

**Annual report : 1995 / Joint Research Centre.**

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European Commission. Joint Research Centre

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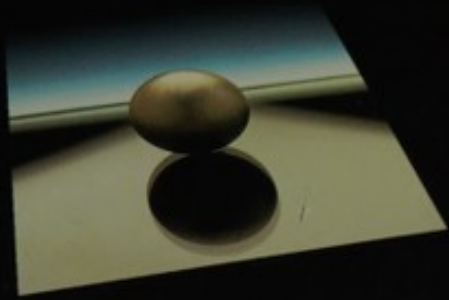
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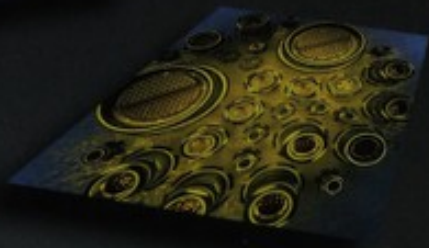
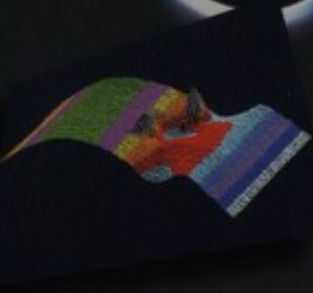
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# ANNUAL REPORT JRC 95





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Published by the  
**European Commission**  
Directorate-General of the Joint Research Centre

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**EUR 16401 EN**

Luxembourg: Office for Official Publications  
of the European Communities, 1996

ISBN 92-827-7310-8

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*Printed in Italy*

# FOREWORD

1995 has been a turning-point in the evolution of the Joint Research Centre: three significant events have characterized this year: the appointment of a new Commission and of a new Commissioner responsible for Research, the entry of three new Member States into the European Union and the start-up of a new 4-year programme for the JRC.

Our new Commissioner, Madame Edith Cresson, has expressed her will to reorient the Joint Research Centre towards objectives which were closer to the current preoccupations of the European Union, i.e. the contribution of Science and Technology to industrial competitiveness while at the same time fulfilling societal objectives such as quality of life, consumer protection, health, etc., and maintaining the essential role of the JRC as a support to the regulatory and normative functions of the European Commission.

Within the framework of the technical objectives defined by the Council decisions on JRC programmes for the 1995-1998 period, the necessary inflexion of scientific and technical themes has been initiated and a new effort for the marketing and commercialisation of JRC research results has been launched.

Thanks to the earlier active participation of Austrian, Finnish and Swedish representatives in the JRC Board of Governors within the scope of the European Economic Area, our three new Member States entered from the beginning of 1995 into the thick of the JRC activities and have been fully associated in its development.

The year 1995 has been marked also by the increased participation of the JRC in a broad spectrum of competitive activities, as agreed by the Council, the Parliament and the Commission in 1994. For the first time, the JRC has participated on a competitive basis in shared cost actions together with partners in Member States; scientific and technical support to other services of the Commission, won on a competitive basis, has constituted also a new challenge, alongside work for external third parties which has grown in importance since 1989. The results obtained in the competitive arena during this first year are encouraging in terms of market shares.

In order to guide the JRC in its further development, the management has developed, together with the Board of Governors, a strategic plan—JRC 2000+—which has been approved by the Board at its December 1995 meeting. JRC 2000+ constitutes the basis for steering the JRC towards the challenges of the new Millennium.

Increased attention has been given to the ways and means by which the JRC communicates its availability, offerings and results to a larger public and to potentially interested quarters. This effort should be sustained in the years to come. As a part of this effort, a new presentation of the Annual Report has been implemented, leaving notably the detailed description of scientific activities to the separate Institute annual reports and concentrating on the more general aspects of JRC activities.

It is sincerely hoped that this new presentation will fulfil the expectations of our readers.



J.-P. CONTZEN  
Director-General

# OBSERVATIONS BY THE THE JRC ANNUAL

1995

## THE FIRST YEAR UNDER MODIFIED ROLE

1995 was a significant year for the JRC. This was the year where the modified role of the JRC, as agreed with the Council, the Parliament and the Commission in 1994, took effect.

This modified role for the JRC called for a wider spectrum of competitive activities than was the case in the past, and from 1995 onwards the JRC could participate in Community programmes on an equal basis with its national partners from research and industry. As witnessed by the present report, the JRC responded in a dynamic way to this new challenge and in the case of the shared cost action programmes, obtained in the competition promising results together with its partners throughout the Member States of the European Union and other countries associated with the programmes. Good results were also obtained for the other modes of competitive activities. It is noteworthy that, in spite of the new modes introduced in 1995, the JRC kept up the pace with work for third parties in comparison with previous years. In this new situation, preliminary targets were set for participation in competitive activities in 1995 and the Board notes with satisfaction that overall, these targets were exceeded.

