COMMISSION OF THE EUROPEAN COMMUNITIES

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JOINT RESEARCH CENTRE

1992 ANNUAL REPORT

(Presented by the Commission)

PREAMBLE

Following

- Article 4 of the Council Decision of 29 April 1992, adopting specific research programmes to be implemented by the Joint Research Centre for the European Economic Community (92/273/EEC) during the period 1992-1994,

- Article 4 of the Council Decision of 29 April 1992, adopting specific research programmes to be implemented by the Joint Research Centre for the European Atomic Energy Community (92/274/Euratom) during the period 1992-1994,

- Article 5 of the Council Decision of 29 April 1992, adopting a supplementary research programme to be implemented by the Joint Research Centre for the European Atomic Energy Community (92/275/Euratom) during the period 1992-1995;

it is foreseen that an annual report on the execution of the programme will be transmitted by the Commission to the Council, the European Parliament and the Economic and Social Committee.

The enclosed document constitutes the first of these reports and concerns the year 1992.

It is accompanied by the observations of the Board of Governors.

OBSERVATIONS OF THE BOARD OF GOVERNORS ON THE JRC ANNUAL REPORT 1992

The Council Decisions 92/273/EEC, 92/274/Euratom, 92/275/Euratom of 29 April 1992 on the JRC Specific Research Programmes 1992-1994 for the EEC and the EAEC and the supplementary programme (HFR Reactor) 1992-1995 for the EAEC request that the Commission's Annual Report shall be accompanied by the observations of the Board of Governors.

The Board notes that the Annual Report provides information on all categories of activities of the JRC, as stipulated in the Council Resolution 92/C 118/03 of 29 April 1992 concerning the activities to be undertaken by the JRC, and enables the addressees to appreciate the impact of the JRC in 1992. In the opinion of the Board, the Report is a well-prepared and usefully structured document.

The Board appreciates the dynamic way in which the JRC has embarked on the new objectives set for the 1992-1994 period by the Council, the European Parliament and the Commission. This encompasses the specific research programmes, the increased scope and volume of scientific and technical support to other services of the Commission and the continuing work for third parties in a field where the competition is markedly increasing both in Europe and world-wide.

Amongst the new programmes, the Board has great expectations for the Human Capital and Mobility Programme now that the modalities for its execution have been finalised. It will not only contribute to the training of young researchers, but also contribute to the JRC collaboration with national research laboratories and universities - an aspect of the JRC activities which has had strong attention by the Board during the year of report.

The Board, being fully aware of the necessity for improved internal efficiency in the administrative and infrastructural activities, has noted the progress made by the JRC by the reorganisation made in these areas at the Ispra site and welcomed the plans towards an ECO-Centre at Ispra. This falls in line with the expectations the Board formulated when commenting on the Annual Report for 1991 and indeed on the proposal for the 1992-1994 activities of the JRC.

Further evidence of the vitality of the JRC was found in the inauguration of the new scientific experimental installations during the year 1992, where the established national collaborations were an important aspect.

Another necessary condition for the scientific vitality of the JRC, are the plans for early retirement of officials with a very long period of service and which the Board sincerely hopes will be approved by the Council in early 1993 to take effect by the middle of that year.

Medium term and long term planning continue to be of high relevance for the work of the Board which, in 1992, has been engaged in the early planning of the JRC contribution to the 4th Framework Programme on Community activities in research and technological development where the Board notably has focused on the application of the subsidiarity principle for the JRC activities, as well as a stringent application of the customer/contractor principle and that in particular for the scientific and technical support to other services of the Commission.

The Board has followed with interest the evolution concerning co-operation with the EFTA countries and looks forward to the extension and to the factuality of this co-operation under appropriate schemes.

The Board expresses its gratitude for the work performed during the year by the Director General, the Directors and indeed the entire staff, and it acknowledges their demonstrated will to embark on new orientations and changes from the past.

In June 1992 there was a change over of the chairmanship of the Board, which wishes to convey its most sincere thanks to its first chairman, Sir John Kendrew, for his excellent guidance of the Board and his unfailing support of the JRC through a very crucial period in the history of the Centre.

The Board finally expresses its gratitude to On. F.M. Pandolfi, the Vice President of the Commission responsible for the JRC for the interest he has taken in the work of the Board and for the fine mutual understanding it has enjoyed.

Brussels, January 1993

JOINT RESEARCH CENTRE

1992 ANNUAL REPORT

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Report of the Commission

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THE 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, with headquarters in Brussels; 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)
IST	The Institute for Safety Technology (Ispra)
ISEI	The Institute for Systems Engineering and Informatics (Ispra)
EI	The Environment Institute (Ispra)
IRSA	The Institute for Remote Sensing Applications (Ispra)
IPTS	The Institute for Prospective Technological Studies (Ispra)

This Annual Report intends to give a general overview of JRC life in 1992.

Furthermore, readers may find more details in the Annual Reports of the eight Institutes. Finally, as in the past, the JRC publishes numerous scientific reports, presents papers in conferences and in scientific journals, and organises workshops, seminars and conferences to disseminate its scientific achievements.

These documents may be obtained from

Public Relations and Publications
CEC - Joint Research Centre
I - 21020 Ispra (VA) Italy
Phone : + 39 332 78 91 80
Fax : + 39 332 78 58 18

1. JRC LIFE IN 1992

1992 has seen the confirmation of the rôle of the JRC in the Community R&D system through a Council Resolution adopted on 29 April 1992 on the activities to be undertaken by the JRC in the 1992-1994 period, and the Council Decisions of the same date on the Specific Research Programmes 1992-1994. These programmes contribute to the objectives of the 3rd Framework Programme through the lines of Industrial and Materials Technologies, Measurement and Testing, Environment, Nuclear Fission Safety, Controlled Nuclear Fusion and Human Capital and Mobility. The Council also decided a supplementary Euratom programme 1992-1995 for the HFR Reactor at Petten.

The JRC has established its strength in executing projects of a multidisciplinary nature with the aim of meeting the needs of the Community as a whole, its Institutions and Member States. All eight Institutes continued their activities within the context of specific programmes, scientific and technological support to the Commission, contractual work for external third parties and exploratory research, operating under the objectives stipulated by the Council and the European Parliament for the JRC and the financial targets set out in the Budget for 1992 and the 1992-1994 period.

The neutral and independent rôle of the JRC was underlined, research of pre-normative character was emphasised as was the true European nature of its scientific-technical activities. Much attention has been paid by the JRC Board of Governors to ensure proper response to the subsidiarity principle and to foster increasing significant collaboration with national research in the Member States. Plans were drawn up for a possible coming collaboration with the EFTA Countries. Europe-wide or international collaboration continued under schemes like EUREKA and EC agreements with several countries around the world. Notably the new orientation in the environmental research (global change) gave rise to extensive planning for new collaborations.

During the year, several large installations were inaugurated such as the European Signature Laboratory on 21 April which will carry out spectral signature research, notably for research in the field of remote sensing applications. The Reaction Wall facility (European Laboratory for Structural Assessment - ELSA) was inaugurated on 16 October 1992 and aims at testing large and full scale models of structures. Also the Advanced Coating Centre at Petten established in collaboration with the Dutch Energy Research Foundation (ECN) became operational, and was inaugurated on 27 November 1992.

Work undertaken as scientific and technical support to the Commission has considerably increased in response to the requests for work from other Directorates General of the Commission and much attention has been paid to applying the customer/contractor principle in the execution of the work. Practically, more than 88% of all operations were covered during the year by an Inter-Directorate General multi-annual contract, a Council Decision or a Commission Decision, and the remaining part executed in response to more punctual requests from Commission Directorates General. New initiatives included the European Centre for Validation of Alternative Testing Methods (alternative to vivisection) and the European Chemicals Bureau both for the Directorate General for Environment, Nuclear Safety and Civil Protection and new work in the nuclear safeguards area for the Directorate General for Energy.

Contractual work for external third parties, continued to be of a high quality and the JRC has strengthened its marketing efforts, both at institute and central levels.

The many exploratory research projects gave stimuli for possible new work orientations and added to the scientific vitality of the JRC.

In order to underline the new orientation for the work it was decided at the end of 1992 to change the name of the JRC Institute based at Geel (B) to Institute for Reference Materials and Measurements, which will include the CBNM activities as foreseen in the EAEC Treaty. The new name will be used from end of December 1992 onwards.

1.1 Specific Research Programmes

The predominant task of the JRC is still its contribution to the implementation of the Framework Programme, which accounted for 65% of the JRC budget, in comparison with 70% in 1991 and 74% in 1990. It contributed to the objectives of the 3rd Framework Programme by the execution of the following specific programmes:

- **The Industrial and Materials Technologies** encompassed research on Advanced Materials executed by the Institute for Advanced Materials (IAM), and on the Working Environment, executed by the Institute for Safety Technology (IST), the Institute for Systems Engineering and Informatics (ISEI) and by the Environment Institute (EI).

IAM concentrated its efforts on providing a scientific understanding of new advanced materials behaviour and new measurement capabilities. Research underpinning the understanding of high temperature materials behaviour in industrial environments has been directed towards more severe conditions (ultra high temperature, aggressive environments). The Advanced Coatings Centre has become operational at IAM-Petten as a joint venture with the Dutch ECN, and scientific efforts have concentrated on the improvement and characterisation of wear and corrosion resistant coating.

The Institute for Advanced Materials catalysed European interest in developing inter-metallic materials for structural applications, within a concerted action under the BRITE/EURAM (Basic Research in Industrial Technologies for Europe/European Research on Advanced Materials) programme; IAM also co-ordinated the EUREKA-CEFIR project, which includes 22 Industrial Partners and 24 Research Institutes, and which aims at the development of a European production capability of ceramic fibres. IAM has also been very active in the promotion of a European Association for pre-normative research of engineering and constructional materials, under the guidelines of IRDAC (Industrial Research and Development Advisory Committee).

In the field of the working environment the Environment Institute has been involved in the biomonitoring of trace metals in human tissue to identify and prevent possible causes of worker diseases arising from occupational exposure. The work on accident prevention and management at ISEI concentrated on the development of a cognitive model to study man-machine interaction and the analysis the various parameters affecting decision-making and thus the performance of man-machine feedback loops. At IST, work focused on ventilation and pollutant transport modelling.

- **The Measurement and Testing** 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 by the Institute for Safety Technology (IST).

Nuclear data measurements were executed at CBNM in 1992 as in the past. Reference materials for reactor neutron dosimetry and for nuclear safeguards measurements and inter-laboratory 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.

At ISEI, a new type of optical interferometric laser holographic technique has been developed for non-evasive evaluation of composite structures, which have large surfaces (e.g. monuments, aircraft, civil structures - bridges, etc.).

The most important achievement in the field of the measurement and testing programme is the completion of the European Laboratory for Structural Assessment (ELSA) for structural dynamics studies with full scale models of buildings and structures. To optimise the use of this unique facility, several research Institutes have been grouped in an association, and integrated European programmes are being established. In particular, a programme of pre-normative research is foreseen to support the setting-up of harmonised construction standards in Europe.

- **The Environment Protection** programme consisted of research projects executed by the Environment Institute (EI) on atmospheric pollution, and on soil, water and waste pollution. 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 by the Institute for Systems Engineering and Informatics (ISEI).

As a contribution to the global change programme, the Environment Institute (EI) has been active in a new European project on Biogenic Emissions in the Mediterranean Area (BEMA). This project aims to assess the amount and fate of vegetation emissions and their rôle in the tropospheric ozone formation processes in comparison to anthropogenic emissions. The Institute for Remote Sensing Applications (IRSA) contributed to the programme by the development of remote sensing based approaches for the study of the terrestrial and marine biospheres, with particular emphasis on changes in vegetation distribution (e.g. biomass burning) and regional and temporal variations of sea surface temperature and biological activity.

