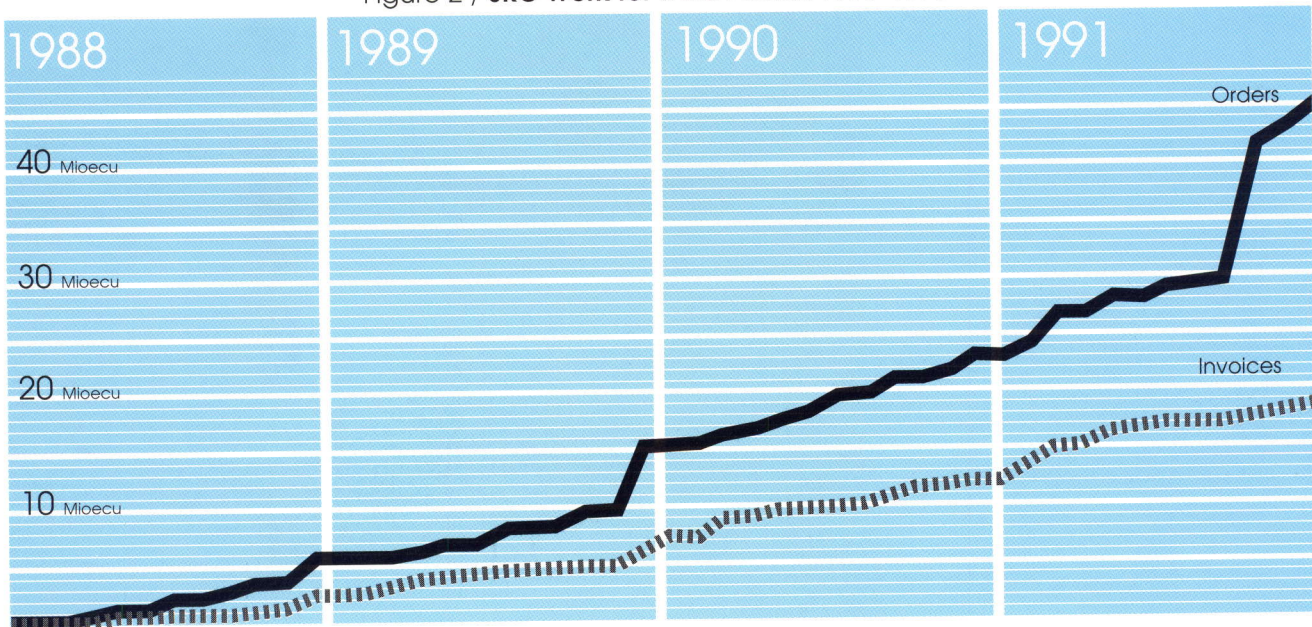
**T**HIRD Party Contract Work continues to grow. The total volume of work ordered from the JRC during the period 1988-1991 reached the level of 45.6 Mioecu, conforming with the management forecast and exceeding the revised target value agreed by the Board of Governors in June 1991.

Table 1 and Figure 2 show the evolution of the JRC order book over this four year period. New orders for Third Party Work received during the year 1991 are totalling 22 Mioecu. The winning of Third Party contracts from outside the Community is particularly noteworthy, therefore the contract signed this year with the Central Research Institute of the Electric Power Industry (CRIEPI) of Japan, for work to be performed by the Institute for Transuranium Elements on nuclear waste (transmutation of actinides), should be mentioned. The large volume of orders received by the Institute for Advanced Materials for research activities on new materials is also noteworthy.

TABLE 1  
Work for Third Parties (MioEcu)

Year	1988	1988-1989	1988-1990	1988-1991
Target value (revised)	2.90	17.50	33.40	40.00
Order book actual	5.79	15.71	23.54	45.64
Amounts invoiced	2.77	6.04	11.17	17.83
Payments received	2.03	4.85	10.15	15.33

Figure 2 / JRC Work for Third Parties 1988-1991





## 4 JRC *Exploratory Research*

**THE** selection and monitoring of exploratory research projects has been achieved throughout the 1988-1991 programme, with the aid of the Sub-Committee for Exploratory Research of the Board of Governors.

Their objective is the improvement of the scientific vitality of the JRC, and to this end up to 5% of the annual resources for specific research programmes were made available to the Institutes by the Director-General on a competitive basis. An indicator of the abundance of ideas is that these resources were over-subscribed each year by four to five times.

Narrowing to the final choice was made by simultaneous consultations with external experts, the Institute Directors, the track records of the leading scientists making the proposals and finally with the aid of the Sub-Committee for Exploratory Research of the Board of Governors. A fine crop of outcomes has resulted in publications, third party contracts, networks and the updating of research programmes for the new large installations as they come on-line.

Exploratory research is a look forward into the future. Inevitably, it is based on the quality and originality of the ideas cultivated by the present staff, but it is also a guarantor of the relevance of the research programmes to come and of the needs of the European Community in times of rapid and startling change.



Three lasers are shown which are used to excite fluorescent light from atoms in a commercialized graphite furnace (in the centre).

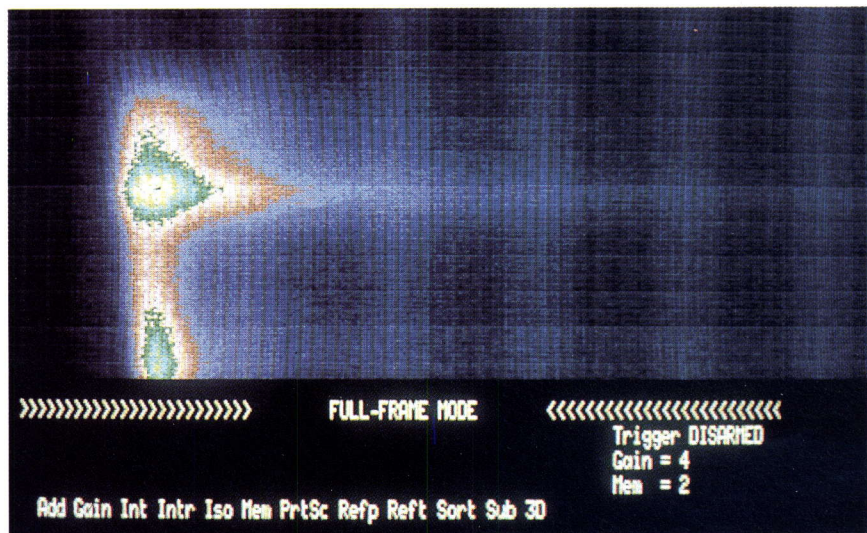


## Participation in EUREKA Projects

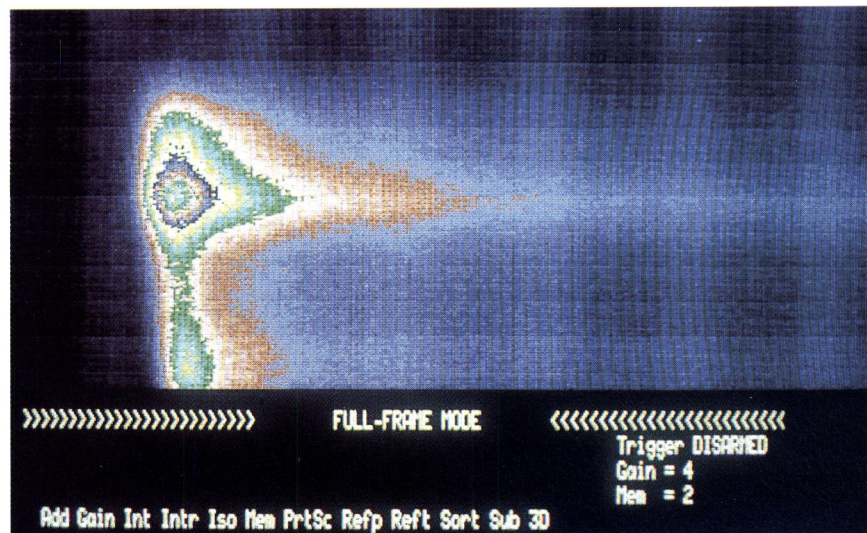
**THE EUREKA initiative is a light framework which supports and encourages autonomous international partnerships to develop innovative products and services. It involves 19 countries plus the Commission of the European Communities.**

JRC participation in EUREKA (European cooperation on advanced technology) projects increased in 1991. Today the JRC is involved:

- in CEFIR (Ceramic European Fibre Research), an initiative aiming at the production of European high temperature resistant ceramic fibres;
- in EUROTRAC, essentially in TRACT activities for the experimental assessment of atmospheric pollutant transport in the Alpine region, in BIATEX to assess the measurements of biogenic hydrocarbons, and in LACTOZ to study night-time degradation of air hydrocarbon pollutants;
- in EUROENVIRON, to develop mobile laboratories for quality measurements of water, soil and wastes, and to establish «reference values» of trace metals in biosamples;
- in FORMENTOR, to develop an on-line expert system to provide advice to operators of complex man-made systems in potentially hazardous situations;
- In LASFLEUR (Laser-induced chlorophyll fluorescence), to develop an airborne system to collect information on the state of plant health across large areas of vegetation.
- in VISIMAR (Visualisation and simulation of marine environmental processes), to monitor the marine environment.



Spectro-temporal images of the laser-induced fluorescence of vegetation in steady state conditions of photosynthesis (above) and after the inhibition of photosynthesis via the herbicide Diuron (below)





## 6 JRC

### *Cooperation with other Laboratories and Organisations*

**THE JRC maintains many scientific relations, both formal and informal, with national laboratories and international organisations. Some recent developments are described below.**

The Institute for Advanced Materials (IAM) at Petten, the Netherlands TNO Institute (Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek) and the CISE Institute (Centro Informazioni Studi Esperienze) of Milan have formed together a European Economic Interest Grouping called «European Materials Research Consortium (E-MARC)» registered in the Netherlands on 20 August 1991.

Within this cooperation, the three Institutes will be in a position to better satisfy the increasing needs of European industry in the field of advanced materials by offering their scientific and technical expertise under contract.

The ATMES (Atmospheric Transfer Model Evaluation Study) study, managed by the Environment Institute with the IAEA and the World Meteorological Organisation (WMO), was completed in 1991. The aim of the study was to validate the atmospheric transport models against the experimental data originated from the Chernobyl accident, collected by numerous (more than 30) national laboratories.

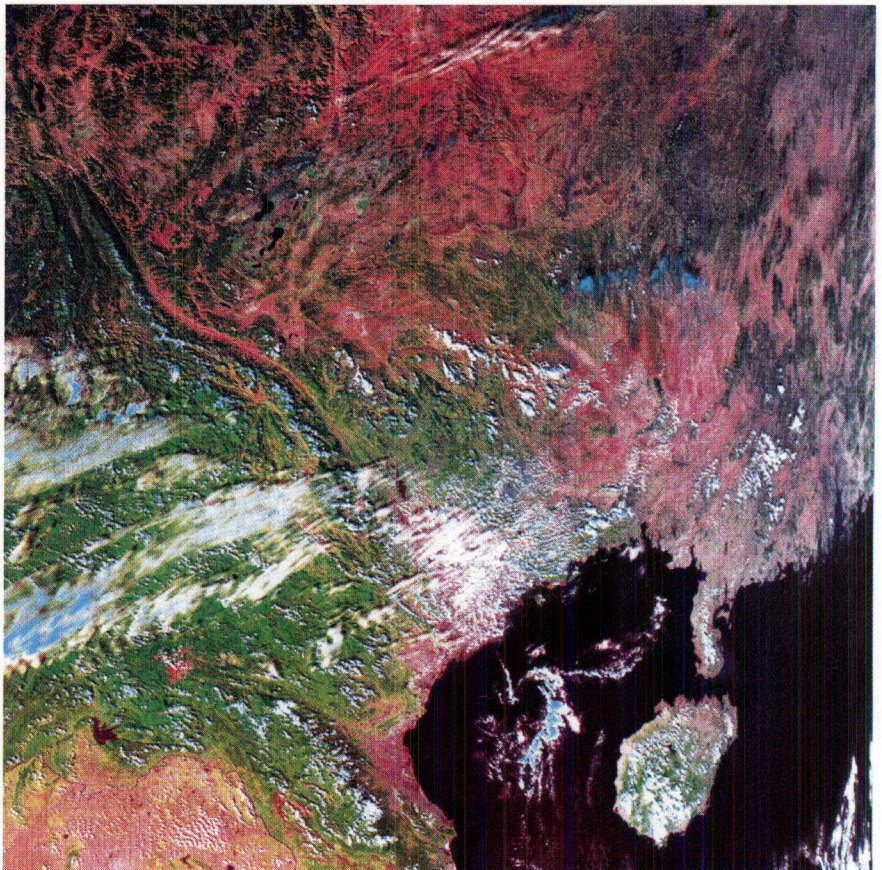
The Environment Institute is also cooperating with the Danish Centre for Atmospheric Research and the Italian Ministry for the Environment.