Competitive activities is only one facet of the JRC work, another being its institutional research and scientific and technical support to the Union's sectorial policies, notably environment, energy, agriculture and industry. The Board appreciates the continuing concern of the JRC to respond positively to the requirements of customers. For the research activities there is a welcome drive towards producing useful results for the benefit of industry and society. The report highlights examples of this and the Board will continue to urge the Centre to pursue the necessary trend towards a further output-oriented JRC with an increased scope for the commercialisation of its research results. Based on frequent evaluations of the JRC, the Board feels satisfied with the generally high quality of the JRC work and its increasing relevance to the needs of the European Union's policies.

The Board already noted last year its expectations for the developments for the JRC from 1995 onwards.

Amongst the measures the Board has taken to strengthen its follow-up on the JRC activities is a restructuring of its Sub-Committees, allowing to follow in more detail the JRC institutes. Continuing efforts are being made to introduce performance parameters and quality assessment.


## EVALUATIONS OF THE JRC

In its guidance of the JRC throughout the year the Board has drawn on the recommendations from the evaluations of the JRC and its Institutes by external, independent, experts available at the end of the previous 1992-1994 programme period. The Board has reviewed the full set of recommendations from this exercise and recognises the JRC's management efforts in working to implement them, while noting that some useful recommendations particularly related to administrative and staff policy matters have not yet been implemented for reasons beyond the control of the JRC.

## RULES GOVERNING THE JRC STAFF ISSUES

The Board continues to press for the JRC to be allowed to operate fully in a way that enables it to achieve the change in working methods envisaged by the Council Conclusions of April 1994. This may call for a further evolution of the rules and regulations governing its activities, possibly involving an evolution of its status within the Commission. This should also lead to an increased flexibility in budgetary and financial matters combined with the noted progress on the financial management systems. The Board has presented its points of view on these important matters to the Commissioner for Research, Mrs. Edith Cresson. Towards the end of the year it was informed of the imminent plans for giving the JRC a larger autonomy within the Commission and other organisational changes planned. Thus as a first step, the JRC will be given status as a separate Directorate General from early 1996 (Decided on 16 January, 1996).

# BOARD OF GOVERNORS ON REPORT 1995



The Board has also discussed staff policy issues with the Commissioner and expects to follow the implications for the JRC under the new policy of the Commission on staff under the research budget of the Union. Like the staff of many other European research institutes, the JRC has an age distribution which will result in many vacancies in the coming few years. Five senior posts as Institute Director became vacant in 1995 and four of these were filled, following appointments by the Commission upon advice from the Board, while a fifth post is still to be filled. The Board welcomes the four new Directors who joined the JRC in mid-1995.

## DISSEMINATION OF INFORMATION ON THE JRC

The modified role of the JRC requires a more intense dissemination of information on JRC activities to all interested parties at a national level. As a contribution to this, in 1995 Members of the Board, together with the JRC, arranged for a continuation of the series of JRC Information Days and presentations of JRC activities throughout the Member States with the aim of fostering further collaboration between national research laboratories, universities, industry and the JRC. To attain proper coordination between the JRC research activities and other related research activities under the Community Framework Programmes, Members of the Board have participated with JRC representatives in meetings of the Community Programme Committees. These exchanges of views as prescribed in the Council decisions on the JRC programmes should be intensified and encompass all relevant programme activities in 1996.

## STRATEGY

The fulfilment of the JRC's mission of performing customer-driven research of the highest quality and integrity in support of Community policies, calls for a clear long-term strategy for the JRC and its Institutes. The Board agreed in late 1995 on an updated JRC strategy and has conducted discussions on the underlying Institute strategies as a guide for the Centre in its current and future activities. One of the measures envisaged in

the 1995 strategy document is a more extensive use of performance indicators to assist the development of the JRC.

## INSTITUTE FOR PROSPECTIVE TECHNOLOGICAL STUDIES (IPTS)

In its observations on the 1994 Annual Report, the Board mentioned the new location of this institute in Seville and the work planned. It is pleased to record the new work programme for IPTS, defined in 1995 and endorsed by the Commission. Moreover, the Board appreciates the inauguration of the important Technological Watch function by the Commissioner, Mrs. Edith Cresson, in the presence of the Chairman of the Board, who emphasised the collaboration IPTS has established throughout the Member States and with the European Parliament.

## HIGH FLUX REACTOR

1995 was the last year of the supplementary EUR-ATOM programme for the High Flux Reactor (HFR) at Petten (NL). Throughout the year discussions have taken place at all levels on the future of the High Flux Reactor (HFR) and its proposed new multi-annual programme to begin in 1996. This has involved a complete overhaul of the management of the facility and an intensive drive towards a more direct commercial use of a considerable part of its capacity with the ensuing improvement in efficiency and economy.

## ACKNOWLEDGEMENTS

The Board welcomes the several contacts it has had during the year with the Commissioner for Research, Mrs. Edith Cresson and looks forward to further discussions on the development of JRC strategy.