In addition atmospheric tracers have been utilised in in-field campaigns in the Alps to study the diffusion of atmospheric pollutants. A European Scale Experiment (ETEX) has been initiated, in collaboration with international and national organisations, to evaluate the real time response of atmospheric models used for emergency management.

During the 1991-1992 European Arctic Stratospheric Ozone Experiment (EASOE), the Environment Institute acted as a network station of the observing system implemented to prepare synoptic maps of the ozone levels.

Advanced techniques of remote sensing are being evaluated such as imaging spectrometry. High spectral resolution sensors have been shown to provide information on specific elements of interest, such as lignin and moisture content, which cannot currently be obtained with existing sensors.

The European Microwave Signature Laboratory, the largest civilian facility of its type in the world for undertaking spectral signature research has been inaugurated on 21 April 1992. The objective of this laboratory is to undertake research in preparation for future spaceborne missions relying on observation techniques which are weather independent,

The Facility for Investigating Runaway Events Safely (FIRES) aimed at studying the safety of batch chemical reactors is operational at IST. In this facility the nitration of toluene has been investigated as a typical case of chemical processes that might lead to severe accidents.

The setting-up of a Centre of Earth Observation (CEO) is being examined by ISEI, IRSA and EI; the main objective of the Centre could be to provide an efficient decentralised network for the full exploitation of the earth observation data including those obtained by spaceborne sensors. A feasibility study, headed by the JRC, is ongoing; a decision on how to proceed will be made by the Board of Governors by mid 1993.

- **The Nuclear Fission Safety** programme encompassed a number of research activities ranging from reactor safety and nuclear waste executed by the Institute for Safety Technology (IST), to research activities in nuclear safeguards and fissile materials management, executed by the Institute for Safety Technology and the Institute for Systems Engineering and Informatics (ISEI), and to research activities on nuclear fuels and actinides executed by the Institute for Transuranium Elements (ITU).

The reactor safety activities at IST have continued with the study of severe accident phenomena in nuclear power plants. Fission products and aerosol transport were studied via the participation in the international PHEBUS-Fission Product programme (fission product release in the containment) at CEA (Commissariat à l'Energie Atomique) Cadarache and in-vessel phenomena were analysed by the FARO (Experimental Facility for Fuel Melting) test programme at Ispra.

The Performance and Training Laboratory on Nuclear Safeguards (PERLA) was put into operation. The number of training and calibration exercises in support to Commission policy, related to nuclear safeguards, continued to grow (support to the IAEA and to the Euratom Safeguards Directorate), demonstrating the relevance and necessity of the facility.

In the area of nuclear safeguards techniques at ISEI, the Laboratory for Surveillance and Containment (LASCO) became fully operational in 1992 and started to test, at real scales, new containment surveillance technologies (optical, robots, etc.).

The Institute for Transuranium Elements (ITU) contributed to the safety of nuclear fission. Particular attention was given to the effect of water intrusion into spent fuel during their storage in repositories, and to basic aspects of the nuclear transmutation of long-lived radioactive waste constituents into products with comparatively short half-lives.

The measurement of nuclear fuel properties at temperatures that might occur in a hypothetical reactor accident involving core melt-down was concluded with a study of the specific heat of uranium dioxide up to 8000°C.

- **The Fusion Technology and Safety programme** is executed by the Institute for Safety Technology, (IST) the Institute for Systems Engineering and Informatics (ISEI) as well as the Institute for Advanced Materials (IAM).

Commissioning of the European Tritium Handling Experimental Laboratory (ETHEL) has continued. Work has also commenced on the preparation of experiments aimed at improving containment and the safe handling of tritium.

The IAM is studying the properties of materials used in components of future fusion reactors. Experiments on He implantation in fibre reinforced SiC and thermal cycling tests on first wall elements have been performed.

Various computer packages are being developed by ISEI to model physical phenomena within the reactor and a facility to simulate remote handling procedures has been built.

Progress made in the execution of these programmes is reported in more detail in Chapter 2, dedicated to the activities of the JRC Institutes.

1.2 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 the scientific management of projects or contracts,
- scientific and technical support in drafting and implementing EC legislation.

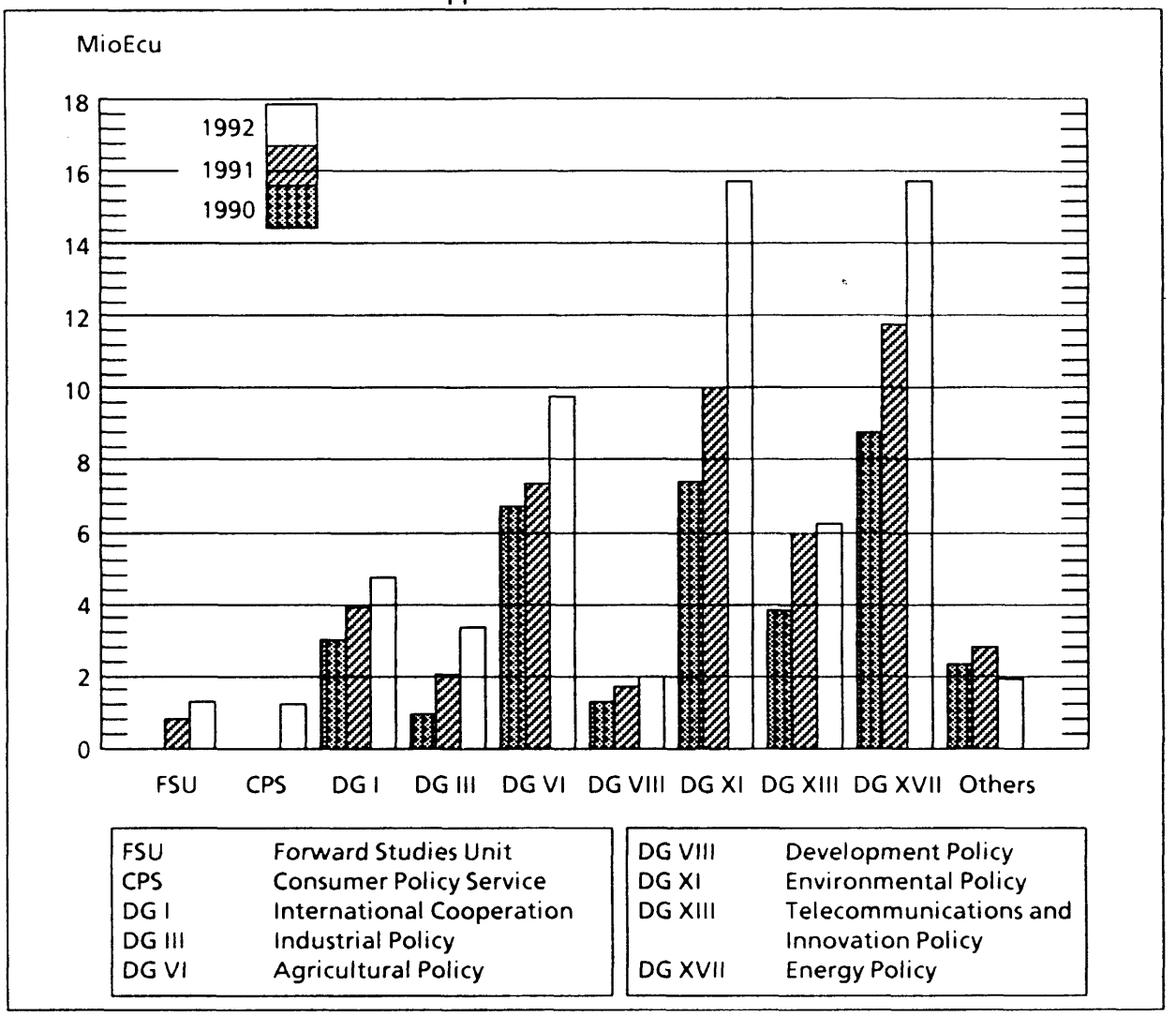
In 1992, JRC scientific and technical support accounted for 22% of the JRC budget, compared with 19% in 1991, 15% in 1990, 13% in 1989 and 10% the year before. Figure 1 shows how this support was divided amongst the various Community policies.

During the year a number of multi-annual agreements have been signed by the Director General of the JRC with other Directorates 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.

Practically more than 88% of all operations were covered during the year by an Inter-DG multi-annual contract, a Council Decision or a Commission Decision, with the remaining part executed in response to more urgent requests from Commission Directorates General.

Figure 1

S/T Support to Commission Services



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

Most of the work undertaken deals with the following tasks:

nuclear energy:

- training of inspectors, providing state of the art equipment, reference analyses of nuclear materials samples and technical support to the Euratom Safeguards Directorate,

non-nuclear energy:

- 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.

- **JRC support for the Environmental policy**, which accounts for 25% of the scientific and technical support budget, provides DG XI with scientific and technical assistance in the drafting and the implementation of legislation on chemical pollutants, atmospheric pollution, water quality, chemical waste, industrial risks and major accidents. This work is part of the EC Action Programme in the field of the Environment and includes the following actions:

  - Work with chemical pollutants deals mainly with S/T support to EC Programmes and Regulations in the field of chemical control for two EC Directives, 67/548 and 79/831/EEC;

  - Atmospheric pollution support concerns the implementation of EC Directives 80/779 and 85/203/EEC on air quality (SO_2, NO_2, photochemical oxidants);

  - Support in the management of waste is offered with the co-ordination of a group of independent experts for the preparation of the European Waste Catalogue (Directive 91/156/EEC);

  - Work on major accidents supports the implementation of EC Directive 82/501/EEC, and the investigation of hazards of certain industrial activities such as processing and storage installations for hazardous chemicals;

  - ECVAM, a new laboratory for the validation of alternative testing methods (alternative to animal testing) for the evaluation of drugs and cosmetics is being set-up and development of the programme activities started.

- **JRC support for the Common Agricultural Policy**, which accounts for 15% of the scientific and technical support budget, covers mainly three research areas:

  - the application of remote sensing to agricultural statistics where the aim is to develop and demonstrate, up to the semi-operational level, 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 of 26.9.1988),

  - support to operational applications in establishing registers of inventory control systems in agriculture, using either airborne or spaceborne 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 (EEC Regulation No 2048/89 - Art 16).

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

1.3 JRC Work for Third Parties

Third Party Contract Work continues to grow. The total volume of work ordered from the JRC during 1992 reached the level of 9 MioEcu.

Table 1 shows the evolution of the execution (amounts invoiced and payments received) of Third Party Work ordered during the past period 1988-1991. The volume of work, still to be executed at the end of 1991, to implement the order book accumulated during the period 1988-1991, amounts to 27.8 MioEcu (45.6 MioEcu - 17.8 MioEcu). Amounts invoiced, or work performed by the JRC in 1992 for these orders, passed during the period 1988-1991, amounted to 7.61 MioEcu, which represent 27.4% of the work which was still to be executed at the end of 1991.