The Interlaboratory Measurement and Evaluation Programme is a new intercomparison programme which aims at enhancing accuracy in the measurements of impurities in, for

example, environmental samples, performed by numerous laboratories.

The cooperation between the European Space Agency (ESA) and the Commission of the European Communities (CEC) in the field of space applications is progressing satisfactorily. The ESA/CEC Environment and Earth Observation Working Group pursued its activities vigorously,

leading to a constructive start of several joint ESA/CEC projects: TREES, OCEAN, EARSEC (described under 2.7). In addition, a joint proposal for setting up an ESA/CEC Centre for Earth Observation (CEO) in close collaboration with Member States was prepared. The overall objective is to provide an effective network for the exploitation and maximum utilisation of earth observation data.



AVHRR image from the TREES project of South East Asia illustrating large scale deforestation



## *Evaluation Panel findings on JRC activities 1988-1991*

**THE** work performed by the JRC during the current four years programme has been scrutinised by an independent high level Evaluation Panel, chaired by Sir Hermann Bondi and set up by the Board of Governors.

The Panel examined the JRC activities from two viewpoints: its quality and its relevance. Its findings may be summarised as follows:

- the JRC work has generally been found to be of good quality, rising to excellent in some places. Nevertheless, changes of emphasis have been recommended in one or two spots.
- the relevance of the JRC work with respect to the activities of the Commission has been recognised. This is clear in the JRC Programme Proposal 1992-1994, and also at working level where the JRC's role is well perceived among staff and management.

The Panel nevertheless recommended that:

- the Commission should more explicitly define the goal of the JRC, the first priority of which is to support the Commission both in the tasks performed under the Framework Programme and those in direct support to Commission services;
- the JRC should manage its human resources under a personnel regime which is much closer to the prevailing rules in modern industrial and other research establishments, where the only sound argument for promotion is merit - the capability to fulfil a function at a higher level and to give leadership;

- close relations should be maintained with industry, both to assess and exchange views on present and future requirements in research and development, and to carry out applied research under contract;
- more attention should be applied to the marketing of the scientific expertise of the JRC;
- the visitor programme should be increased and the training function of the JRC should be enhanced.

The Panel also noted with pleasure the level of enthusiasm and interest shown by the staff, the quality of the work done, the excellent equipment and the progress made during the last years.

In its opinion on the evaluation of the 1988-1991 multiannual research programme, the Board of Governors was generally in accordance with the conclusions of the Panel, with regard to the quality of work performed, the need for aggressive marketing by the Institutes of their scientific and technical expertise, and a reexamination of the staff situation.

The Board also agreed with the need to better define the general role of the JRC and to manage its human resources accordingly, as well as continuing to develop strong links with the outside world.



## 8 A step towards the future: *New JRC Programme Proposal for 1992-1994*

**ON July 22, 1991 the Commission adopted a communication to the European Parliament and the Council with its proposals on the activities of the JRC during the period of 1992-1994.**

These proposals are based on an analysis of the present accomplishments of the JRC. They take into consideration the work performed and described in the annual reports of 1988, 1989 and 1990, as well as the recommendations from the evaluation of programmes performed by a group of independent experts at a very high level. They are also in line with the long strategic outlook towards the year 2000, prepared in 1990. The Commission proposes the continuation of the four present types of activity of the JRC.

In the context of the specific programmes, JRC should contribute to the objectives of the third Framework Programme (1990-1994) in the areas of industrial technologies and materials, testing and measurements, environment, nuclear fission safety and controlled thermonuclear fusion, as well as that of human capital and mobility.

Concerning Scientific and Technical Support to the Commission, it is envisaged to further reinforce the customer/contractor relationship, with more pluriannual contracts as a result.

In the scope of Third Party Work, further marketing efforts will be made, particularly foreseeing joint ventures with entities at national or regional level.

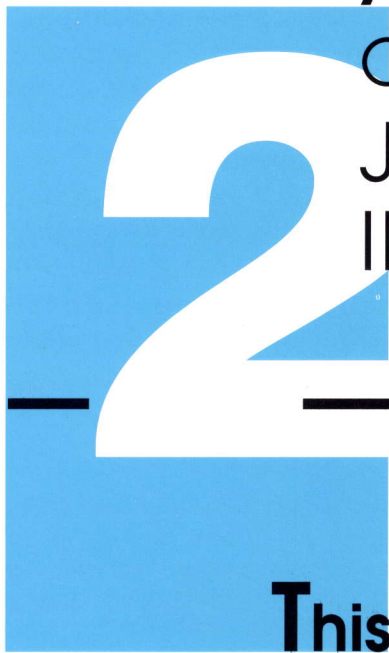
Among the new activities for the period 1992-1994 are the European Centre for the Validation of Alternative Testing Methods, on-site laboratories for safeguards analysis and a feasibility study for establishing a Centre for Earth Observation in collaboration with the European Space Agency and the Member States.

### Acknowledgments

The Commission and the Director-General of the Joint Research Centre take this opportunity to gratefully acknowledge the help and advice given by the Board of Governors during the critical discussions on JRC policy and future programmes, and the Panel of High Level Scientists who evaluated the 1988 to 1991 multiannual research programme under Professor Sir Hermann Bondi. They are also most grateful to the Council Committees, and in particular its Dutch Presidency, to the European Parliamentary Committees dealing with JRC matters, and to the Section Energy, Nuclear Questions and Research of the Economic and Social Committee, for their speedy and careful handling of the JRC programme proposal for 1992-1994.

Lastly the Commission and the Director-General of the Joint Research Centre thank the JRC staff; without their enthusiasm and their dynamism, none of the activities reported here would have been possible. They truly represent the most valuable asset of the JRC.

# ACTIVITIES OF THE JRC INSTITUTES IN 1991



**This** chapter outlines the activities of the Institutes of the JRC during 1991.

Furthermore, a section is dedicated to JRC Publications and Eurocourses.



## *The Central Bureau for Nuclear Measurements (CBNM)*

**T**HE CBNM, based at Geel, is dedicated to the promotion of European Standards and the harmonisation of reference methodologies and materials. The Institute contributed to the Framework Programme line «Technical Standards, Measurement Methods and Reference Materials» by executing its specific programme «Nuclear Measurements and Reference Materials». It is engaged in support activities related mainly to nuclear safeguards at the request of the Directorate-General for External Relations (in support to the IAEA) and the Directorate-General for Energy (Euratom Safeguards Directorate), and provides reference materials to various customers. The scope of the activities of the Institute is increasingly shifting from nuclear to non-nuclear fields, from fundamental research to applications.

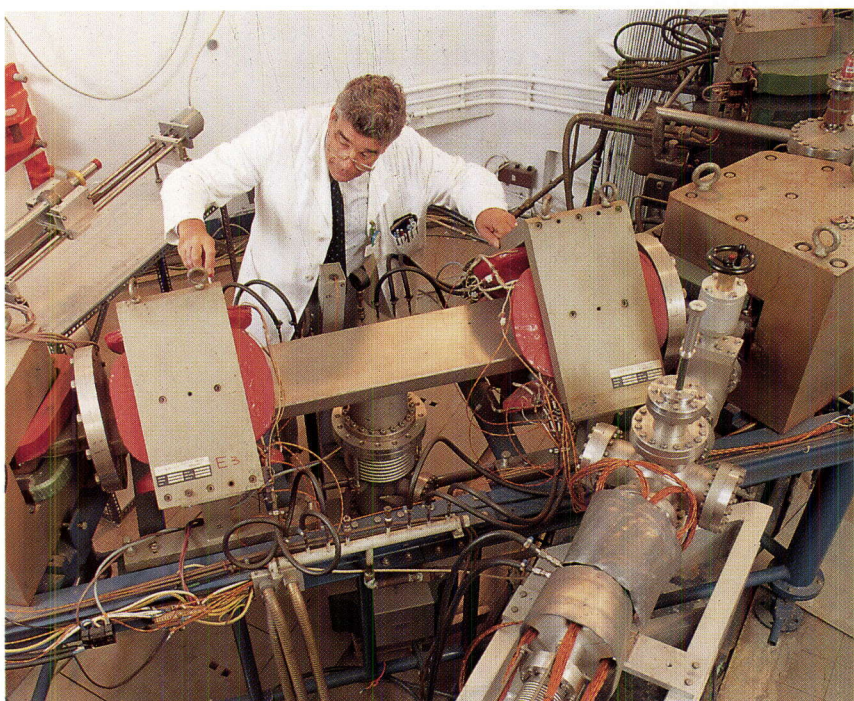
### ■ Nuclear Measurements and Reference Materials

Nuclear data, requested as standards to which relative measurements can be referred, were further determined

within the Nuclear Measurements and Reference Materials Programme. The spontaneous fission of  $^{252}\text{Cf}$  has been further studied as well as the  $^{235}\text{U}(n,f)/\text{H}(n,n)$  cross-section ratio.

Neutron interaction data with structure material nuclides (Ni, Cr, Fe) were requested for application in fission technology. Data for neutron capture and transmission of  $^{58}\text{Ni}$  and  $^{61}\text{Ni}$  were determined and capture gamma-ray measurements were made in the resonance energy range of  $^{53}\text{Cr}$ . Neutron capture widths ( $\Gamma_n$ ) in  $^{56}\text{Fe}$  and  $^{52}\text{Cr}$  were determined by neutron transmission experiments. The series of measurements of fission cross sections for common fissile isotopes in the subthermal energy region was concluded with  $^{241}\text{Pu}$ . Measurements of the capture to fission ratio ( $\alpha$ ) of  $^{235}\text{U}$  confirmed previous determinations of the number of fission neutrons emitted per neutron absorbed ( $\eta$ ) for the same nuclide.

Data for fusion technology were determined for the reaction  $^9\text{Be}(n,2n)$  and several  $(n,\alpha)$  reactions with Nickel and Copper isotopes as a function of energy and angle of the emitted particles. The specific activity of Iridium wires containing  $^{192}\text{Ir}$ , to be used for radiotherapy, was measured. The  $\alpha$ -decay scheme of  $^{237}\text{Np}$  was refined (collaboration with CIEMAT, Spain).



General view of a set-up for the deflection of electron beam for photon production and application studies at the Geel Linear Accelerator (GELINA)



Nuclear and non-nuclear reference materials were prepared, characterised and certified. Reactor neutron dosimetry reference materials are in ever increasing demand, which reflects the worldwide recognition of CBNM's contribution to reactor safety. An analytical interlaboratory measurement campaign initiated by the ESARDA-LEU (low enriched uranium) working group was finalised.

The accuracy of atomic weight determination of Silicon, necessary for the Avogadro constant project, was further improved. Using synthetic isotope mixtures for mass spectrometry calibration, the atomic weight of Iron could be determined as  $55.84514 \pm 0.00045$ , the highest accuracy ever achieved.

### ■ Trace Element Measurements

PIXE microprobe analysis was applied for the determination of trace elements distribution in Silicon wafers and in human tissue.

In collaboration with the International Union for Pure and Applied Chemistry (IUPAC) and the National Institute for Standards and Technology (USA), a non-nuclear analytical Interlaboratory Measurement Evaluation Programme was started. The programme aims at the establishment of the real state of the practice in measurements of toxic and life essential elements. It has been so far successfully applied to the comparison of methods and measurement results in the cases of lithium and iron in human serum and cadmium in plastics. CBNM is responsible for the coordination of the exercise, test sample preparation and characterisation, the coding of participants and the collection and evaluation of results. The programme will profit from the ultra clean laboratory, the construction of which was finished.



Sieving of organic material (e.g. orange juice powder) under controlled atmospheric conditions

### ■ Community and External Services

In Support to Services of the Commission the CBNM prepared a first pilot series of solid spikes for safeguards measurements which were sent to the IAEA Seibersdorf laboratory for distribution to reprocessing plants. Safeguards verification measurements were made according to the requests of Euratom Safeguards Directorate. The ECSAM laboratories participated in the REIMEP (Regular European Interlaboratory Measurement Evaluation Programme) programme for analytical quality control, organised by CBNM.

Various reference materials (orange juice, pig liver, fly ash, several sediments and milk powder) were prepared. Continuous support for storage, distribution and sale of re-

ference materials was given to BCR. Various gas measurements at trace level were also performed.

Numerous samples and targets were prepared, characterised and supplied to external customers, one example being the 4 reference materials (Cadmium traces in plastics) for the «Verband der Automobilindustrie», Germany.

The REIMEP rounds on uranium oxide powder and pellets and uranyl-nitrate were finished and the results transmitted to the participants. Rounds on mixed uranium and plutonium oxides, spent fuel and synthetic input solutions started.

Neutron and gamma-ray irradiations of biological materials and neutron irradiations of silicon samples were executed, at the request of external customers.



## *The Institute for Transuranium Elements (ITU)*

**THE ITU**, located in Karlsruhe, executes the Nuclear Fuels and Actinide research programme, which aims to improve the safety of the nuclear fuel cycle. The Institute also contributes to the Radioactive Waste Management Programme and provides scientific and technical support to nuclear safeguards at the request of the Directorates-General for External Relations and for Energy. The Institute is engaged in a number of important contracts at the request of the nuclear industry.

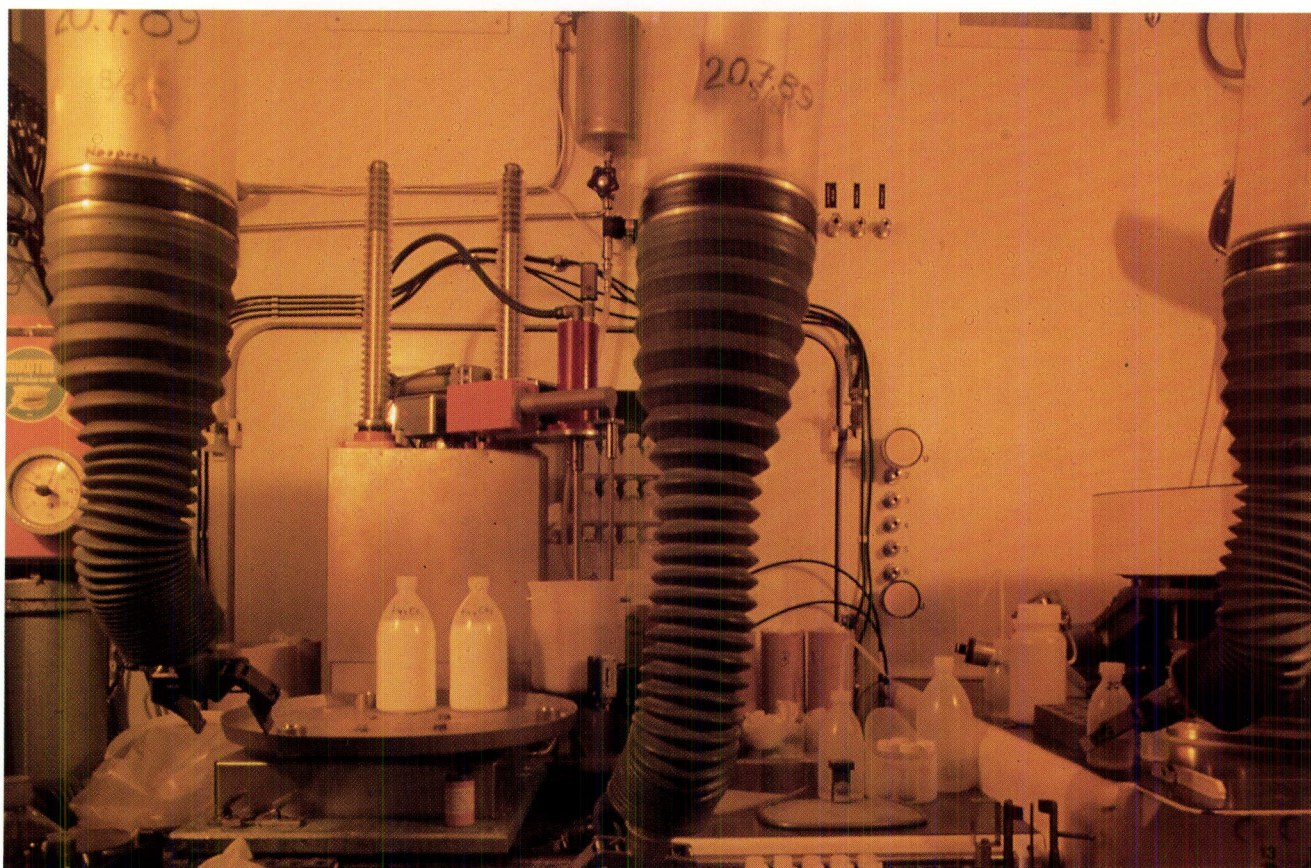
### ■ Nuclear Fuels and Waste

The Institute continued its efforts to contribute to the safety of nuclear fission by concentrating its research activities on investigations of the

behaviour of nuclear fuel after prolonged irradiation and under variable reactor operating conditions. Mechanisms for the release of fission products from irradiated fuel were further elucidated, and the forma-

tion of particular structural features which may limit the fuel lifetime were better understood.

First results of the post-irradiation examination of nitride fuels irradiated



Interior of a hot cell for the solidification of radioactive waste



in the French PHENIX reactor were obtained, demonstrating the technological potential and the limitations of this fuel type.

The measurement of physical fuel properties of interest for reactor safety considerations at extremely high temperatures was continued, and first results of the thermal expansion of uranium dioxide far above its melting temperature were obtained.

A major effort was made to extend studies on the characterisation of nuclear waste to unprocessed nuclear fuel in view of its behaviour under temporary and final storage conditions. These investigations comprised the interaction of irradiated  $UO_2$  with water and the development and testing of equipment for the non-destructive analysis of irradiated fuel rods by passive neutron interrogation.

The development of a code to model the consequences of ground water intrusion in a spent fuel storage facility got under way. Instruments to measure the mechanical properties of waste glasses were tested with inactive glasses.

A facility was installed in order to study possibilities of (nuclear) aerosol agglomeration under dynamic conditions in a high-power acoustic field at ultrasonic and audible frequencies. Non-nuclear applications of the aerosol agglomeration techniques have been extensively studied with European partners as projects of Exploratory Research.

### ■ Basic Studies

Np-based specimens, mostly in the form of single crystals, were prepared for basic experimental solid state physics studies at the Institute and in

various overseas and European laboratories. Progress was made in understanding the electronic structure of transuranium elements and their compounds by further development of theories and experimental efforts in high-pressure research and photoelectron spectroscopy.

Equipment for Moessbauer spectroscopy and for physical property measurements at cryogenic temperatures was installed in the new transuranium research user facility.

### ■ Community and External Services

In support of Community policies, the analytical work for the Euratom Safeguards Directorate was continued. The analytical tools were further refined, and first encouraging results of the field test of a robotised analytical laboratory, installed in collaboration with the International Atomic Energy Agency at the Radium Khlopin Institute in Gatchina, Russia, became available.

Progress was made in developing equipment for safeguards laboratories to be installed and staffed by the Institute at the reprocessing plants in Sellafield (UK) and Cap de la Hague (F).

Major contract work for external clients dealt with the preparation and characterisation of minor actinide-based alloys and the preparation of their ultimate irradiation in a fast reactor, the post-irradiation examination of industrial fuel rods exposed to high burn-up, the development of methods for preparing short-lived alpha emitting nuclides for radiotherapeutical applications, and the characterisation of residues from high-level waste dissolution.

## *The Institute for Advanced Materials (IAM)*

**WITH sites at both Petten and Ispra, the IAM executes the specific programme Advanced Materials and operates the High Flux Reactor for the Dutch and German authorities. The Institute is engaged in various support activities and in particular in those related to standards and codes. The Institute is also engaged in numerous contractual work for third parties.**

### ■ Materials and Measurements

During 1991 the Institute for Advanced Materials concentrated its efforts on providing scientific understanding of materials behaviour and new measurement capability.

Advances were made in component testing, using a unique thermal cycling rig where the growth of defects in both the inner and outer surfaces of tubular components can be monitored under thermal fatigue conditions. Crack growth can also be measured under creep conditions.

In the Surface Modification Centre, hard coatings of the B-N-Ti type were successfully prepared via different processing routes. They exhibit a hardness approaching that of a diamond. These coatings have a high application potential in various industrial sectors.

With prenormative R&D, the focus has been on the characterisation of continuous fibre reinforced ceramic matrix composites over a range of temperatures for tensile, creep and fatigue behaviour.

A simple, phenomenological model has been put forward, allowing reliable long term extrapolations on the basis of tensile and short time creep data.

Low activation materials were further developed in the frame of the EC Fusion Programme and in support of the NET (Next European Torus) design.

The clinical facility for Boron Neutron Capture Therapy research and application at Petten is now in operation. Phantom irradiations and healthy tissue tolerance studies on a representative animal model have been started. First results from these initial experiments validate the calculations of neutron fluxes made as an Exploratory Research project.

Several materials phenomena involving Marangoni driven flows (liquid motion close to the surface, caused by a gradient in surface tension) were modelled, taking into consideration the influence of impurities in the liquid phase. Accurate prediction of flux line erosion mechanisms in steel converters and for plasma disruption melting in first wall materials of fusion reactors will be possible. The mathematical model was developed as a project of Exploratory Research.

### ■ Commission and External Services

The scientific/technical support to Commission services was for 1991 characterised by contributions to:

- pre-standardisation of advanced ceramics and pressure vessels (DG

III) and quality protocols of radiopharmaceutics (DG XI);

- materials R&D implications in environmental problem areas, such as car exhaust catalysts and fossil fuel fired power stations (DG XI);
- the valorisation of patents and licenses for sensors, ultrasonic transducers and passive downwards heat transfer (DG XIII).

The Institute for Advanced Materials continued its efforts to open its unique research capabilities for work contracted to third parties, mostly in the industrial field. Here, one can report steady advances and good reception on the part of many European firms in a variety of technological sectors, such as aeronautics, automobiles, energy, chemicals and materials. One measure of the appreciation of many of the firms is that they have returned to expand or to repeat earlier contracts.

In the unique E-MARC Consortium, promoted by the Institute with major European research organisations involved in materials R&D, the status of a European Economic Interest Grouping has been achieved.

In connection with R&D network developments, the Institute for Advanced Materials initiated and coordinated a pan-European collaborative project under the EUREKA ini-



tiative, entitled «Ceramic European Fibre Research (CEFIR)». The project aims at the production of European high temperature fibres in order to respond to the current total dependence on Japanese fibres.

As part of the expansion in R&D capacities, the Joint Venture on Coating Technology, initiated in 1990 between the Institute in Petten and the Netherlands Energy Research Foundation, concluded its implementation phase. The experimental facilities became operational during 1991.