Figure 2 shows the evolution of the new orders received by the JRC during 1992, which amounted to 8.9 MioEcu. Related figures for amounts invoiced and payments received were respectively 5.2 MioEcu and 2.8 MioEcu

Table 1

Execution of Work for Third Parties (MioEcu) ordered during the period 1988-1992

Year	1988	1988-1989	1988-1990	1988-1991	1988-1992
Order book	5.79	15.71	23.54	45.64	45.64
Amounts invoiced	2.77	6.04	11.17	17.83	25.43
Payments received	2.03	4.85	10.15	15.33	23.38

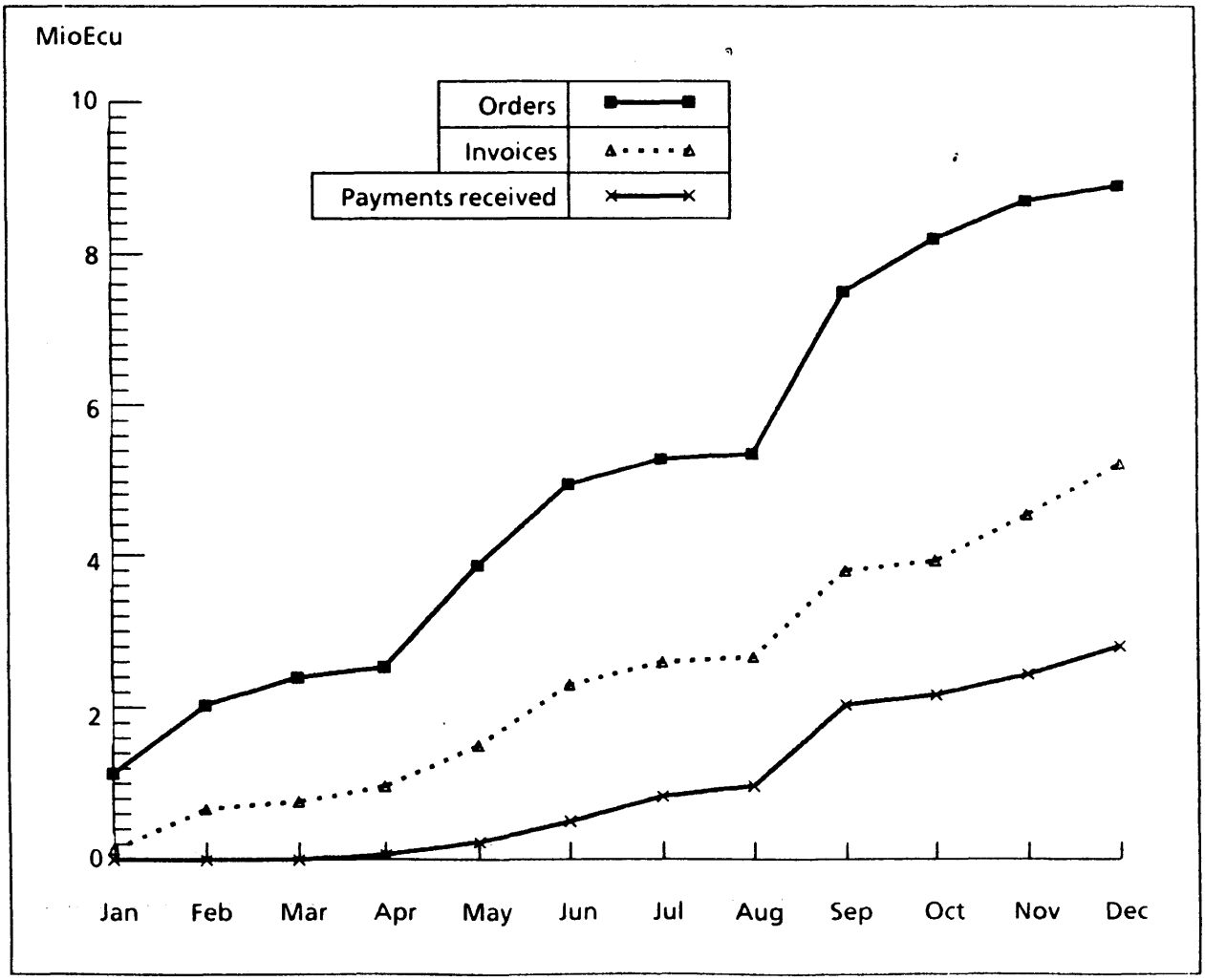
Contracts obtained so far show that all JRC Institutes are involved in Third Party Work; nevertheless two Institutes, IAM and ITU are far ahead in the winning of contracts.

Industry is the most important customer of the JRC, with 70% of the total Third Party Work provided by the JRC, while contracts with other research organisations or public administrations amount to 22% and 8% of JRC Third Party Work respectively.

Most EC countries are benefiting from JRC scientific expertise through Third Party Work; outside the EC, Japan, the USA and Canada are the main customers of the JRC.

Figure 2

JRC Work for Third Parties in 1992



1.4 JRC Exploratory Research

The selection and monitoring of exploratory research projects has been achieved in 1992 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. In order to enable the Institutes to steer their activities in a more direct manner, part of the resources has been put directly in the hands of these Institutes, while another part has been reserved for exploratory research on a competitive basis. The following exploratory research activities should be underlined, in particular:

- ITU is studying the main parameters, such as acoustic power, aerosol concentration and size, leading to the agglomeration of aerosols using ultra sound to improve the precipitation rate of current gas cleaning techniques;

- IAM executed various experiments using instrumented phantoms to verify computer models needed to predict the dose distribution within patients in preparation of Boron Neutron Capture Therapy at the high flux reactor in Petten;

- Experimental neural network software for image classification used to map land cover is being developed into an operational system by ISEI and IRSA. Improved techniques using significantly less computation time were applied to mapping land cover in Portugal for inter-comparison with existing databases;

- EI is developing a methodology, based on the use of pulsed, laser induced fluorescence, to analyse atomic and molecular species in gaseous samples by a single absolute measurement. The detection of HO radicals in the troposphere will be a possible application of this method;

- ISEI is assessing the potential of thin-film photovoltaic devices as window material for buildings. Performance evaluation tests for double-glass design, which allows to increase the efficiency by extracting heat from within the glass sandwich are being implemented.

1.5 JRC Participation in EUREKA Projects

The EUREKA initiative was set-up to raise, through closer co-operation among enterprises and research institutes in the field of advanced technologies, the productivity and competitiveness of Europe's industries and national economies on the world market, and hence strengthen the basis for lasting prosperity and employment. It involves 20 countries plus the Commission of the European Communities.

JRC participation in EUREKA (European Co-operation on Advanced Technology) continued in 1992 in the following projects:

- CEFIR (Ceramic European Fibre Research, EU 658), an initiative aiming at the production of European high temperature resistant ceramic fibres. The first stage was concluded by defining the needs and targets for European ceramic fibres and evaluating the prospects for European manufacture from the commercial and technological viewpoint (see para. 2.3);

- FORMENTOR (EU 19), related to the development of expert systems to support decision making in hazardous situations (see para. 2.4),

- EUROTRAC (EU 7), with the TRACT (Transport of Air Pollutants over Complex Terrain) subproject that uses artificial tracers for assessing the transport of atmospheric pollutants in the Alpine region; the BIATEX (Biosphere Atmosphere Exchange of Pollutants) subproject that aims to understand the rôle of biogenic emissions and deposition processes; and the LACTOZ (Laboratory Studies of Chemistry related to Tropospheric Ozone) subproject that evaluates, by

laboratory experiments, the chemical and photochemical transformation of atmospheric pollutants (see para. 2.6),

- EUROENVIRON (EU 330), with the TRACY (Toxic Metals in Human Tissues and Fluids) project (EU 618) which aims to develop a state base for toxic materials in human tissue and fluids and the mobile analysis laboratory project (EU 674) aiming at developing a mobile analytical laboratory for the in-field analysis of water, waste and soil (see para. 2.6),

- VISIMAR (Visualisation and Simulation of Marine Environmental Processes, EU 495), to monitor the marine environment.

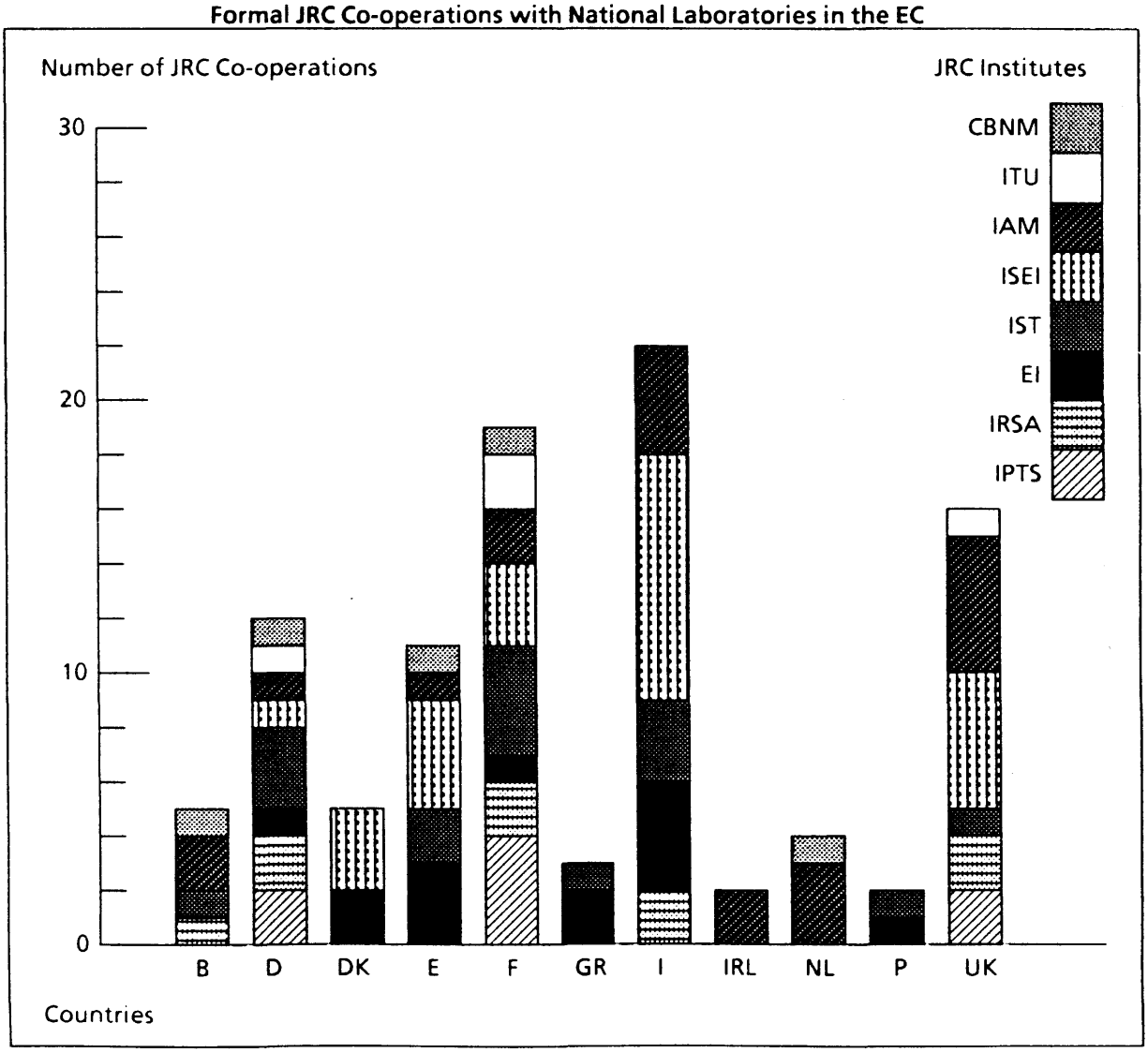
1.6 JRC Co-operation with Other Laboratories and Organisations

The JRC maintains many scientific relations, both formal and informal, with national laboratories and international organisations.

All of the JRC's Institutes have been able to extend their co-operation network during 1992. Figure 3 shows the number of formal co-operations with national research institutions in the EC. Apart from these collaborations the JRC is also expanding its network towards the EFTA countries and world-wide.