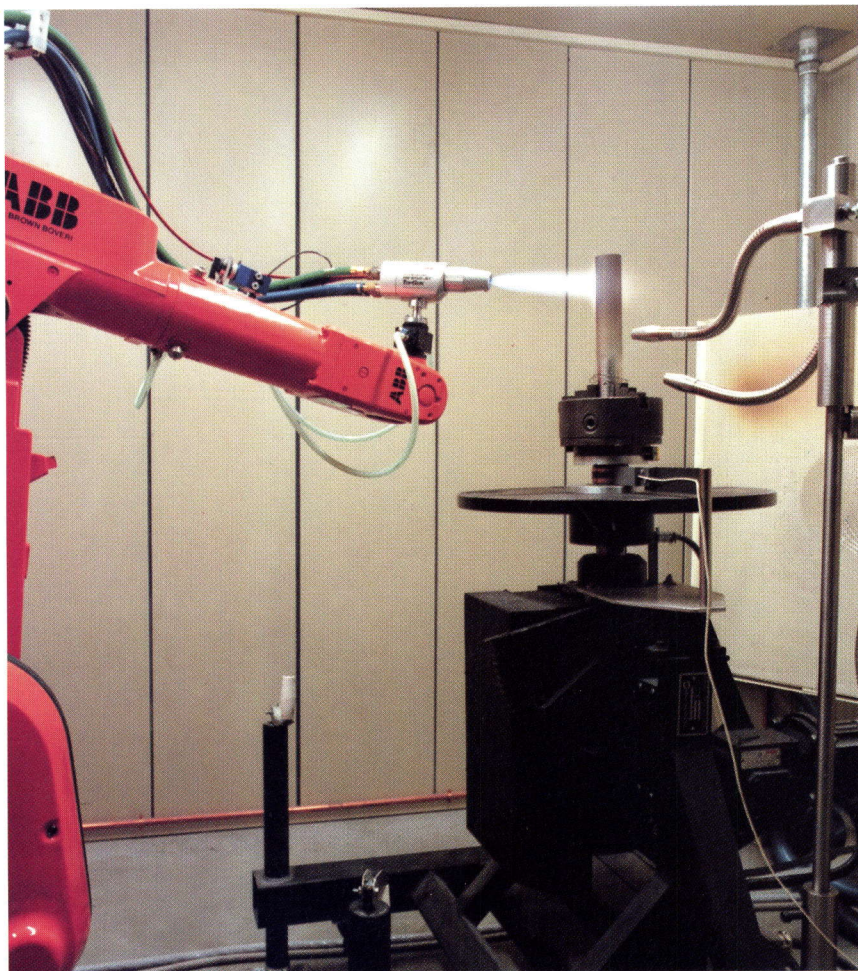
### ■ High Flux Reactor

The High Flux Reactor at Petten was operated during 1991 without any significant disturbances and ac-

ording to schedule. The availability was near to 100% of the scheduled operation time. The utilisation of the irradiation positions was more than 70%.

An important share of the reactor's irradiation capacity was again utilised for irradiation experiments on fuel and structural materials for nuclear fission reactors, as well as for radiation damage investigations of prospective first wall and structural materials and the tritium behaviour in prospective blanket breeder materials for fusion applications.

Radioisotope production services for the medical sector and industrial applications have markedly increased.



Robotised high velocity flame spraying equipment produces high density carbide layers.



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

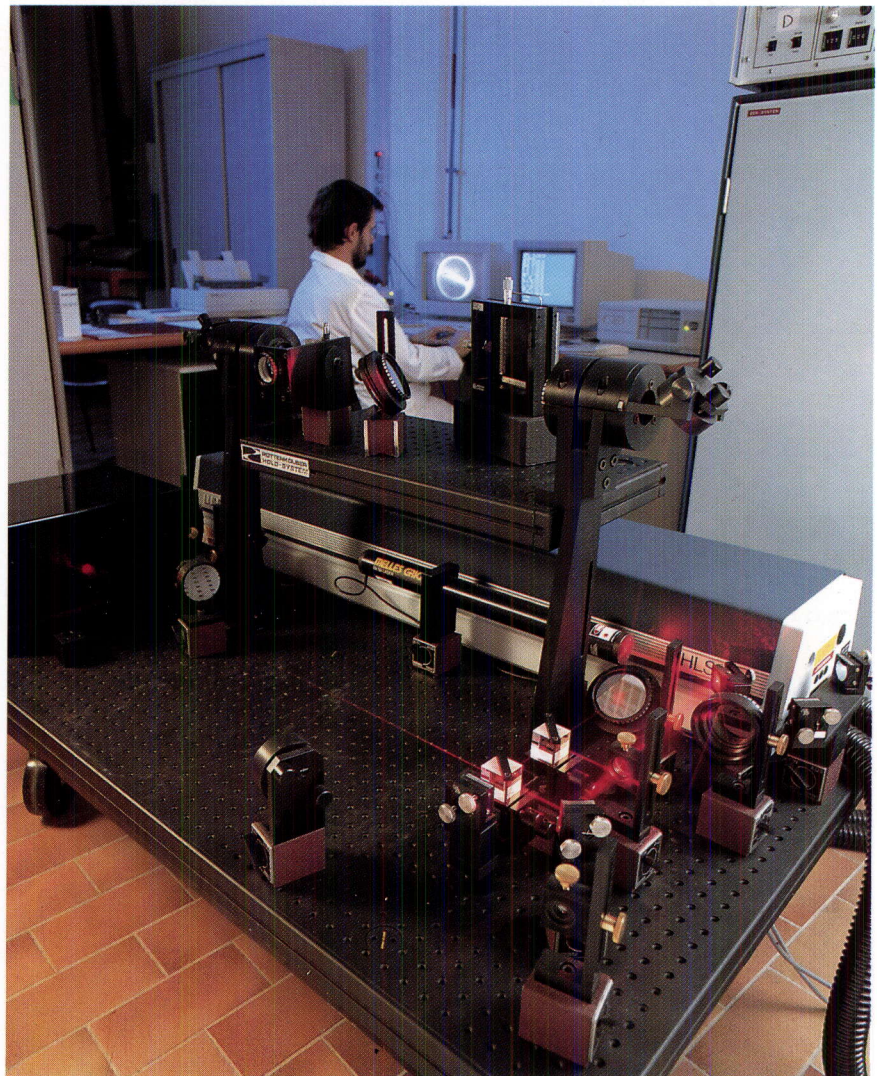
**THE ISEI**, based in Ispra, executes the programme on Reference Methods for Non-Nuclear Energies and contributes to the programme on Reference Methods for Reliability Modelling of Structures. It contributes also to the Safeguards and Fissile Materials Management, the Fusion Technology and Safety, the Advanced Materials and the Industrial Hazards programmes. The Institute is engaged in numerous support activities at the request of several Directorates-General.

### ■ Reference Methods Programme

The European Solar Test Installation ESTI has furthered its international recognition as a centre of excellence for measurement and tests. In the field of prenormative research, an indoor degradation test procedure for thin-film devices has been developed, as well as a proposal for a thin-film device qualification test, currently called CEC Specification 701.

The destructive examination of the 1/5 scaled vessel No 1 has allowed to check the models for prediction of environmentally-assisted fatigue crack growth. For the Pressurised Thermal Shock Experiment (1500 shocks performed), the basic structure has been designed using the knowledge based system (KBS) BOSS, conceived as an example of a high level controller of a plant.

The implementation of the prototype of the KBS RAMINO (Reliability Assessment for Maintenance and Inspection Optimisation) for pressure vessels and off-shore structures has been completed. Good results have been obtained in the detection of impact-induced damage on graphite-epoxy composites by means of real time laser holographic



Pulsed wave laser system with PC-based control and image analysis



interferometry. Improvements have been achieved in the use of adiabatic thermal emission measurement for material damage assessment.

### ■ Nuclear Safeguards, Fusion Technology and Industrial Hazards

For safeguarding nuclear fissile material, ISEI has developed an ultrasonic technique for the unique identification of seals for storage and transport containers. Teleoperation techniques have been applied to advanced storage and remote verification of fissile materials. The laboratory prototype, comprising a remote guided vehicle and a graphics workstation, has been extended. The calibration of the vehicle's position based on laser range data has been completed.

The TELEMAT laboratory has constructed a mockup in scale 1/5 for testing computer engineering solutions for the robotic maintenance of future nuclear fusion reactors.

Integrated computer expert systems for industrial and environmental risk assessment and accident management support have been elaborated, as well as knowledge-based systems for man-machine interaction studies of process control operators in accident situations.

The Community Documentation Centre on Industrial Risk edits regular publications concerning the Seveso Directive requirements, safety assessments and accidents

### ■ Community and External Services

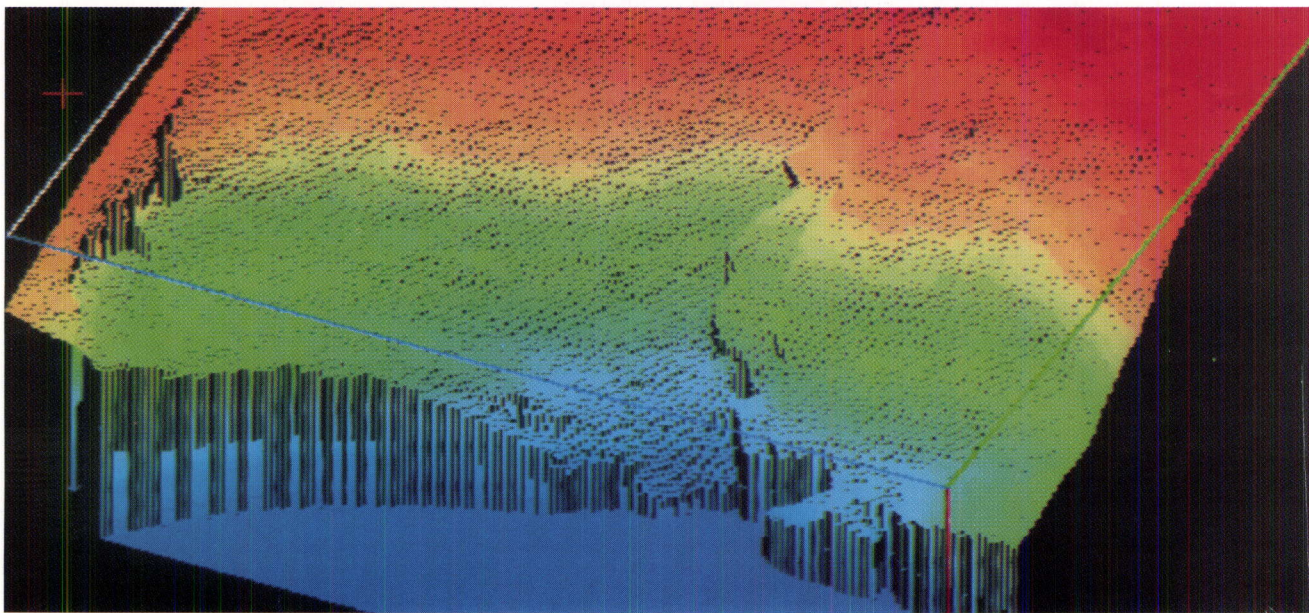
In Support to the Community Policies the following activities were executed:



Three-dimensional scenes generated on the high-speed SUPERNODE massive parallel transputer computer

- An unsupervised neural network model has defined a fuzzy similarity measure for many European regions, characterised by various socio-economic features (Statistical Office).
- The preliminary project for a European Coordination Centre for Aircraft Incident Data Bases has been prepared (DG VII).
- As a part of the VALUE activity (DG XIII - Valorisation), software to create real three-dimensional scenes with very high efficiency on massive parallel computer systems has been developed.
- The User Interface Agents and the Developer's Interface for the ARCHON Virtual Machine have been prototyped (DG XIII - ESPRIT). A framework for automatic planning and distributed problem solving has been integrated in the KWICK system.
- A second generation of computer controlled surveillance systems has been completed and installed at the Euratom Safeguards Directorate in Luxembourg. It provides the programmed multiplexed recording of 16 video signals during extended periods of unattended optical surveillance. A computer vision system for reviewing video pictures has been improved and tested at the IAEA headquarters in Vienna. A multicamera surveillance system was delivered to the Euratom Safeguards Directorate and installed in a nuclear facility. The system includes a computer-aided technical review of the large number of images produced.
- In support to EURATOM and IAEA safeguards, six campaigns were performed for the installation and identification on site of special seals on spent fuel casks at the Sellafield reprocessing plant.
- For IAEA safeguards, and in cooperation with the Institute for Safety Technology, a new test and training facility for volume and weight measurements in large tanks is being designed.