Figure 3

Formal JRC Co-operations with National Laboratories in the EC



2. ACTIVITIES OF THE JRC INSTITUTES IN 1992

This chapter outlines the activities of the Institutes of the JRC during 1992. Furthermore, a section is dedicated to JRC Publications and Eurocourses.

2.1. The Central Bureau for Nuclear Measurements (CBNM)

The CBNM, located in Geel (Belgium), is dedicated to the promotion of European Standards and the harmonisation of reference methodologies and materials. The Institute contributed to the Framework Programme line "Measurement and Testing" by executing its specific programme under the heading "Reference Materials and Measurements". It is engaged in support activities related mainly to nuclear safeguards at the request of the Directorate General for External Relations (DG I) in support to IAEA and of the Directorate General for Energy (Euratom Safeguards Directorate, DG XVII). It also provides reference materials to various customers. The scope of the activities of the Institute is steadily shifting from nuclear to non-nuclear fields, and from fundamental research to applications.

- **Reference Materials and Measurements**

CBNM is providing high quality reference materials for the calibration of analytical equipment in all stages of the nuclear fuel cycle and in the non nuclear field for BCR ("Bureau Communautaire de Référence"), with the aim of improving the reliability of chemical analyses and physical measurements.

In that context, the preparation, characterisation and certification of a number of nuclear and non-nuclear reference and spike materials continued. Several special reference materials for BCR were prepared, such as orange juice (sugars, aminoacids), pig liver (vitamins), fly ash (dioxines), soils (phenols, cyanides). Analytical work on metallo-proteins and heavy metal traces of environmental or clinical importance also continued.

The new ultra-clean chemical laboratory was completed and inaugurated in November. This laboratory provides an atmosphere with extremely low concentrations of dust and metals. Hence it is very suitable for low concentration trace determination in all kind of samples.

The accuracy in silicon atomic weight measurements could be increased by a factor of 10 to $3 \cdot 10^{-7}$. This result will be used to further refine the value of the Avogadro constant. Silicon has been selected because extremely pure crystals are available as a result of the advances in the semi conductor industry. Improving the accuracy of the Avogadro constant is a necessary prerequisite to improve the basic unit system in physics.

In the non-nuclear analytical Interlaboratory Measurement Evaluation Programme (IMEP), using isotopic specific measurements as a reference for toxic/essential element assay, the progress was as follows: for Cadmium in polyethylene the results were published, for trace elements in natural and synthetic water the results were under evaluation, and for iron in human serum certification has been finished.

In the frame of the EURACHEM (European Organisation for Metrology in Chemistry) activities, a first workshop on "Comparability and Traceability in Measurements of Amount of Substance" was initiated by CBNM and took place at the Institute in November.

Activities in neutron measurements for fission covered data on standards, structural materials and basic research.

- The neutron standards data set, to which other measurement can be referred, was further improved. Measurements were done of the ^{235}U fission cross-section, a measure for the probability of interaction, relative to the neutron-proton scattering cross-section in the neutron energy range from 0.3 to 2 MeV. Results on nuclear mass and charge distributions in

the cold region of the spontaneous fission of ^{252}Cf, which is a standard for fission studies, have been published;

- The study of neutron interaction with structural materials, a long-standing programme on resonance parameters, was concluded by complementary measurements of the total cross-section and of capture γ-ray spectra for ^{60}Ni and resonance parameter analysis of the total cross-section up to 800 keV;

- Basic research on measurements of the ^{239}Pu fission cross-section has been performed in the energy range from thermal to 1 keV, showing that the hitherto existing discrepancies were due to a normalisation problem. Fragment mass- and energy-distributions from the spontaneous fission of ^{244}Pu, and for the ^{237}Np fission reaction in the region of the threshold were studied. A search of shape isomers in ^{239}U and ^{233}Th, in the latter case with a positive indication, was completed.

In the context of fusion data double emission cross-sections for ^{207}Pb have been measured and earlier data on ^{9}Be (n, 2n) have been finally corrected for multiple scattering effects. High resolution transmission measurements on natural iron have also been started.

The EUROMET (European Organisation of Metrology Laboratories) project on the metrology of ^{192}Ir brachytherapy sources was finished. The Institute participated in a BIPM ("Bureau International des Poids et Mesures") intercomparison of the activity concentration measurements of a ^{75}Se solution and also in the standardisation of a ^{152}Eu solution and comparison with other laboratories through the "Système International de Référence" of BIPM.

The programme on radiation physics was continued at the CBNM's Linear Accelerator with measurements on transition radiation in the soft X-ray energy domain. Also several novel X-ray sources produced by electron beams were studied.

Nuclear methods are capable of detecting extremely low concentrations of light elements in near-surface regions. One of these methods, Nuclear Reaction Analysis, was applied in a study of the oxidation of aluminium implanted and non-implanted stainless steel samples at the 7 MV Van de Graaff Accelerator.

- **Community and External Services**

In Support to Services of the Commission the CBNM continued the preparation of a series of solid spikes for safeguards measurements which were supplied to the International Atomic Energy Agency (IAEA). Safeguards verification measurements were made according to the requests of the Euratom Safeguards Directorate of DG XVII. The analytical quality control programme co-ordinated by the Institute for all ECSAM (European Commission's Safeguards Analytical Measurements) laboratories continued. Results of the analytical measurements on mixed uranium plutonium oxide pellets, plutonium nitrate solution, spent fuel and synthetic input solutions were collected for evaluation.

Development and application of the isotopic fingerprint method which allows the identification of origin of some products or pollutants, have been started. Candidates for this analysis were sulphur in fossil fuels to detect environmental pollution, and carbon, oxygen and nitrogen in food and drugs, to prevent fraudulent actions.

The alpha-spectrum analysis code developed during the study of emission probabilities in ^{239}Pu could be provided to users in alpha-spectrometry research.

A special effort has been made in the field of neutron flux metrology including the preparation of neutron dosimeters. This work has concentrated on the activity determination after irradiation and the calculation of the neutron flux.

2.2. The Institute for Transuranium Elements (ITU)

The ITU, located in Karlsruhe, has expertise and unique equipment for property studies on nuclear fuel materials. It executes, within the Nuclear Fission Safety Programme, research on the Safety of Actinides in the nuclear fuel cycle; it also contributes to research on Reactor Safety and on the management of Radioactive Waste. ITU provides scientific and technical support to nuclear safeguards upon the request of the Directorates General for External Relations (DG I) and for Energy (DG XVII). In addition, the Institute is engaged in a number of important contracts at the request of the nuclear industry.

- **Safety of Actinides in the Nuclear Fuel Cycle**

The Institute continued its research on the behaviour of nuclear fuels at high burn-up and under off-normal working conditions to provide information on possible extensions of their operation limits. In this context the study of specific structural features which may limit the fuel lifetime has been extended to the so-called "rim effect", a region of increased porosity at the periphery of the fuel.

Mixed nitride fuels can now be fabricated according to current safety requirements, and nitride irradiation tests and post-irradiation examinations are under preparation (in collaboration with the "Centre d'Etudes Nucléaires" of Cadarache and HFR Petten).

The results of measurements of the specific heat capacity of uranium oxide fuel, at temperatures up to 7000 K, were analysed. Mathematical models of fuel rod behaviour under transient and steady state conditions were further refined. The models will contribute to the improved prediction of the fuel behaviour.

Fission gas release from UO_2 was investigated by annealing irradiated fuel segments and by systematically comparing release rates at different heating modes, under various atmospheres and at different burn-ups. The international fission gas release project RISØ III was concluded, and the contributions of the Institute were summarised in various reports.

Studies on transmutation were continued in order to assess its technical feasibility. A continuation of the collaboration with CEA Cadarache on the development and testing of minor actinide containing fuels (oxides) was established. In the field of partitioning, work on the properties of extraction agents for actinides was started using centrifugal extractors and genuine high-level waste. Efforts to improve the safety of handling radioactive materials were continued.

- **Characterisation of Radioactive Waste**

Leaching studies were continued with UO_2 and with fuel with simulated burn-up. The surface state of UO_2 in the presence of water was studied in detail; the composition and thickness of leached layers were measured. While previous leach tests were carried out under dynamic conditions, further testing was performed under static conditions in autoclaves at 200°C in order to quantify the influence of the environment (liquid or gaseous) and of oxidising conditions on the leaching mechanisms.

Modelling the interaction of steam and water with spent fuel in an underground waste repository was continued.

- **Basic Studies on Actinides**

A new family of actinide compounds of the composition $An_2Me_2Me^*$ was discovered, synthesised and characterised. Equipment for the preparation of high-purity Am and Cm on the hundred gram scale was set-up. The synthesis of quasi crystalline uranium compounds was attempted.

Equipment for determining magnetic and transport properties and for Mössbauer spectrometry on actinide samples was commissioned.

Close collaboration with external scientific institutions involved exchange of staff and samples. These collaborations included magnetic and electrical measurements, neutron scattering experiments, and the use of synchrotron radiation for the diffraction, absorption and the magnetic scattering of X-rays on actinides and actinide compounds.

- **Community and External Services**

The robotised reprocessing input analysis equipment, which the ITU had developed for and installed at the Gatchina reprocessing plant in Russia undergoes field testing. The results of the first field test were evaluated and compared with those of parallel tests performed at the IAEA Seibersdorf laboratories (SAL) and at the ITU Karlsruhe. A bias of the order of 1% was observed between the Gatchina plant results on the one side and the SAL and ITU results on the other side, which could be explained by the spike calibration procedure employed in Gatchina.

Analytical support was given, upon request, to the Euratom Safeguards Directorate (DCS) in Luxembourg. It consists of analysing samples which have been taken by inspectors at different nuclear installations within the European Community. The instruments employed by DCS at the various installations have been modernised according to the state of the art. An expert system for quality assurance was further perfected and tested. Components of a glove box for sample titration including auxiliary preparatory steps have been developed.

The prototype equipment of a laboratory for on-site safeguards analysis, at the Sellafield reprocessing plant, has been assembled and is being tested. Some equipment related to non-destructive test are still to be provided. A team of twelve inspector analysts is presently being trained.

Major work for external contractors concerned the continuation of the preparation and characterisation of minor actinide containing alloys and the preparation of their irradiation in a fast flux reactor. Fuel rods from commercial light-water reactors subject to an elevated burn-up were analysed. Investigations to produce monoclonal antibodies tagged with short-lived radio isotopes for cancer therapy were continued. All in all, new orders for third parties amounted to 1.5 MioEcu, which represents 5.2% of the Institute's budget in 1992.

- **Exploratory Research**

The investigation of the transport of large aerosol particles in ducts and chimneys performed as exploratory research helped to clarify aerosol transport mechanisms under conditions of turbulence. A system with a combined electro-acoustic precipitator for particle agglomeration was characterised and successfully tested with glycol aerosol.

2.3 The Institute for Advanced Materials (IAM)

With sites at both Petten and Ispra, the IAM executes the specific programme on Advanced Materials and exploits and operates the High Flux Reactor for the Dutch and German authorities. The Institute is engaged in various support activities and in particular in pre-normative research related to standards and codes. The Institute also expands considerable effort to attract and execute work on a contractual basis for industry. During 1992 the Institute for Advanced Materials concentrated its effort on the research areas of materials for extreme environments, reliability and life extension, surface modification technology and fusion materials.

- **Materials and Measurements**

Important observations were made in the formulation of failure mechanisms for coated and uncoated single crystals of Ni based alloys used in aero-engines in close association with aerospace industry.

Two surprising results were obtained in the frame of the fusion materials studies. The first experiments on He implantation in SiC/SiC has shown that, against any expectation, even quantities as high as 1000 parts per million did not produce any visible damage to the material. If this positive

result can be confirmed by more sophisticated investigations, one of the major restrictions for the applicability of SiC/SiC in fusion reactors would be overcome.