Numerical mapping (by contouring technique) of the surface of a damaged piece of sand-stone

- In support to the THERMIE programme (DG XVII), data from more than 20 projects have been analysed and 24 performance reports produced. Four on site inspections were carried out. The highlights of this activity were presented at the 10th EC Photovoltaic Solar Energy Conference in Lisbon. Activity centred on Solar Thermal Demonstration Projects included evaluation of actual energy savings of projects through monitoring campaigns, data analysis and site visits, organization of workshops, preparation of European guidelines for performance and durability tests of solar collectors, and technical evaluation of new proposals.
- In the field of energy conservation and transport concerning the redefinition of the Degree-Day Indicator published in EUROSTAT Energy Statistical Tables, a method has been developed for obtaining an indicator which more closely reflects the climate experienced by a country's population.

The following work for Third Parties was executed during 1991:

- Revenues from calibration, certification of photovoltaic devices, assistance in new module developments by testing hail resistance, and temperature/humidity cycling in the ESTI laboratory were more than double those in 1990.
- In non-nuclear energy activities, operating tools for carrying out energy savings in building stock were developed under contract for the Regional Government of Lombardy.

#### ■ Exploratory Research and International Cooperation

Exploratory research has been carried out in the following fields:

- The combination of holographic contouring and optical correlation techniques turned out to be successful for the identification of the surface state of monuments.

- A neural network developed to classify two-date multispectral SPOT imagery has achieved an accuracy of the order of 85% for 20 land cover classes.
- A reinforcement connectionist approach to robot path finding has been developed.
- The project «Thin-Film Photovoltaic Devices in Buildings» was successfully initiated.

International cooperation with the US Department of Energy and the Japan Atomic Energy Research Institute is being performed in the field of optical surveillance review techniques, ultrasonic sealing techniques and performance assessment of containment and surveillance techniques in general.



## *The Institute for Safety Technology (IST)*

**LOCATED** at Ispra, the IST contributes to the Reference Methods, Reliability and Structures, the Nuclear Reactor Safety, the Fusion Technology and the Industrial Hazards programmes. It also operates the PERLA nuclear facility, and is responsible for constructing the ETHEL laboratory. The Institute is engaged in several support activities at the request of Commission's services, mainly in the field of nuclear safeguards for the Directorates-General for External Relations and for Energy.

### ■ Nuclear Reactor Safety - Fusion Technology

The LOBI facility was closed in June 1991 after 11 years of successful operation, during which 70 Large and Small Break Loss-of-Coolant Accidents and Special Transients were performed. This programme started as a joint undertaking between the Bundesministerium für Forschung und Technologie (D) and the Commission, but results were also extensively used by many OECD countries for improving Safety Analysis tools and procedures. The approach followed in the LOBI programme, the execution of large scale demonstration tests and the development of reference calculation tools for European licensing authorities and industry, has also been vigorously pursued in the area of most improbable but severe accidents.

In particular the JRC FARO and the joint CEA and JRC PHEBUS programmes have become a focus for European cooperation in areas where the public perception of risk is particularly high.

In the nuclear complex at Ispra, construction and cold commissioning of two important test facilities were completed: PETRA, a pilot plant for improving existing and developing alternative waste treatment pro-

cedures, and ETHEL, the European Tritium Handling Laboratory, which will be dedicated to solving safety and construction problems of fusion reactors. During the several years of construction of ETHEL a series of Ex-

ploratory Research projects have been executed so as to keep abreast of developments elsewhere and ensure that the initial experiments with the ETHEL installations are relevant to the actual state of the art.

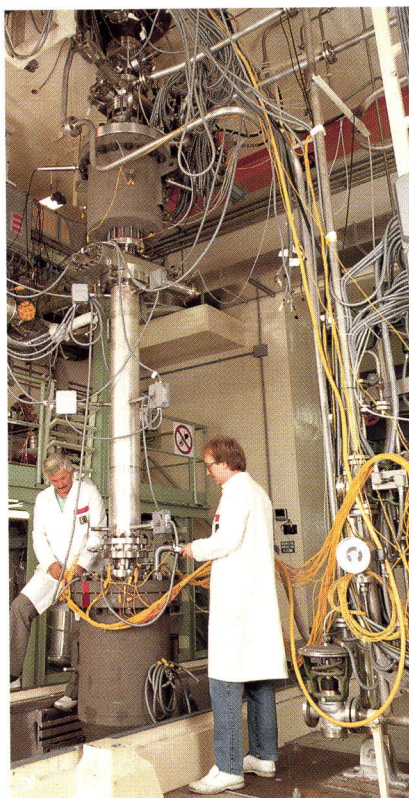
### ■ Reference Methods, Reliability of Structures

The most important achievement of the Structural Dynamics Laboratory is the completion of the construction of the Reaction Wall facility, and the start of a collaborative programme developed and executed by about 20 European laboratories. These have created an association, and are planning to efficiently use the Reaction Wall as a unique European tool made available by the Commission.

### ■ Industrial Hazards

The activities launched for the improvement of safety technology in the chemical industry have produced their first significant results in the prediction of pressure release mechanisms in chemical reactors and in the development of fast prediction models for gas cloud dispersions.

Recognising the high standard of the Institute's Exploratory Research work in Multiphase, Multicomponent Flow,



View of the FARO experimental facility



JRC has been accepted as a pilot centre in ERCOFTAC, the European Cooperation on Flow, Turbulence and Combustion.

### ■ Community and External Services

The Institute for Safety Technology is providing Scientific and Technical services in the field of Nuclear Safeguards to the Directorate-General for External Relations (IAEA) and to the Euratom Safeguards Directorate of the Directorate-General for Energy.

Non-Destructive Assay instruments, including data management software, have been delivered to the Euratom Safeguards Directorate. They have been used for the Physical Inventory Verification by Euratom inspectors in several European low enrichment Uranium plants, and for Pu measurements in mixed oxide fuel fabrication plants.

Detailed specifications have been laid down for an automated, remote controlled, neutron gamma system to be installed on a European reprocessing plant for the assay of plutonium oxide powder. Specifications have also been prepared for a Headquarters Database, to be used for the evaluation of Plutonium isotopic measurements.

Training courses for Euratom and IAEA inspectors have been organised in PERLA. One type of course simulates a physical inventory in a fabrication facility, and 16 inspectors participated in 2 such courses of 10 days each. A second type of course concentrates on the use of non-destructive assay instruments. Approximately 25 inspectors were trained in six such courses, each of 3 days duration.

A new experimental layout for volume and weight measurements systems in liquid tanks in reprocessing

facilities is being studied for future evaluation tests and training of inspectors. For that purpose the input measurement tank (volume 12m<sup>3</sup>) has been transferred from Deutsche Gesellschaft für Wiederaufarbeitung von Kernbrennstoffen MbH Karlsruhe and is now being mounted in the newly established TAME laboratory.

The Institute for Safety Technology has also provided scientific and technical services to DG XXI (Customs Union) in cases relevant to the import of scientific instruments.

The Institute was also very active in trying to secure Third Party Work. It continued to provide its expertise in developing calculation tools and provided its large experimental equipment for cooperation.

Furthermore, a vigorous effort is being made with the help of external experts to increase the knowledge about the Institute's capabilities in non-nuclear industries.



## *The Environment Institute (EI)*

**THE EI is based at Ispra, and contributes to the Environmental Protection Programme and partly executes the Radioactive Waste Management Programme. The Institute is engaged in numerous support activities at the request of various Commission services, mainly for the Directorate-General for Environment, Nuclear Safety and Civil Protection.**

### ■ Environmental Chemicals

Examples of the different environmental research activities of the Institute in the field of environmental chemicals include the first PC-based compact disk version of the ECDIN data bank, focusing on 1700 compounds of primary environmental importance, and the launch of the toxicological EUREKA/EUROENVIRON EU 618 and EUOTERVIHT projects, on the biomonitoring of trace metals for establishing «reference values» in human populations in Europe.

Under the concerted action «Indoor air quality and its impact on man», collaboration with a number of European laboratories was underway for the establishment of harmonised methods for indoor investigations.

Exploratory Research projects were chosen so as to optimise the potential of the Institute to respond effectively to the extremely varied demands for precise, up-to-date chemical analysis. The topics included Innovative Laser Technology for Chemical Analysis and Laboratory for Separation Science, which evaluates separation techniques in tandem with Mass Spectrometry.

### ■ Atmospheric Pollution

Work continued concerning the reaction of nitrate radicals with



Thermostated room with three chambers, two made of glass and one of stainless steel, for the measurement of organic emissions from building materials, household and hobby products

biogenic emissions from vegetation (isoprene) and phytoplankton (dimethylsulphide), in order to identify reaction products and their role on the radiative properties of the atmosphere.

In the field of biosphere/atmosphere interactions, field experiments confirmed the variability of conifer emissions. This matches the results, obtained at laboratory scale, from cloned spruce trees fumigated and non-fumigated with ozone and sul-

phur dioxide mixtures (collaboration with EUREKA/EUROTRAC project).

Activities on the impact of natural and anthropogenic aerosols on climate change have merged into a project on the sulphur cycle, including both modelling and experimental activities.

The analysis of a historical series of daily ozone measurements from 1868 to 1893 helped to ascertain that present tropospheric ozone levels are 2-3 times higher than in the past.



Within the framework of the EUREKA/EUROTRAC TRACT/TRANSALP sub-project, the 3rd atmospheric tracer campaign has been carried out with release of the tracer 50 km north of the alpine barrier under north wind conditions. The tracer was followed up to 150 km downwind, demonstrating transalpine pollutant transport processes.

### ■ Soil, Water and Waste Pollution

A stochastic model has been applied to pollutant migration in soil porous media. The EUREKA/EURO-ENVIRON EU 674 Mobile Lab project has been officially started to perform «in-field» sampling and analysis of waste, water, and soil contaminants.

A first experimental campaign has been launched within the framework of the European project MITO on microphyte toxin in Mediterranean waters, and a collaborative sampling error assessment study concerning trace metals in sea water has been performed during a cruise of the Italian research vessel «Minerva» from La Spezia to Venice.

### ■ Community and External Services

The Environment Institute provided scientific and technical support to several Commission Services, DG I (External Relations), DG III (Internal Market and Industrial Affairs), DG V (Employment, Industrial Relations and Social Affairs), DG VI (Agriculture), DG XI (Environment, Nuclear Safety and Civil Protection), DG XIII (Telecommunications, Information Industries and Innovation), DG XXI (Customs Union and Indirect Taxation) and CPS (Consumer Policy Service).



The Gottard pass is one of the main paths of air flow across the Alps. In the Transalp campaign the mechanism of air channelling and mixing into local wind systems were studied by a perfluorocarbon tracer technique.

To highlight a few examples of the work done:

- for DG XI, work focused on Chemicals (by updating Annex I to the Council Directive 67/548/EEC concerning Dangerous Substances), Water Quality (by studies on the quality of drinking water in connection with the Council Directive 80/778/EEC), Atmospheric Pollution (by an intercomparison of nitrogen dioxide primary standards in EC laboratories, a six month analytical campaign to re-assess the Madrid air pollution network and the evaluation of analytical methods for asbestos with a view to implementing the Council Directive 87/217/EEC) and on the preparation of a data bank for Radioactive Environment Measurement (REM)
- for DG III, work continued on the development of the European pharmaceutical data bank (ECPHIN)
- a data bank of Nuclear Magnetic Resonance (NMR) fingerprints of European wines was further developed for DG VI.