The thermal cycling tests on first wall elements demonstrated that the base material can easily undergo the requested number of cycles. Weak points, however, were observed in the brazings, where cracks nucleate and propagate and finally penetrate the base material.

In the Surface Modification Centre thermal shocks on thermal barrier coatings were simulated by using electron beams and laser. The successful investigation of a wide range of materials has created a knowledge base for attracting contracts from industry.

Plasma spray coatings for the corrosion protection, of high temperature turbine blades have been developed and exhibit improvement in oxidation resistance. These results are of importance for the transport and power industry.

In a joint venture with ECN, the Advanced Coating Centre has work in progress on coating continuous fibres for reinforcing composites.

In addition, a laser-spallation facility was set up to measure the adherence of coatings to substrates. In this technique, the shock wave induced by a laser pulse is used to detach the coating. Measurement of the amplitude of the shock wave and of the vibration of the specimen surface provides the input data for a finite element model from which the adhesion strength is calculated.

In a contribution to engineer the micro-structure of structural ceramics on a submicron scale, nanocrystalline Yttria (Yttrium oxide) was developed to coat Zirconia ceramic powders. A chemical technique provided the starting materials with the fine scale control composition.

The EUREKA-CEFIR project, co-ordinated by the Institute, has achieved the primary objectives of the first stage Definition Phase. The project, which includes 22 Industrial Partners and 24 Research Institutes, has defined the needs and targets for European ceramic fibres and has evaluated the prospects, both from technological and commercial viewpoint, for their European manufacture. The decision to commit the necessary resources for long term research turns upon the perception of the strategic vulnerability of the European aero-engine industry. The leading industries of the project have prepared an R&D working programme, on a European-wide scale, in order to allow this project to proceed to a full implementation phase.

The Institute for Advanced Materials catalysed European interest and actions on joint efforts in developing inter-metallic materials for structural applications. This year a concerted action has been agreed under the BRITE/EURAM programme, in which the Institute participates as one of a large number of European laboratories.

A concept for a European Association for pre-normative research of engineering and constructional materials has, under the guidelines of IRDAC (Industrial Research and Development Advisory Committee), been formulated in association with national standards organisations and CEN ("Comité Européen de Normalisation"). The aim of the Association will be the promotion of pre-normative research of materials leading to European standards. The work will be executed in a decentralised mode.

- **Community and External Services**

The Scientific/Technical Support to Commission Services encompassed in 1992 activities in:

- pre-standardisation of advanced ceramics and pressure vessels and analysis of the rôle of materials in the competitive position of the European aeronautics industries for DG III,

- materials R&D implications in environmental problem areas and quality protocols of radio-pharmaceuticals for DG XI,

- the valorisation of patents and licenses for sensors, ultrasonic transducers and passive downwards heat transfer for DG XIII.

The Institute for Advanced Materials maintained its position for third party contract work in the field of materials and experienced a significant increase in contracts for the production of isotopes, used in medical and industrial applications, and for the irradiation of structural materials. New orders for third party work earned by IAM during 1992 exceeded 5 MioEcu, which amounts to 10% of the 1992 budget of the Institute.

The Institute for Advanced Materials initiated two pan-European collaboration projects, both building on the experience gained during the past 15 years in the PISC (Programme for the Inspection of Steel Components) Programme:

- AMES: European Network on Reactor Pressure Vessel Embrittlement and Annealing,

- EBIQ: European Bureau for Inspection Validation or Verification.

- **High Flux Reactor**

The High Flux Reactor at Petten was operated during 1992 according to schedule. The availability was near to 100% of the scheduled operation time. The utilisation of the irradiation positions was between 60% and 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 fusion applications.

Radioisotope production services for the medical sector and industrial applications have markedly increased again. The new facility for Boron Neutron Capture Therapy has been used intensively for investigating the preconditions for the treatment of patients.

2.4. The Institute for Systems Engineering and Informatics (ISEI)

ISEI, based at Ispra, executes some parts of the specific research programmes on Working Environment, Measurement and Testing, Environment, Nuclear Fission Safety and Fusion. The Institute executes several activities in Support to the Community Policies and it is engaged in exploratory research and in Third Party Work.

- **Working Environment**

In the field of accident prevention and safety, the cognitive model COSIMO (Cognitive Simulation Model) has been fully documented and a first set of field studies for the development of a model of "stress" and of "temporal reasoning" affecting decision-making has been carried out. A prototype of a system response generator aiming to analyse human decision-making during accidents has been set up. The Human Error Analytical Taxonomy (HEAT) project has completed the phase of audits on past accidents.

- **Measurement and Testing, Environment**

In the field of reliability modelling of structures various surface characterisation and profiling techniques have been applied and tested on stone specimens. In the field of pre-normative research on optical diagnostic techniques, main developments were on:

- Double exposure and real time holographic interferometry, which has been successfully applied to evaluate the deformation state of stone material;

- Software tools to obtain three dimension deformation profiles from interferograms and three dimension surface maps from contouring images.

In the field of pre-normative research on photovoltaic conversion systems, performance measurements for advanced devices and thin film reliability test procedures have been developed. An experimental performance assessment of large area transparent modules has been carried out as a part of the integration of photovoltaic systems in building facades.

The following four main contributions were made in the pre-normative research areas on methods and software for risk assessment and environmental planning:

- The STARS (Software Tools for Analysis of Reliability and Safety) code is ready for use.
- The second phase of the FORMENTOR project was completed; applications have been carried out, one on a chemical process plant and one on a satellite ground system.
- A directory of models has been established in the emergency management area.
- Two decision support systems for environmental planning have been implemented; a computer package for decision support on transport of hazardous goods has been finalised.

- **Nuclear Safeguards, Nuclear Fission Safety and Fusion**

Nuclear Fission Safety, Reliability and Risk Assessment: a study of the informatics structure of an object-oriented data base to record all event types occurring in a specific plant has been performed, with a view to its implementation in STARS. A tool for dynamic reliability analysis, DYLAM (Dynamic Logic Analytical Methodology) has been developed. A pilot study related to accident management, based on the system response analyser concept with a simple human behaviour model, has been worked out to be used in severe nuclear accident management.

In *Structural Reliability* the campaign of thermal shocks on a pressure vessel nozzle corner, where a crack has been induced by mechanical fatigue, has been completed and the results have been used to validate theoretical models adopted in licensing procedures.

Safeguards and Fissile Materials Management: the data base of the European R&D Safeguards activities (ESTABANK) has been updated. The software for the control of the robot vehicle for remote surveillance has been developed. The software for a new family of image processing systems allowing real time application has been developed. A series of software packages for verification and processing of ultrasonic seal signatures has been developed. The installation of the LASCO storage facility and the instrumentation for monitoring and surveillance are underway and the facilities to test the components are operational.

Nuclear Fusion: the feasibility study on an attaching lock system ("Twin-belt") for the Next European Torus (NET) chamber has been concluded. The concept is considered as becoming an option for the future International Thermonuclear Experimental Reactor (ITER). A test-rig for the validation of models to deal with electromechanical effects of plasma disruptions on the Torus internal surface has been installed. The facility (ROBERTINO) for testing remote operation procedures on models (Scale 1:3) of the inner components of the fusion reactor became operational during 1992. In the area of safety, analyses of accidents which could stem from the loss of active cooling system (loss of electrical supply) have been carried out.

- **Community and External Services**

In support of DG I, on nuclear safeguards for the IAEA, a system of reviewing and image processing for the remote surveillance of nuclear fuel storage areas has been performed. Demonstration to IAEA inspectors of the use of sealing bolts on spent fuel containers has been made. A new laboratory (TAME) for the calibration of mass and volume measurements has been established and it is now being used for training purposes.

Specifications to implement a co-ordination centre for an aircraft incident reporting system have been defined and software/hardware is being procured at the request of DG VII.

In support of DG XI in the field of major accidents, the design of the Community Documentation Centre on an industrial risk informatics system has been completed and the new data base of the major accident reporting system has been defined. A Community documentation centre for biotechnology safety and regulation (BIOSAFE) has been constituted. The civil protection pilot information system has been put into operation.

For DG XIII a remote sensing software package named SPACE has been implemented. In the frame of the VALUE (Valorisation and Utilisation for Europe) programme, a transputer parallel system for real time image acquisition has been completed and the ray-tracing technique improved.

For DG XVII the support to the THERMIE ("Technologies Européennes pour la Maîtrise de l'Energie") programme has been pursued by the analysis and evaluation of new photovoltaic and solar thermal demonstration projects (a total of more than 70 projects was evaluated). A number of proposals in the sector of buildings and transport has been also analysed. In the area of nuclear safeguards a computer aided system station for reviewing computer aided video surveillance tapes has been developed. Tests on ultrasonic sealing bolts have been performed. Work on accounting and data management has been pursued.

Statistical applications of artificial neural networks progressed in support to EUROSTAT. As a support to the Secretariat General of the Commission an information system to centralise and analyse information on the prevention of frauds was under development.

For Third Party Work, calibration and certification tests as well as assistance tests on new photovoltaic devices have been performed in the ESTI (European Solar Test Installation) facility under contract with various organisations. Contracts have also been won in the areas of risk assessment and nuclear safeguards. Computer aided engineering work in support to industrial projects has also been executed.

- **Exploratory Research and International Co-operation**

Exploratory research has been carried out in the areas of neural networks for teleoperated vehicle navigation and image classification for land cover mapping, as well as of thin photovoltaic devices in buildings.

2.5. The Institute for Safety Technology (IST)

Located at Ispra, the IST contributes to the Measurements and Testing, the Nuclear Fission Safety and Fusion, and to the Environment Programmes. 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 (DG I) and Energy (DG XVII).

- **Reactor Safety**

The programme on Reactor Safety is focused on the study of severe accident phenomena which is an area where public perception of risk is high and international co-operation is very important. The activities related to the JRC FARO and the joint CEA-JRC PHEBUS Fission Products programmes are absorbing the largest part of resources. Concerning FARO, the first tests on molten fuel quenching in water, simulating on a large scale in-vessel phenomena during severe accidents, have been successfully carried out.

In relation to PHEBUS the preparation work for the first test involving fuel melting and release of fission products in a simulated reactor containment has been completed with IST staff contributing in the setting-up of test instrumentation and in the qualification/documentation of test data. In addition benchmark exercises have been mounted to stimulate participation of European partners. The ESTER (European Source Term Research Code) computer code package is being developed by IST, in co-operation with many other institutions, and is designed to be the European best estimate tool

for the modelling of the source term in severe accident calculations. A first pilot version of ESTER has been released for testing to the European partners.

- **Fusion Technology**

The construction of ETHEL, the European Tritium Handling Experimental Laboratory, has been completed. The principal objective of its research programme is to assess the tritium propagation modes and transfer pathways and to validate new protective barriers for achieving an improved confinement of tritium under normal or accidental conditions, and thus to minimise subsequent dilution and dispersion into the environment.

Provided with unique test equipment in the form of two "climate chambers" ETHEL is especially suited to validating the large scale plant performance of dynamic containment barriers. This represents an important source of necessary information in support of designers and regulatory authorities for ITER.

In the frame of the co-operation between IST and the Kernforschungszentrum Karlsruhe, Germany, a workshop and several topical meetings have been organised to present and discuss progress achieved in TLK (Tritium Laboratory Karlsruhe) and in ETHEL, as well as preparatory research activities for both installations.

- **Working Environment**

The expertise in computational fluid dynamics has allowed the IST to contribute to a new research programme in the field of ventilation and pollutant transport modelling. The first step was the development of a turbulence model to be included in a three dimension finite element code.

- **Measurement and Testing**

The new reaction wall facility, named ELSA (European Laboratory for Structural Assessment), started operation in May 1992 with the preparation and execution of experiments at large scale in view of checking the proper functioning of the servo-hydraulic equipment and the implementation of the pseudo-dynamic test method. A 3-storey steel frame with concrete-slab floors has been constructed, instrumented for pseudo-dynamic testing and tested under simulated earthquake loading. On October 16, 1992, ELSA was inaugurated with the participation of the Commission's Vice-President Pandolfi and some 300 representatives from industry and national research organisations.

As a part of the ongoing research in collaboration with the European Association of Structural Mechanics Laboratories, a 4-storey reinforced concrete structure has been designed according to Eurocode 8. It will be tested in early 1993.

- **Industrial Hazards**

The focus of this work is on the assessment, improvement and harmonisation of safety methodologies. The FIRES facility for studying the safety of batch chemical reactors has become fully operational, and typical incidents regarding the nitration of toluene have been investigated.

The MPMC (Multi-Phase Multi-Component) venting facility continues to produce results of industrial relevance and is now being directed towards large scale studies. Experimental data and design methodologies have contributed to a number of international working groups (ISO/Technical Committee 185, DIERS -Design Institute for Emergency Relief Systems and DECHEMA - "Deutsche Gesellschaft für chemisches Apparatewesen, chemische Technik und Biotechnologie, e.V").

In the field of dense gas dispersion, a three-dimensional computer code is under validation, and a one-dimensional shallow layer model is near completion.

- **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.

The assessment of Non Destructive Assay (NDA) techniques' performances, the calibration of instruments, and the characterisation of standards continued as the principal activities in the field of nuclear safeguards.

Together with the new TAME facility (an industrial size volume calibration and measurement laboratory for reprocessing plants, installed and set to operation this year) the PETRA facility (a set of installations representative of the whole back-end of the nuclear fuel cycle) is now available at IST representing a unique opportunity for the integrated development and assessment of techniques and concepts for the fission fuel cycle safety control in support of the Commission's and IAEA obligations in nuclear safeguards.

In response to the first call for proposals launched by the Human Capital and Mobility (HCM) Programme, the setting-up of a co-operation network involving 19 European laboratories has been proposed. This has the aim of covering, through experimental and analytical investigations, the priority needs for pre-normative research in support of Eurocode 8 identified by the Directorate General of Industrial Affairs. The ELSA facility has also been included in the "Access to Large Installations" sub-programme of the HCM Programme, with two groups of users already identified.

The international interest and participation in the FARO programme is increasing. USNRC (United States Nuclear Regulatory Commission) has extended the agreement with IST to include also the small scale fuel-coolant interaction tests under way in the KROTOS facility.

- **Exploratory Research Activities**

IST is engaged in the execution of exploratory research in various areas, i.e. radioactive waste (transmutation of actinides, plutonium waste measurement), materials investigations (high temperature crucibles, stress-strain diagram of brittle materials, new zeolite substrates for gaseous off-gas treatment), and computer modelling activities (chemical reactors control, aerosol transport, engineering programming).

2.6. The Environment Institute (EI)

The EI, based at Ispra, contributes to the Environmental Protection Programme and to the Working Environment Subprogramme. The Institute is engaged in several support activities at the request of various of the Commission's services, mainly for the Directorate General for Environment, Nuclear Safety and Civil Protection (DG XI).

- **Environmental Chemicals**

The Environment Institute has been actively involved in the biomonitoring of trace metals to assess the occupational exposure to "newer" metals (Pt, Ge and Rare Earths) used in high technology processes (electronics industry, catalytic converters, energy production).

A second updated compact disc version of the ECDIN (Environmental Chemical Data Information Network) data bank on environmental chemicals has been delivered.

The former COST ("Cooperation Scientifique et Technique") action "Indoor Air Quality and its Impact on Man" has been transferred as a European Collaborative Action (ECA) to the JRC Environment Programme activities. Experts from 14 laboratories from different European countries are contributing to the development of harmonised methods for indoor investigations and assessments.

A large walk-in type environmental test chamber for investigations in indoor emissions has recently been installed at EI and will be made available to ECA.

The work in the EUREKA project TRACY, where the objectiv is to collect and evaluate the published information concerning trace metals in human tissue and fluids, continued with the establishment of the criteria for the evaluation of publications, the definition of the procedure for evaluating each element and the evaluation of publications concerning Cd, Cr, Co, Ni, Pb and V.

- **Atmospheric Pollution**

In the field of biospheric/atmospheric interactions, the BEMA (Biogenic Emissions in the Mediterranean Area) project aimed at clarifying the rôle of vegetation emissions in the Mediterranean basin has been set-up in collaboration with 15 European laboratories and the Directorate General for Science, Research and Development. A BEMA Operational Plan Group has been appointed in order to develop an operational plan for the in-field measuring campaign to be performed in 1993 at the BEMA test site at Castelporziano (Rome).

Chemical aspects of the marine sulphur cycle and its impact on the radiative properties of the atmosphere due to the formation of aerosols were investigated in the laboratory and by modelling studies. A ship measurement campaign across the North Atlantic was organised in collaboration with the Institute for Remote Sensing Applications.

Laboratory studies on the night-time oxidation of organics, with special reference to the biogenic isoprene, were carried out in the frame of the EUREKA/EUROTRAC project in view of assessing the chemical transformation of atmospheric pollutants.

In the framework of the same project, the final experiment on the transport of the atmospheric pollutants over complex terrain of the TRACT subproject was carried out. The JRC participated with a tracer experiment to study the air flow patterns of the experimental site (the Rhine valley). Two perfluorocarbon tracer releases were undertaken, with the collection of over 600 air samples, both at ground level, and using special aircraft.

During the 1991-1992 European Arctic Stratospheric Ozone Experiment (EASOE), the Environment Institute acted as a network station of the ground based observing system set-up to provide, on a daily basis, maps of the total ozone fields over Europe and the Arctic.

- **Soil, Water and Waste Pollution**

The large-scale verification of laboratory-derived models for contaminant spreading in terrestrial and aquatic systems has been started: a new technique for tracing ground-water movement has been tested in a fractured rock formation and discrepancies between laboratory and field observation of trace metal diffusion in clays solved in terms of different chemical reactivities.

New analytical procedures have been developed and applied in the study of the fate of persistent organochlorine pollutants in terrestrial and lacustrine ecosystems.

Analytical protocols for algal samples have been set up and reports on experimental campaigns in the Mediterranean Sea, to evaluate the innovative methods for phytoplankton analysis, drawn.

In the framework of the EUREKA project EU-674 (mobile analysis laboratory) the units have been ordered and delivery is foreseen by the end of February 1993. All the instrumentation is ready to be installed.

- **Community and External Services**

The Environment Institute provided scientific and technical support to several of the Commission's 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 XXI (Customs Union and Indirect Taxation), and CPS (Consumer Policy Service), DG XIII (Telecommunications, Information Industries and Innovation).

To highlight a few examples of the work done:

- intercomparison programmes organised and jointly managed by the JRC and LIS (Landesanstalt für Immissionsschutz, FRG) on NO_2 calibration standards implemented in the Member States at Central Laboratory level (EC Directive 85/205), and by the JRC and NPL (National Physical Laboratory, UK) on volatile organic compounds measurement techniques (new Directive on tropospheric ozone) in support to DG XI,

- preparation of the hardware and software for the EC Urgent Radiological Information Exchange System (ECURIE), including the transmission of radiological information undertaken in Support to DG XI,

- The Institute has assumed responsibility, at the request of DG XI, for the new EUCLID (European Chemical Information Database) data bank which is the central tool for the implementation of the Council Regulation on the risk evaluation of existing chemicals (to be adopted in March 1993). In addition EI is preparing a European Waste Catalogue to classify different types of waste;

- Work has continued for DG III on the development of the European pharmaceutical data bank (ECPHIN);

- A NMR Reference Laboratory for the sugar control in various wines was created for DG VI;

- The microbiological control of specific chemical compounds in food and cosmetics was undertaken on behalf of the CPS (Consumer Policy Service)

- The Institute continued to support the DG XI Task Force on the European Environment Agency.

In collaboration with the World Meteorological Organisation and the International Atomic Energy Agency a new project, entitled ETEX (European Tracer Experiment) has been initiated. The project aims to verify the quality of atmospheric models when used in real-time conditions, as required for emergency management in case of large accidents. The project also includes Central and Eastern European countries.

In the frame of a research contract sponsored by the Polish Ministry of the Environment, a measurement campaign for the evaluation of the transboundary transport of SO_2 and NO_2 across the Brama Morawska region was performed.

The Institute is working under contract with several regional and national administrations in the fields of air and water pollution and in the collection of data for priority chemicals.

2.7. The Institute for Remote Sensing Applications (IRSA)

Located at Ispra, 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 for Agriculture (DG VI) and the European Statistical Office (EUROSTAT); it also provides scientific and technical support at the request of the Directorates General for External Relations (DG I), Development (DG VIII), and Environment, Nuclear Safety and Civil Protection (DG XI).

Within the programme on the Application of Remote Sensing Techniques IRSA has undertaken work on a number of themes related to monitoring the environment and to participating in global change activities.

- **Environmental Monitoring In Europe**

The Collaborative Programme between remote sensing laboratories for the development of remote sensing techniques to monitor less favoured areas of the European Community, has completed its second phase. The Collaborative Programme will now be transformed into a project on integrated ecological mapping focusing on less favoured areas within the EC, with a smaller number of themes such as high accuracy forest and grassland ecosystem maps.

In support of these activities new techniques for data interpretation were further developed, including such techniques as neural networks, expert systems, integrated geographical information systems and automatic image segmentation.

The land use mapping and inventory experiment for Mediterranean areas was completed in 1992. This project has formed the basis for a new study which is developing techniques, including linear spectral modelling, to map and to monitor Mediterranean land degradation and soil erosion. The work is currently undertaken in the Mediterranean areas of France, Spain and Greece.

- **Global Change**

As a contribution to the world wide effort to understand and predict changes in the global environment IRSA has continued to develop techniques to derive relevant information from earth observation data.

Considerable effort has been given to the collection and processing of continental scale data sets for Africa and Asia in order that continental scale vegetation processes, including biomass burning, can be evaluated on a multi-temporal basis. In addition new techniques have been developed to derive information from these data. In this respect a new vegetation index, the Global Environmental Monitoring Index (GEMI), has been developed.

- **Advanced Techniques of Earth Observation**

The evaluation and promotion of advanced techniques of earth observation have continued. Polarimetric radar data from airborne campaigns held in 1989 and 1991 have been analysed, with particular emphasis being given to the synergy of the data with high spectral resolution optical data. The objective of the campaign has been to obtain a better understanding of forests and their evolution.

In addition a number of ERS-1 (European Remote Sensing Satellite Nr 1) projects are being undertaken. One, the International Forest Investigation project, is evaluating the potential of satellite borne Synthetic Aperture Radar (SAR) data to map and monitor forests. The second, an ERS-1 Pilot Project, is evaluating the capability of the SAR data to provide information on European agriculture in terms of surface and yield.

The European Microwave Signature Laboratory (EMSL) was officially inaugurated in April. After a series of acceptance tests, the provisional acceptance was notified to the contractor of the installation in July. Since then experimental activity has started with the characterisation tests of the laboratory. In addition a call for experiments has been distributed to European laboratories for use in the EMSL.

Finally a new programme has been initiated that explores the performance of high spectral resolution data in order to derive geophysical parameters, with particular reference to forestry and agriculture applications. This will use laboratory, field and airborne data as inputs.