The Third Party Work under contract with IAEA and the World Meteorological

Organisation (WMO) on the Atmospheric Transfer Model Evaluation Study (ATMES) has been completed. The aim of the study was to validate the atmospheric transport models used in emergency management by comparing their prediction with experimental measurements. The data of radioactivity in air and depositions originated by the Chernobyl accident and collected by more than thirty national laboratories was especially assembled by the JRC for the study. In the framework of a cooperation agreement established with the Danish Centre for Atmospheric Research (DCAR) different projects focused on atmospheric chemistry and on the transport of pollutants have been initiated.

Several contracts with the Italian «Consiglio Nazionale delle Ricerche», «Ente Nazionale dell'Energia Elettrica» and some Italian regional administrations have either been completed or are currently ongoing in the fields of air and water pollution. A contract with the German Ministry for the Environment/German Federal Environmental Agency, aiming at collecting data for 150 priority chemicals, has been finalised.



## The Institute for Remote Sensing Applications (IRSA)

Located in Ispra, the IRSA executes the programme on the application of remote sensing techniques. The Institute is providing a major scientific support for the utilisation of remote sensing data in agricultural statistics, at the request of the Directorate-General of Agriculture and the Statistical Office.

Within the Programme on the application of remote sensing techniques, progress was made over a range of activities. An on-going study concerning land use mapping over the Ardche test area continued with good results. Considerable effort was given to producing a multi-temporal classification of the area, and new techniques, such as imaging spectrometry, neural networks and expert systems, have been evaluated as Exploratory Research projects.



Looking from the outside into the Microwave Signature Laboratory; foreground the target positioner with a small tree and operator.

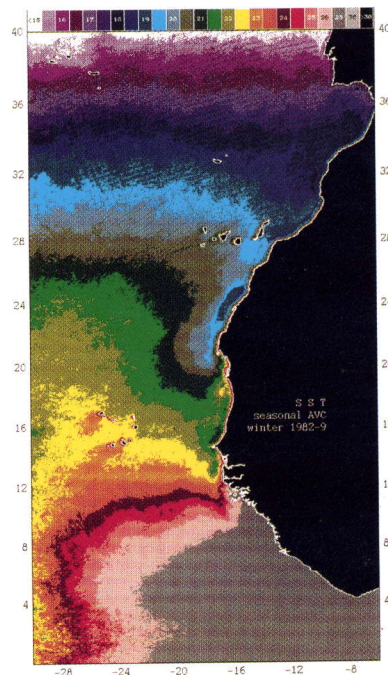
The analysis of advanced earth observation techniques, such as the application of laser and microwave techniques, were developed with emphasis being placed on the evaluation of polarimetric synthetic aperture radar data and preparation for the European Space Agency's ERS-1 satellite.

The installation of the European Microwave Signature Laboratory was completed in 1991, and the commissioning phase was initiated. In preparation for its operation, software and calibration techniques were developed.

1991 also saw the start of a new project, the objective of which was to provide input into the worldwide effort into the analysis of global change, with emphasis being placed on atmosphere/biosphere interactions over marine and land areas.

### ■ Community Services

Scientific and Technical Support to the Commission was undertaken for a number of Directorates-General (DGs). The Agricultural Information Systems project for DG VI (Agriculture) and the Statistical Office of the European Communities (EUROSTAT) made progress in all of its major actions. In particular, for Action 1 (regional inventories), much of the development work has been completed and transferred for operation to national and regional organisations. For



Seasonal averages of sea surface temperature from 1981 to 1989 constructed from 1700 satellite images.

Action 4 (rapid estimates), thirty sample sites were regularly monitored throughout 1991, with regular bi-monthly status reports delivered directly to DG VI and EUROSTAT.

In addition, work for the «Fonds Européen d'Orientation et de Garantie Agricole» (FEOGA) of DG VI focused on monitoring, on a field by field basis, the declarations made by farmers in southern Europe concerning durum wheat, cotton, vineyards and set-aside land.



For the marine environment, good progress was made for DG I (External Affairs) and DG XI (Environment), particularly for the Upwelling Project for DG II, where an initial analysis of the spatial and temporal variation in coastal upwelling along the northwest African coast was undertaken using the Advanced Very High Resolution Radiometer (AVHRR) archive for the period 1981 to 1989. For DG XI, the Ocean Colour European Archive Network (OCEAN) project (a joint undertaking with the European Space Agency (ESA)) progressed well, with software being completed for the production of chlorophyll-like pigment images using data from the Coastal Zone Colour Scanner (CZCS) sensor.

For DG VIII (Development), a methodology is being developed, in collaboration with "The Institut Français de Recherche Scientifique Pour le Développement en Coopération" (France), to interface information derived from remote sensing data with hydrological models. The work concentrates on Senegal and Niger. In addition, bush fire activity was monitored for the same watersheds and used as an indicator of ecological change.

In support of DG XI (Environment), work was undertaken to investigate the use of remote sensing in the revision of the CORINE land cover map. New test sites in Portugal and Luxembourg were established, with ground data being collected.

#### ■ External Services and International Collaboration

In the summer of 1991 IRSA participated in the Multiple Airborne Campaign Europe (MACEUROPE), organised by NASA. Polarimetric SAR and imaging spectrometer data were collected over a range of test sites in Europe, along with supporting ground data.

In 1991 the Tropical Ecosystem Environmental observations by Satellites

(TREES) was initiated. This project (a joint undertaking with ESA) is concerned with the development of space observation techniques, primarily using Advanced Very High Resolution Radiometer (AVHRR) and the Synthetic Aperture Radar (SAR) on ERS-1, for improving the monitoring of the world's tropical forests. A first forest/non-forest map was obtained over continental south-east Asia.

The European Airborne Remote Sensing Capabilities (EARSEC) (a joint

undertaking with ESA) made progress in 1991, with the selection of the European Synthetic Aperture Radar (SAR) and imaging spectrometer sensors to be used for operational measurements. In addition the first demonstration measurements were taken.

A Third Party contract with an Italian company saw the development of pre-operational techniques for oil detection by means of a helicopter-mounted, time resolved, laser-induced fluorosensor.



Single shot spectro-temporal measurement performed from the helicopter operating at 300 feet. The two bright spectral lines are the backscattering signal (355 nm) and water Raman diffusion signal (404 nm); the spectrally broad signal is the fluorescence of the dissolved organic matter.



## *The Institute for Prospective Technological Studies (IPTS)*

**The IPTS mainly performs scientific and technological studies at the request of the Services of the Commission. Studies requested by external third parties are also carried out.**

The S/T observatory continued to develop and a number of studies were executed. Some methodological developments were carried out by grantholders.

The structure of the documentation and information system, as a backup to the S/T observatory function, was improved. It now consists of three parts:

- The documentation system, including the on-line system for the interrogation of bibliographical data bases.
- The informatics structure of the NOVA (Innovation Technology) data base, which is now available on-line in the internal network.
- The test case of the information system on ongoing R&D in Europe, based on the Institute's data base, was completed.

A number of new studies in support of the Commission services were undertaken and a follow up of some of the work of the previous year was requested. Work for third parties was negotiated with national institutes or regional organizations in Italy, Greece and Spain; some of this work will now be executed.

In 1991, the following studies were carried out:

- The present situation of the European space industry was reviewed and the potential of the various sectors outlined, including launching devices, satellites, telecommunications systems, meteo-

logical and earth observation, and microgravity applications. An interim report «Competitivité des industries spatiales européennes» was issued.

- A strategic and prospective analysis of high speed rail transportation was started in order to provide the background elements for the analysis of the related electric energy distribution system, as a contribution to DG III's mandate on coherence and harmonisation. An interim report «L'alimentation en énergie des réseaux de Trains à Haute Vitesse» was issued.
- In order to investigate the size, trends and opportunities for the environmental industry/business, two actions were undertaken. The first was intended to collect up-to-date information on the situation in Japan, and the second to survey selected technologies in use or potentially useful in Europe and in the USA
  - A first report was prepared on «The Japanese Technological Response to Global Environmental Problems»
  - A review of the available literature in Europe and the USA allowed identification of existing and emerging technologies for pollution clean-up and low-pollution technologies and processes that may find future applications. A report entitled «A survey of technological and economic opportunities in the

environmental industry» was prepared.

- As a follow-up to the work performed in 1990 on the Greenhouse Effect, a periodic survey of the scientific and policy aspects of climate change was started and a first report «Climate Change Research and Policy: Updates» was issued in May. A second report is in preparation.

A Workshop has been organised to prepare a training/education network on prospective technological analysis techniques, as part of the future programme «Human Capital and Mobility». A workshop on «Literature-based innovation output indicators» was held at Ispra at the end of November.

Some exploratory investigations in fields relevant to the activity of the Institute were carried on by Grantholders and Trainees. Two papers concerning the innovation process in the field of advanced materials were prepared: «Perspectives on the process of innovation for advanced materials» and «Ruolo dei materiali innovativi nello sviluppo dell'industria ad alta tecnologia in Europa» (Thesis at Milan University). Use of the co-word and co-citation analysis technique was made for the identification of emerging S/T areas and a report on «Foci of interest and attention in global environmental change research - a literature-based assessment» was prepared.



# 2 9

ACTIVITIES  
OF THE JRC  
INSTITUTES  
IN 1991

## Publications, Eurocourses

### Publications

In 1991 the JRC published 886 papers. The following Table gives the distribution of these publications among the JRC Institutes.

An evolution of these publications during the last seven years is illustrated in Fig. 3

The detailed list of JRC publications is published each year in the «Publications Bulletin». The last issue, No 11/ISSN, 0254-3133, published in September 1991, gives the list of JRC publications in 1990.



TABLE 2

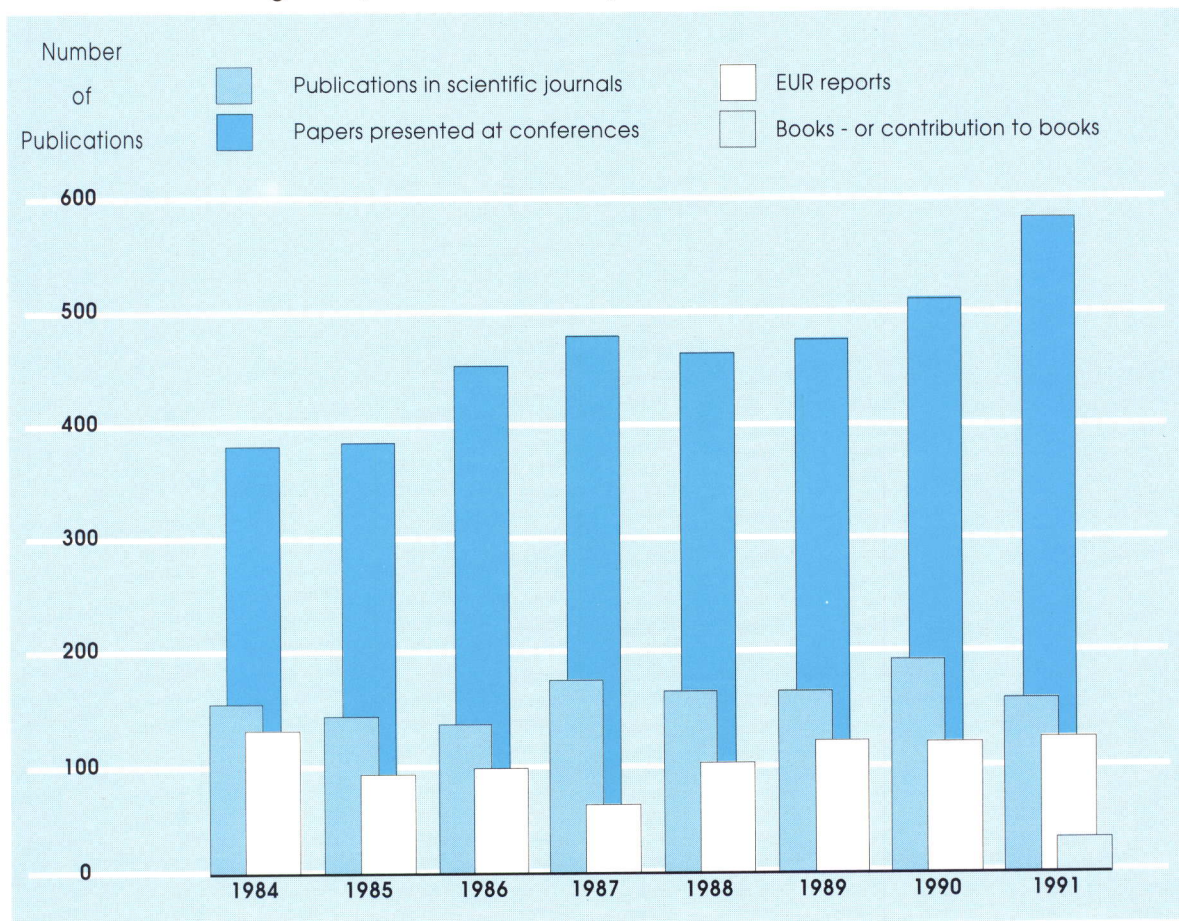
### Distribution of JRC publications among JRC Institutes in 1991