- **Community Services**

In support of DG I (External Relations), work continued on the observation of the upwelling area off the North West African coast to assess the marine productivity in this area. In support of this a sea truth collection campaign was undertaken in this area. These data will be used to validate the

ongoing work on the derivation of chlorophyll maps from satellite data and the modelling of the hydrodynamics of the upwelling area.

A new project in support of DG I has been initiated in 1992 to evaluate the potential of detecting illicit narcotic plants using remote sensing.

In support of DG VI (Agriculture) and the European Statistical Office (EUROSTAT) work has progressed in the Pilot Project for the application of remote sensing to agricultural statistics. In particular Action 1 (Regional Inventories) has expanded as a number of countries, in particular Greece and Portugal and also eastern European states including Czechoslovakia and Romania are now applying the methodology. Action 4 (Rapid Estimates) has also expanded to take into account 53 sites across Europe, from which biweekly facsimiles showing the current estimate of areas under crop are forwarded to DG VI and EUROSTAT.

In addition work for the "Fond Européen d'Orientation et de Garantie Agricole" (FEOGA) of DG VI has concentrated on the establishment of olive tree, vineyard and citrus registers and the declaration made by farmers in southern Europe concerning a selection of crops. These methods are particularly necessary as the new Common Agricultural Policy (CAP) extends the subsidies based on surfaces.

For DG VIII (Aid to Development) work concentrated on the development of techniques to monitor and characterise biomass burning patterns at continental scales. This was supported by a field campaign to southern Guinea and the collection and processing of continental scale earth observation data sets.

For DG XI the Ocean Colour European Archive Network (OCEAN), a joint project with the European Space Agency (ESA), has progressed well. All facilities and tools required for the processing and archival of the satellite data have been completed as planned.

In support of DG XI work was also undertaken to investigate the use of remote sensing in the revision of the CORINE land cover map using computer aided photo-interpretation, plus semi-automatic and automatic updating techniques.

- **External Services**

The Tropical Ecosystem Environmental Observations by Satellites (TREES) project (a joint project with ESA) has progressed towards its initial aim of establishing a base line inventory of tropical forest cover using data from the Advanced Very High Resolution Radiometer (AVHRR) sensor. In addition the first data from the ERS-1 SAR have been received and are being evaluated.

For the European Airborne Remote Sensing Capability (EARSEC - a joint project with ESA) a contract was signed with a German institute for the development of an advanced airborne imaging spectrometer. In addition a contract was signed with a Danish institute for the improvement of an existing airborne SAR in order to make it a fully polarimetric C- and L-band system.

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

2.8. The Institute for Prospective Technological Studies (IPTS)

The IPTS has a technology watch function and performs scientific and technological studies at the request of the Services of the Commission mainly in the fields of transport, environment and energy and with particular attention to industrial innovation.

Work on the development of the observatory on science and technology continued and progress was made in the information system of on-going R&D in Europe. An additional number of national and regional data bases was selected and their structure and content were analysed.

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.

As a follow-up of the previous report prepared for DG III on the competitiveness of European space industries, IPTS is running a series of interviews with top executives of the aerospace industries in order to critically review available literature on space competitivity.

Following the final report of phase 1, and a review by a panel of industrialists and the UIC ("Union International des Chemins de fer") representatives, a series of specific studies concerning the electrification of the European High Speed Train Network was launched on behalf of the Directorate General for Industrial Affairs.

Activities in support of the Forward Studies Unit of the Commission concerned industrial and environmental problems, including global change aspects.

Work related to market-based approaches for environmental protection addressed two subjects. One was a focus on market-based approaches as a least-cost solution for achieving environmental quality targets, and the other focused on barriers to business acceptance of market-based instruments.

Information concerning energy and environment were collected and analysed. The conclusion is that although the information available is not good enough for short-term sectoral decision making, it is probably sufficient for broad political decisions.

The continuing survey of global change research and policy, begun in 1991, was carried on in 1992. A report was issued in June, emphasising the importance of on-going international research about the effects of anthropogenic sulphate aerosols for the elucidation of the greenhouse effect itself. Ozone depletion research was also included in the report. Another report includes a first survey of international research and development on CO_2 removal and storage technologies, using, among others, the results of a study undertaken by NERSC (Nansen Environmental and Remote Sensing Centre), Bergen, Norway.

Two closely related aspects of environmental protection were addressed in the work carried out for the Directorate General for Environment, Nuclear Safety and Civil Protection. The first study focused on the current and prospective technologies for dealing with environmental pollution, whilst the second study sought to define the existing potential for pollution prevention in industry.

Additional studies for the Directorate General for Environment, Nuclear Safety and Civil Protection involve the development of the first Technical Note on "Coating Lines/Iron and Steel Production" undertaken in co-operation with an external consultant. In the mean time data collection and analysis of the environmental characteristics of the "Coating Lines process" is progressing with the aim to being to prepare the first meeting of the BAT (Best Available Technologies) Working Group of National Experts in January 1993.

In the second part of 1992 work started in support of the Directorate General for Energy concerning the review and the assessment of energy technologies which may become available in the long term (2020 and beyond). Two case studies were initiated on the future prospects of fuel cells and on CO_2 separation and disposal with the aim of avoiding the greenhouse effect.

Twelve seminars or workshops, with the participation of external experts, were organised in Ispra or in Brussels during 1992 in connection with the above studies.

2.9. Publications and Eurocourses

- Publications

In 1992 the JRC published 825 papers. The following Table gives the distribution of these publications among the JRC Institutes.

Table 2

Distribution of JRC Publications among JRC Institutes in 1992

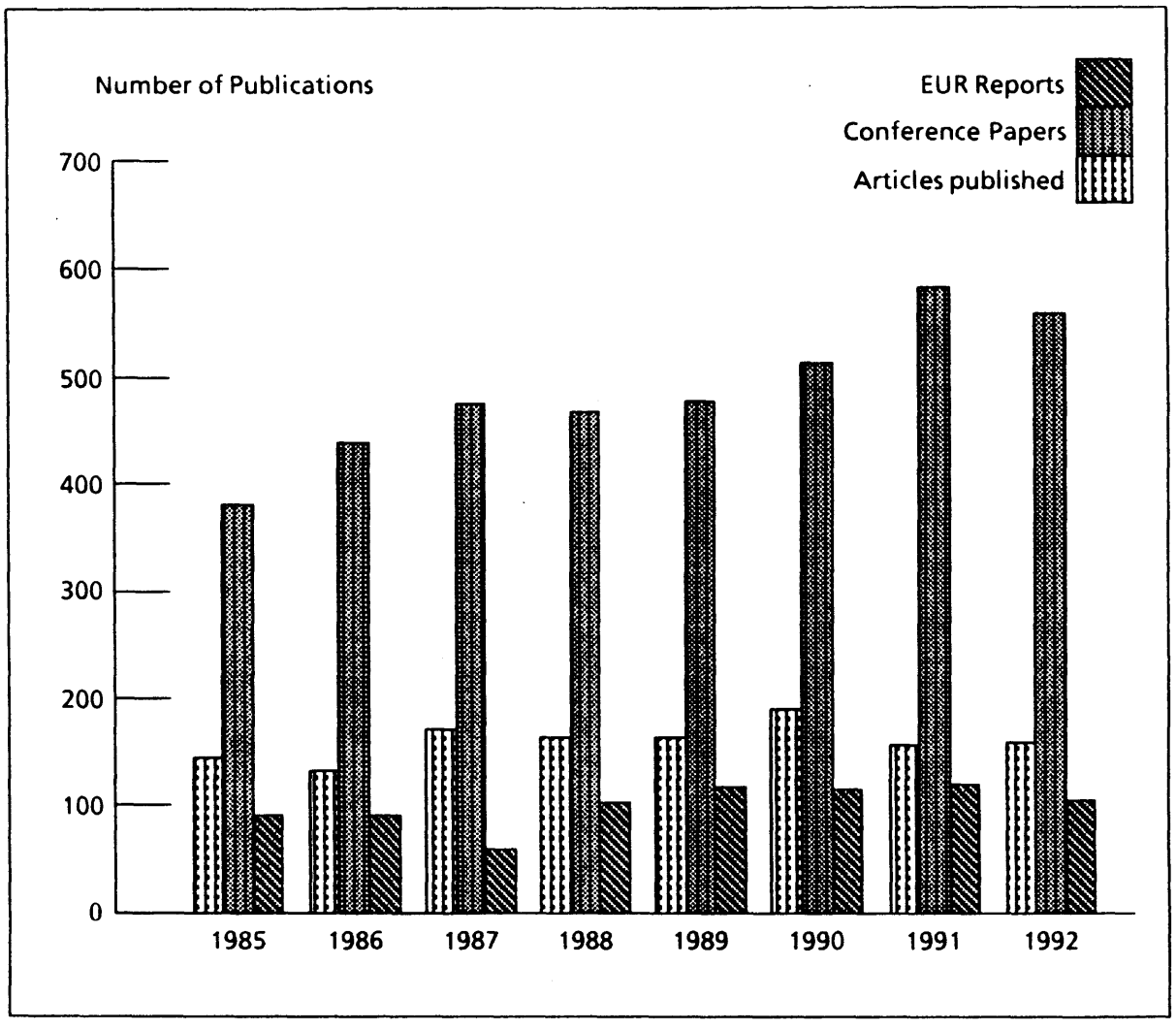
Institutes	EUR Reports	Conference Papers	Articles published	Total
Directorate General	5	1	-	**6**
Central Bureau for Nuclear Measurements	6	44	39	**89**
Institute for Transuranium Elements	3	50	34	**87**
Institute for Advanced Material	16	97	19	**132**
Institute for Systems Engineering and Informatics	17	103	16	**136**
Institute for Safety Technology	25	66	15	**106**
Environment Institute	19	112	23	**154**
Institute for Remote Sensing Applications	12	86	12	**110**
Institute for Prospective Technological Studies	1	1	-	**2**
Administrative & Technical Services, Ispra	2	1	-	**3**
Total	**106**	**561**	**158**	**825**

An evolution of these publications during the last eight years is illustrated in Figure 4.

The detailed list of JRC publications is published each year in the "Publications Bulletin". The last issue, No 12/ISSN, 0254-3133, published in September 1992, gives the list of JRC publications in 1991.

Figure 4

Evolution of JRC Publications (1985-1992)



- **Eurocourses - Other Workshops and Seminars**

The JRC organised 9 Eurocourses. The lecturing staff was composed of 92 guest lecturers from EC Member Countries and the USA, and 38 experts from both the JRC Institutes and various Directorates General of the Commission.

The courses were residential at Ispra except one in Lisbon. They were attended by 223 participants, coming from industry, public administration, universities and research organisations. All of the EC Member States except Luxemburg were represented at the Eurocourses and the world-wide interest can be demonstrated by the participation of representatives from 28 non EC countries. Details on the attendance in 1992 and over the two past years are given in Figure 5.

The courses covered the following topics:

Chemical and Environmental Science

- Chemical, Microbiological, Health and Comfort Aspects of Indoor Air Quality,
- Chemistry and Environment: Legislation, Methodologies and Applications,
- Technologies for Environmental Cleanup: Soil and Ground-water.

Remote Sensing

- Remote Sensing Applied to Agricultural Statistics - Area Frame Sampling,
- Imaging Spectroscopy as a Tool for Environmental Observations.

Mechanical and Materials Science

- Cyclotron Production, Quality Control and Utilisation of Medical Radionuclides,
- Advanced Techniques for Surface Engineering .

Health and Radiation Protection

- Techniques and Management of Thermoluminescence Dosimetry.