	EUR Reports	Conference papers	Public. in scientific journals	Books(*)	Total
Central Bureau for Nuclear Measurements	3	64	18		85
Institute for Transuranium Elements	6	97	21		124
Institute for Advanced Materials	16	97	5		118
Institute for Systems Engineering and Informatics	29	63	17		109
Environment Institute	19	70	51	6	146
Institute for Remote Sensing Applications	15	107	33	11	166
Institute for Safety Technology	25	86	10		121
Institute for Prospective Technological Studies	2				2
Other publications (Eurocourses)	5	1		9	15
<b>TOTAL</b>	<b>120</b>	<b>585</b>	<b>155</b>	<b>26</b>	<b>886</b>

(\*)Or contribution to books



Figure 3 / Evolution of JRC publications (1984-1991)



#### ■ Eurocourses - Other Workshops and seminars

The JRC organized 9 Eurocourses in 1991. Lecturing staff were composed of 96 guest lecturers from Europe and the USA and 44 experts from both the JRC-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 Applied to Agricultural Statistics: Regional Inventories
  - Ocean Colour: Theory and Applications in a Decade of the Coastal Zone Colour Scanner (CZCS) Experience
- **Chemical and Environmental Science**
  - Applied Multivariate Analysis in SAR and Environmental Studies
  - Environmental Impact Assessment
- **Reliability and Risk Analysis**
  - Safety of Chemical Batch Reactors and Storage Tanks
  - Experimental and Numerical Methods in Earthquake Engineering and Structural Dynamics
- **Computer Science**
  - Distributed Artificial Intelligence: Theory and Praxis
- **Technological Innovation**
  - Scientific-Technical Backgrounds for Biotechnology Regulation

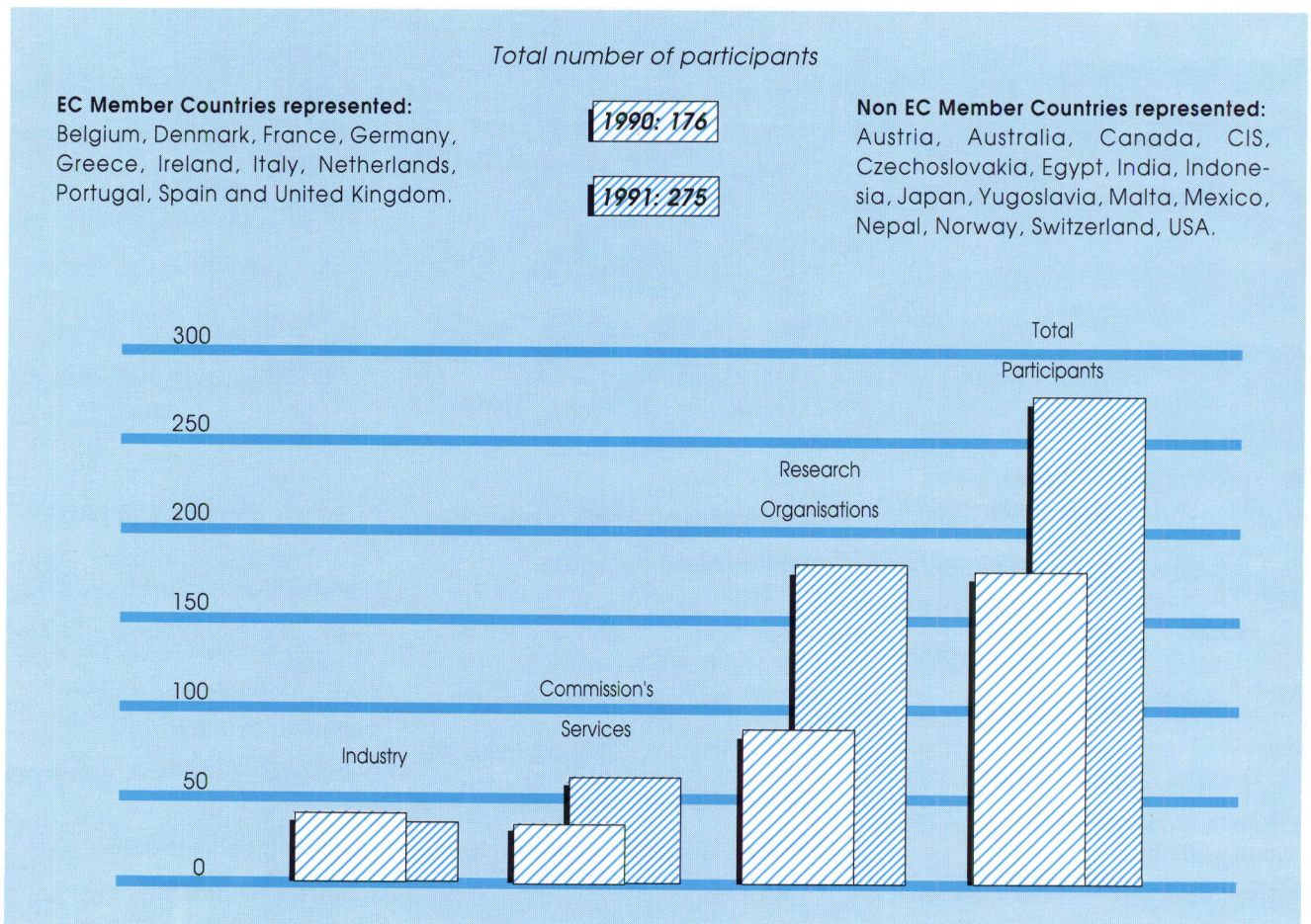


All courses were residential at Ispra. They were attended by 275 participants, coming from industry, public administration, universities and research organisations. This is an increase of 56% in comparison with 1990, as shown in Figure 4, which also lists the countries represented.


The course material is being published in various volumes, each one describing the state of the art in a specific field.

The JRC Institutes also organised various workshops and seminars to discuss their activities with scientists from other organisations.

Figure 4 / Participants and countries represented in 1990 and 1991







HUMAN  
RESOURCES

---



## Staff Policy

The JRC authorised statutory staff table amounts to 2180, including both scientific-technical and administrative staff.

Statutory employees are governed by the EC staff regulations. For many years the JRC has not recruited staff as officials; as a consequence this category of staff is decreasing and represents today only 40% of the total JRC staff. Temporary agents are generally recruited under a five year contract, which is renewable; after two terms the contract becomes of indefinite duration. Auxiliary agents are generally hired under a contract of 12 months which may be extended up to 18 months at a maximum.

Table 3 gives the distribution of the JRC officials and temporary agents present at the JRC in December 1991, by Directorates and Institutes. During 1991, 39 people from these two categories left the JRC and 56 people were recruited.

The difference between the authorised ceiling in statutory staff and the staff effectively present at the JRC can be explained as follows:

- posts for statutory staff, in agreement with the Council and the Parliament, have been deliberately kept vacant, in order to save personnel credits to allow an influx of visiting scientists, seconded experts and scientific grant holders;
- the remaining part of the difference corresponds to the necessary margin of flexibility ( $\pm 6\%$ ) required to allow for movement of staff during the year.

TABLE 3

### Distribution of statutory staff

Location	Staff
Directorate-General	22
Programmes Directorate	20
Coordination of Resources - Scientific & Technical Support	410
Central Bureau for Nuclear Measurements	170
Institute for Transuranium Elements	198
Institute for Advanced Materials	277
Institute for Systems Engineering and Informatics	249
Environment Institute	177
Institute for Remote Sensing Applications	80
Institute for Safety Technology	325
Institute for Prospective Technological Studies	14
<b>Total</b>	<b>1942</b>



## Visiting Scientists, Seconded Experts and Scientific Fellows

Numerous scientists, besides the statutory staff, are active in the JRC, under various hosting schemes:

- the JRC hosts visiting scientists and senior scientists for one or sometimes two years;
- experts from national organisations may be seconded to the JRC to participate in selected scientific work;
- the JRC trains specialists through a programme of fellowships, granted to three different types of scientists: post-doctoral fellows, postgraduate students preparing a master's degree or doctorate, and undergraduate students. They are given a grant for one to three years.

Table 4 shows where these people worked in the various JRC Institutes.

It is also worthwhile mentioning that about ten scientists from third countries worked at the JRC on a grant in the framework of a Commission agreement with their countries or the IAEA. Besides the above mentioned scientists, about eighty trainees or scientists were working at the JRC without expense to the EC budget, in general for a short period of time.

**TABLE 4**  
Visiting Scientists, Seconded Experts, Grant Holders

By Institute and by categories on 1 December 1991  
(EC and non EC citizens)

Institutes	Visiting scientists	Seconded experts	Post-doctoral grant holders	Post-Graduate grant holders	Under-Graduate grant holders	Total
Central Bureau for Nuclear Measurements	8	1	-	14		23
Institute for Transuranium Elements	1	7	2	14	1	25
Institute for Advanced Materials	3	1	2	22	-	28
Institute for Systems Engineering and Informatics	1	5	3	29	-	38
Environment Institute	4	4	2	12	1	23
Institute for Remote Sensing Applications	3	4	1	10	-	18
Institute for Safety Technology	3	4	2	13	-	22
Institute for Prospective Technological Studies	-	-	1	1	-	2
<b>Total</b>	<b>23</b>	<b>26</b>	<b>13</b>	<b>115</b>	<b>2</b>	<b>179</b>

Furthermore the Coordination of Resources has two seconded experts.









# 4 FINANCES



## *Expenditures committed in 1991*

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

- Specific Research Programmes	167,30 Mioecu
- S/T Support to the Commission	43,80 Mioecu
<b>Total</b>	<b>211,10 Mioecu</b>

Other resources for HFR operation and third party work are:

- HFR Reactor	17,70 Mioecu	<i>(Supplementary programme)</i>
- Work for Third Parties	20,30 Mioecu	<i>(Budgetary advance)</i>
<b>Total</b>	<b>38,00 Mioecu</b>	

The total amount of the available credits is therefore 249,10 Mioecu.

Details about 1991 commitments are given in the following table 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 6.6 Mioecu was transferred from specific credits to reinforce personnel credits.

This transfer was necessary in order to take into account:

- the adaptation of salaries for the period 1.7.1990 - 31.12.1990;
- the increase of inflation in Italy which reached the threshold of 3,4%

- the modification of the correction coefficient for Germany from 1.10.1990 following German unification.

Commitments over the period 1988-1991 are given in Tables 6 and 7. In Table 6 the personnel credits and the specific credits for the various JRC activities are each given on the line, whereas in Table 7 global credits are listed by programme.