Training and Education

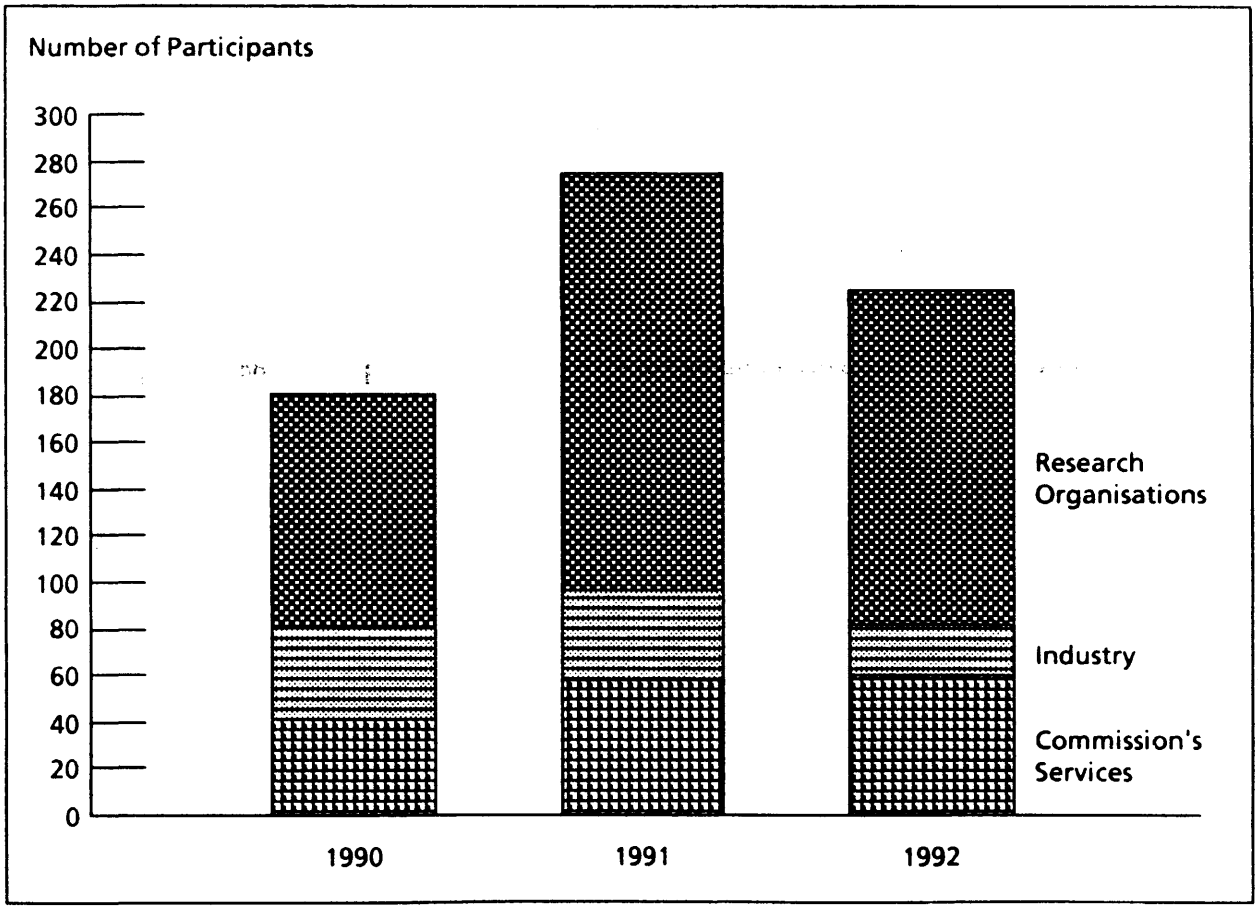
- COMETT II: A Project for the Development of Multimedia Training Materials in the Field of Remote Sensing, Risk Assessment, Geography and Environment.

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

The JRC Institutes organised also various workshops and seminars to discuss their activities with scientists of other organisations and to disseminate the results of their work.

Figure 5

Participants in Eurocourses for the Years 1990, 1991 and 1992



3. HUMAN RESOURCES

3.1. Staff Policy

The JRC authorised statutory staff table amounts to 2080, including both scientific-technical and administrative staff.

JRC statutory personnel is governed by the EC staff regulations. For many years the JRC has not recruited staff as officials. Scientific/Technical temporary agents are recruited under a five year contract, which is renewable; after two terms the contract becomes of undetermined duration. Administrative tempory agents are directly recruited under a contract of undetermined duration.

Table 3 gives the distribution of the JRC officials and temporary agents present at the JRC on 31 December 1992, by Directorates and Institutes. Until December 1992, 67 people of these two categories left the JRC and 24 people were recruited.

Table 3

Distribution of Statutory Staff

Location	Staff
Directorate General	16
Programmes Directorate	19
Resources Co-ordination - Scientific & Technical Support	392
Central Bureau for Nuclear Measurements	167
Institute for Transuranium Elements	193
Institute for Advanced Materials	271
Institute for Systems Engineering and Informatics	224
Environment Institute	199
Institute for Remote Sensing Applications	88
Institute for Safety Technology	308
Institute for Prospective Technological Studies	13
JRC Seconded Staff	11
Total	**1901**

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 hiring of visiting scientists, seconded experts and other scientific grant holders falling outside the Human Capital and Mobility Programme conditions;

- The remaining part of the difference corresponds to the necessary margin of flexibility (± 6%) required to allow for movement of staff during the year.

3.2. 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 senior scientists for one or sometimes two years as visiting scientists;
- Experts from national organisations may be seconded to the JRC to participate in selected scientific work;
- The JRC trains researchers through a programme of fellowships, granted to postgraduate students preparing a doctor degree.
- The JRC participates in the Human Capital and Mobility (HCM) Programme and hosts post-doctoral scientists under this programme.

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

It is also worthwhile mentioning that there are about ten scientists from third countries working at the JRC on a grant in the framework of a Commission agreement with their countries or with the IAEA. Besides the above mentioned scientists, several senior scientists and about eighty trainees 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 on 31 December 1992

Institutes	Visiting scientists	Seconded experts	Post-Doctoral Scientists	Post-Graduate Students	Total
Central Bureau for Nuclear Measurements	8	1	1	10	**20**
Institute for Transuranium Elements	-	2	1	9	**12**
Institute for Advanced Materials	-	1	2	25	**28**
Institute for Systems Engineering and Informatics	2	4	4	19	**29**
Environment Institute	4	1	1	15	**21**
Institute for Remote Sensing Applications	3	1	1	3	**8**
Institute for Safety Technology	-	4	3	9	**16**
Institute for Prospective Technological Studies	-	1	-	3	**4**
Total	**17**	**15**	**13**	**93**	**138**

Furthermore the Directorate General has two seconded experts bringing thus the total to 140.

4. FINANCES

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	178.80 MioEcu
-	S/T Support to the Commission	62.36 MioEcu
	Total	241.16 MioEcu

Other resources for HFR operation and third party work are :

-	HFR Reactor	19.47 MioEcu (Supplementary programme)
-	Work for Third Parties	13.72 MioEcu (Budgetary advance)
	Total	33.19 MioEcu

The total amount of the available credits is therefore 274.35 MioEcu.

Details about 1992 commitments are given in Table 5 covering Specific Research Programmes, Exploratory Research, S/T Support to the Commission and Work for Third Parties (HFR Reactor and others).

In addition to the commitments given in Table 5, 2.522 MioEcu were spent due to the completion of previous programmes.

- 0.4 MioEcu due to the upgrade of the safeguards of the Ispra 1 reactor foreseen in 1973,

- 1.346 MioEcu as a consequence of the modification of the weighting factor for the Netherlands,

- 0.776 MioEcu as a consequence of the decision of the court of the first instance of 28 February 1992 providing for interest on arrear to be paid to the beneficiaries of a previous decision of the court stating Varese as the reference for the calculation of the weighting factor for the Ispra site.

Table 5

Commitments for Programme Execution 1992
(Rounded figures, MioEcu)

	Personnel	Other Expenditures	Total	Budget 1992
Specific Research Programmes				
Industrial and Materials Technology	16.70	6.79	23.49	24.69
Measurement and Testing	16.69	10.92	27.61	27.13
Environment	31.25	16.49	47.74	47.10
Human Capital and Mobility	0.05	5.36	5.41	7.92
Nuclear Fission Safety	29.27	21.24	50.51	55.51
Controlled Thermonuclear fusion	8.72	4.42	13.14	12.66
Exploratory Research	6.22	3.74	9.96	3.79
Subtotal	**108.91**	**68.95**	**177.85**	**178.80**
S/T Support to the Commission	30.98	28.51	59.49	62.36
Subtotal	**30.98**	**28.51**	**59.49**	**62.36**
Others				
HFR Reactor	5.82	10.90	16.72	19.47
Work for Third Parties (Advance: reimbursable credits)	5.15	2.64	7.79	13.72
Subtotal	**10.97**	**13.54**	**24.51**	**33.19**
Total	**150.85**	**111.00**	**261.85**	**274.35**

The advance in the budget of reimbursable credits for the execution of work for Third Parties has been committed only to the level of 7.79 MioEcu because the amount of orders for such activities did not reach the original target; the unused credits of this advance, of 5.93 MioEcu have been reimbursed to the budget by cancellation.

For exploratory research the budget initially foresaw a preliminary figure of 3.79 MioEcu, whereas further appropriations have been provided during the year by transfers from the programme lines within the cealing set by the Council Decisions, and the Financial Regulations.

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ANNEX B

JOINT RESEARCH CENTRE

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

BCR	Bureau Communautaire de Référence
BEMA	Biogenic Emmissions in the Mediterranean Area
BRITE/EURAM	Basic Research in Industrial Technologies for Europe/European Research on Advanced Materials
CBNM	Central Bureau for Nuclear Measurements
CEA	Commissariat à l'Energie Atomique
CEN	Comité Européen de Normalisation
COMETT	Community Action Programme for Education and Training for Technology
DCS	Direction Contrôle de Sécurité de l'Euratom - DG XVII
DG	Directorate General
EAEC	European Atomic Energy Community
ECN	Energy Centrum Nederland
EI	Environment Institute
ELSA	European Laboratory for Structural Assessment
EMSL	European Microwave Signature Laboratory
ERS-1	European Remote Sensing Satellite Nr 1
ESA	European Space Agency
ESTER	European Source Term Research Code
ETHEL	European Tritium Handling Experimental Laboratory
EURATOM	European Atomic Energy Community
EUROENVIRON	EUREKA Environmental Umbrella Project
EUROSTAT	European Statistical Office
EUROTRAC	European Experiment on Transport and Transformation of Environmentally Relevant Trace Constituents in the Troposphere (EUREKA project)
FARO	Experimental Facility for Fuel Melting
FIRES	Facility for Investigating Runaway Events Safely
FORMENTOR	EUREKA project to develop expert system to help decision in hazardous situations (complex man made systems)
HCM	Human Capital and Mobility
HFR	High Flux Reactor (Petten Site)
IAEA	International Atomic Energy Agency
IAM	Institute for Advanced Materials
IPTS	Institute for Prospective Technological Studies
IRDAC	Industrial Research and Development Advisory Commitee
IRSA	Institute for Remote Sensing Applications
ISEI	Institute for Systems Engineering and Informatics
ISO	International Standards Organisation
IST	Institute for Safety Technology
ITU	Institute for Transuranium Elements
JRC	Joint Research Centre
LASCO	Laboratory for Surveillance and Containment
NMR	Nuclear Magnetic Resonance
PERLA	Performance and Training Laboratory (Nuclear Safeguards)
PHEBUS	French In-Pile Programme (Severe Fuel Damage)
R&D	Research and Development
S/T	Scientific/Technical
SAR	Synthetic Aperture Radar
STARS	Software Tools for Analysis of Reliability and Safety

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