Table 7 shows that the expenses for the specific programmes stayed within the foreseen 700 Mioecu corresponding to the decisions on the specific research programmes.

TABLE 5

### Commitments for programme execution 1991 (Rounded figures, Mioecu)

	<b>Personnel</b>	<b>Other Expenditures</b>	<b>Total</b>	<b>1991 Budget</b>
Specific Research Programmes	109,56	51,28	160,84	167,30
Exploratory Research	5,24	2,66	7,90	p.m.
<b>Subtotal</b>	<b>114,80</b>	<b>53,94</b>	<b>168,74</b>	<b>167,30</b>
S/T Support to the Commission	24,02	18,50	42,52	43,80
<b>Subtotal</b>	<b>24,02</b>	<b>18,50</b>	<b>42,52</b>	<b>43,80</b>
<b>OTHERS</b>				
HFR Reactor	5,77	12,98	18,75	17,70
Work for Third Parties (reimbursable budgetted credits)	4,71	3,37	8,08	20,30
<b>Subtotal</b>	<b>10,48</b>	<b>16,35</b>	<b>26,83</b>	<b>38,00</b>
<b>Total</b>	<b>149,30</b>	<b>88,79</b>	<b>238,09</b>	<b>249,10</b>



TABLE 6

Annual expenditures 1988-1991  
(Rounded figures, Mioecu)

	Commitments 1988	Commitments 1989	Commitments 1990	Commitments 1991	Commitments 1988 to 1991
Personnel	124,79	131,06	137,71	149,30	542,86
<b>Subtotal</b>	<b>124,79</b>	<b>131,06</b>	<b>137,71</b>	<b>149,30</b>	<b>542,86</b>
Specific Research Programmes	67,03	69,64	60,97	51,28	248,92
Exploratory Research	2,29	2,36	2,80	2,66	10,11
<b>Subtotal</b>	<b>69,32</b>	<b>72,00</b>	<b>63,77</b>	<b>53,94</b>	<b>259,03</b>
S/T Support to the Commission	10,21	14,54	15,71	18,50	58,96
<b>Subtotal</b>	<b>10,21</b>	<b>14,54</b>	<b>15,71</b>	<b>18,50</b>	<b>58,96</b>
OTHERS					
HFR Reactor	10,78	14,47	12,18	12,98	50,41
Work for Third Parties		2,89	2,72	3,37	8,98
<b>Subtotal</b>	<b>10,78</b>	<b>17,36</b>	<b>14,90</b>	<b>16,35</b>	<b>59,39</b>
<b>Total</b>	<b>215,10</b>	<b>234,96</b>	<b>232,09</b>	<b>238,09</b>	<b>920,24</b>

TABLE 7

Annual expenditures (commitments) over the 1988-1991 time period  
(Personnel and other expenditures according to activity)

JRC Activities	1988	1989	1990	1991	Total over the period 1988 to 1991
Specific Research Programmes including Exploratory Research	178,05	179,73	173,07	168,74	699,59
S/T Support to the Commission	21,13	30,74	35,59	42,52	129,98
OTHERS					
HFR Reactor	15,70	19,38	17,08	18,75	70,91
Work for Third Parties (reimbursable budgetted credits)	0,22	5,11	6,35	8,08	19,76
<b>Total</b>	<b>215,10</b>	<b>234,96</b>	<b>232,09</b>	<b>238,09</b>	<b>920,24</b>









# ANNEXES

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## *JRC Board of Governors and Organisation Chart*

### LIST OF MEMBERS OF THE JRC BOARD OF GOVERNORS IN 1991

**Sir John KENDREW (Chairman)**

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

**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

**Mr. André DEMILDT**

Conseiller  
Cabinet des Affaires Economiques  
23 Square de Meeus,  
B-1040 BRUXELLES  
(replaced Mr. J.P. Poncelet on  
20.03.91)

**Dr. Werner GRIES**

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

**Monsieur Jean HOFFMANN**

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

**Ing. Carlo MANCINI**

Direttore  
ENEA  
Viale Regina Margherita 125  
I-00198 ROMA

**Dr. Julio MONTES PONCE DE LEON**

CIEMAT  
Avda Complutense 22  
E-28040 MADRID  
(replaced Dr. F. Mingot Buades on  
15.12.91)

**Prof. Christos**

**PAPAGEORGOPOULOS**

Director  
Laboratory of Surface Physics  
Department of Physics  
University of Ioannina  
P.O. Box 1186  
GR-45110 IOANNINA  
(replaced Prof. A.J. Karabelas on  
15.02.91)

**Prof. Fernando Manuel RAMÔA  
RIBEIRO**

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

**Prof. William STEWART**

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

**Dr. Jacques WINTER**

Directeur  
Département de Recherche  
fondamentale  
Commissariat à l'Énergie Atomique  
(CEA)  
Centre d'études nucléaires de  
Grenoble  
Boîte postale 85 X  
F-38041 GRENOBLE Cédex  
(replaced Dr. J. Horowitz on  
20.03.91)

**Prof. Flemming WOLDBYE**

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

**Prof. Gerard T. WRIXON**

Director  
National Micro Electronics Re-  
search Centre



**ORGANISATION CHART JOINT RESEARCH CENTRE**  
**February 1992**
**Directorate-General**
*Director-General*

Adviser

 Adviser in charge of the  
 Board of Governors

Budget Coordination

Assistant to Director-General

**Brussels**

Jean-Pierre CONTZEN

 Piedad GARCIA DE LA  
 RASILLA Y DE PINEDA

Samuel LLOYD

Michel GRIN

Gisèle VANWERT

**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

**Programmes Directorate**
*Director*

Safety engineer

- Coordination of scientific  
 activities
- Interinstitutional relations
- General planning
- Marketing
- Space Applications

**Brussels**

Hans Jørgen HELMS

Marcello BRESESTI

François LAFONTAINE

Reinhold HACK

Roberto CUNIBERTI

Ettore CARUSO

Anver GHAZI

**Coordination of Resources**
*Coordinator of Resources*

- Human resources
- Analytical accountancy  
 and management  
 of central services

**Ispra**

Helmut HOLTBECKER

Bernard CHAMBAUD

Noëli VAN HATTEM

(acting)

Michele ACTIS-DATO

Alberto AGAZZI

Argeo BENCO

Emanuela ROSSI

Learco DI PIAZZA

Michel LE DET

Mary CONNOLLY

Domenico SEVI

**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. BENEDICT

Paul BLAES

Klaas BUIJS

Gérard 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 and Ispra**

Ernest Demetrios HONDROS

Walter KLEY

Jürgen AHLF

Marcel VAN DE VOORDE

Hermann KRÖCKEL

Peter SCHILLER

Pierre JEHENSON

Livio MANES

Abraham BAHBOUT



**Institute for Systems****Engineering and Informatics Ispra***Institute Director*

Robert W. WITTY

Head of unit acting

as Institute Deputy Director

Giuseppe VOLTA

Adviser (Thermonuclear fusion)

Giampaolo CASINI

Adviser

Jean-Pierre AUBINEAU

Adviser

Gilles NULLENS

- Systems Engineering  
and reliability

Giuseppe VOLTA

- Reference methods  
and measurementsfor non-nuclear  
energy sources

Eric ARANOVITCH

- Control of fissile materials

Marc CUYPERS

- Informatics services

.....

- Advanced energy systems

.....

**Environment Institute***Institute Director***Ispra**

Friedrich GEISS

Head of unit acting

as Institute Deputy Director

Bruno VERSINO

- Administration  
and Technical Services

Guglielmo ROSSI

- Atmospheric Physics

Francesco GIRARDI

- Atmospheric Chemistry

Giambattista RESTELLI

- Atmosphere -

Biosphere Interactions

Bruno VERSINO

- Environmental Informatics

.....

- Environmental Chemicals :

Sergio FACCHETTI

Soil, Water, Waste

- Environmental Chemicals :

.....

Life Sciences

- Environmental Chemicals :

Helmut KNÖPPEL

Indoor Pollution

- Food and Drug Analysis,

Giorgio SERRINI

Consumer Protection

- European Centre

for the Validation of

Alternative Methods

(ECVAM)

.....

**Institute for Remote  
Sensing Applications***Institute Director***Ispra**

Raymond KLEERSY

- Environmental Mapping  
and Modelling

J. MEGIER

- Agriculture Information  
Systems

J. MEYER-ROUX

- Monitoring

of Tropical Vegetation

J.P. MALINGREAU

- Marine Environment

Peter SCHLITTENHARDT

- Advanced Techniques

A. SIEBER

**Institute  
for Safety Technology***Institute Director***Ispra**

Helmut HOLTBECKER

Head of unit acting

as Institute Deputy Director

Heinz DWORSCHAK

Head of unit acting

as Institute Deputy Director

Paola FASOLI

- Thermodynamics

Paola FASOLI

- Process engineering

Claus BUSSE

- Applied mechanics

Jean Michel DONEA

- In-pile experiments

Peter VON DER HARDT

- Nuclear fuel cycle

Heinz DWORSCHAK

- Nuclear experiments

Giuseppe BARBERA

**Institute for Prospective  
Technological Studies***Institute Director***Ispra**

Pierre BONNAURE

- Studies and reviews,  
network coordination

Carlo RINALDINI



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*Glossary of acronyms and abbreviations*

ARCHON	Architecture for Co-operative Heterogenous On-line Systems		Relevant Trace Constituents in the Troposphere (EUREKA project)
ATMES	Atmospheric Transport Models Evaluation Study	FARO	Experimental Facility for Fuel Melting
CEA	Commissariat à l'Énergie Atomique	FORMENTOR-EUREKA	Project to develop expert system to help decision in hazardous situations (complex man made systems)
CEC	Commission of the European Communities	HFR	High Flux Reactor (Petten Site)
CEO	Centre for Earth Observation	IAEA	International Atomic Energy Agency
CIEMAT	Centre for Energy, Environmental and Technological Research	KWICK	Knowledge Workers Intelligently Collecting/Coordinating/Consulting Knowledge
CISE	Centro Informazioni Studi Esperienze	LASFLEUR	Laser Induced Chlorophyll-Fluorescence
CORINE	Co-ORDination of INformation on the Environment	LOBI	LWR Off Normal Behaviour Investigation (Installation)
COST	Scientific and Technical Cooperation	NASA	National Aeronautics and Space Administration (USA)
CRIEPI	Central Research Institute of Electric Power Industry (Japan)	OCEAN	Ocean Colour European Archive Network
CZCS	Coastal Zone Colour Scanner	OECD	Organisation for Economic Co-operation and Development
EARSEC	European Airborne Remote Sensing Capabilities	PERLA	Performance and Training Laboratory (Nuclear Safeguards)
ECDIN	Environmental Chemical Data Information Network	PETRA	Facility for Treatment of Radioactive Waste
ECSAM	European Commission's Safeguards Analytical Measurements	PHEBUS	French In-Pile Programme (Severe Fuel Damage)
E-MARC	European Materials Research Consortium	SPOT	Système Probatoire pour l'Observation de la Terre
ERS-1	European Remote Sensing Satellite Nr 1	RAMINO	Reliability Assessment for Maintenance of Inspective Optimization
ESARDA	European Safeguards Research and Development Association	TELEMAC	Teleoperation Laboratory for Experimentation Modelling, Analysis and Computation
ESPRIT	Strategic Programme for Research and Development in Information Technologies	THERMIE	Technologies Européennes pour la Maîtrise de l'Énergie
ESTI	European Solar Test Installation	TRANSALP	Transalpine Transport of Air Pollution
ETHEL	European Tritium Handling Experimental Laboratory	TREES	TRopical Ecosystem Environmental observations by Satellites
EURATOM	European Atomic Energy Community	VALUE	Valorisation and Utilisation for Europe
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 European Communities		
EUROTRAC	European Experiment on Transport and Transformation of Environmentally		



Commission of the European Communities

**Joint Research Centre**

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