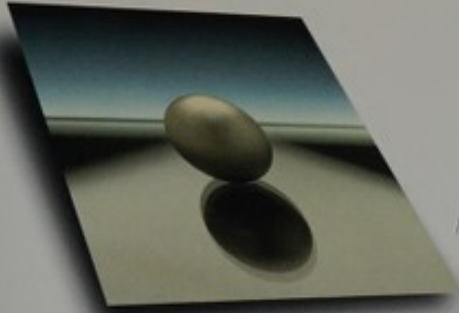
At the same time the Board expresses its appreciation for the hard work of the Director General, his Directors and the entire JRC staff in addressing the challenges facing them.



# THE HISTORY OF THE CITY OF BOSTON

The history of the city of Boston is a story of growth and resilience. From its founding as a small settlement of Puritan settlers, it has become one of the most important cities in the United States. The city's location on a narrow neck of land between the harbor and the mainland provided a natural defensive position, which was a key factor in its early success. The city's economy was initially based on trade and commerce, but it soon diversified into manufacturing and industry. The city's role in the American Revolution was pivotal, and it has since become a center of education, culture, and innovation. The city's history is a testament to the power of human ingenuity and the ability to overcome adversity.

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GEEL



PETTEN



KARLSRUHE



SEVILLE



ISPRA

# THE JOINT RESEARCH CENTRE

The Joint Research Centre is the corporate research laboratory of the European Union. It is established by the European Commission with headquarters in Brussels. Five separate sites, located in Belgium, Germany,

Italy, the Netherlands and Spain, house eight different institutes, each with its own focus of expertise.

These institutes are:

|      |  |                                  |
|------|--|----------------------------------|
| IRMM | The Institute for Reference Materials and Measurements | <i>Geel (B)</i>                  |
| ITU  | The Institute for Transuranium Elements                | <i>Karlsruhe (D)</i>             |
| IAM  | The Institute for Advanced Materials                   | <i>Petten (NL) and Ispra (I)</i> |
| ISEI | The Institute for Systems Engineering and Informatics  | <i>Ispra (I)</i>                 |
| EI   | The Environment Institute                              | <i>Ispra (I)</i>                 |
| IRSA | The Institute for Remote Sensing Applications          | <i>Ispra (I)</i>                 |
| IST  | The Institute for Safety Technology                    | <i>Ispra (I)</i>                 |
| IPTS | The Institute for Prospective Technological Studies    | <i>Seville (E)</i>               |

The mission of the JRC is to promote and carry out customer-driven research of the highest quality and integrity in support of Community policies.

The Joint Research Centre, being an integral part of the Community research and technological development system, contributes to Community research policy, particularly in those sectors in which it has special, if not unique, skills and in areas where its neutrality is essential for scientific and technical support for Community policies. These institutional activities are performed in executing the JRC specific programmes decided by the Council and funded by the European Union budget. Furthermore the JRC is increasingly engaged in competitive activities participating, on a competitive basis, with industry, research organisations and universities within the Member States or associated countries, in Community programmes, including shared cost actions under the Framework Programmes, and offering its services against payment to various customers.

The statutory staff, comprising officials and temporary agents of the JRC, was 1,786 at the end of 1995. To this number one must add 319 scientists who were active in the Centre and were paid by the JRC under various hosting schemes.

The global credits committed by the JRC in 1995 were slightly lower than 258 MioEcu.

This Annual Report is intended to give a general overview of JRC activities in 1995.

Readers may find more details in the Annual Reports of the eight institutes. The JRC also publishes numerous scientific reports, presents papers to conferences and in scientific journals (all these reports are referred to in the Publications Bulletin which is published yearly), and organises workshops, seminars and conferences to disseminate its scientific output.

# Part I: THE JOINT RESEARCH CENTRE IN 1995



1995

## A SIGNIFICANT YEAR

1995 was the first year of a new approach for the JRC. This had been defined by the Council of the European Union, the European Parliament and the European Commission in discussions which led, in 1994, to decisions on the Framework Programmes for Community activities in research, technological development and demonstration and to subsequent decisions on the specific research programmes to implement the Framework Programmes. These include two JRC specific, 1995-1998, research programmes, one for the EC (European Community) and the other for the EAEC (European Atomic Energy Community). In conformity with the Council conclusions of 26 April 1994 on the role of the JRC, the Centre in 1995 has engaged in institutional activities as well as competitive activities, the former covering institutional research and institutional scientific and technical support to Community policies. The competitive activities include participation in shared-cost actions under the Framework Programmes, competitive support measures for Commission services responsible for the various Union policies, competitive activities outside the Community Framework Programmes and contractual work performed for outside third parties.

1995 was, moreover, the year in which the newly appointed Commission launched initiatives for establishing better bonds between industry and research. Within this frame the Commissioner for research, Mrs. E. Cresson, strongly emphasised the need for further commercialisation of JRC research results and for improved communication of JRC activities.

Finally, 1995 also saw the enlargement of the European Union. The three new Member States (Austria, Finland and Sweden) had already participated in 1994 in JRC activities under the EEA (European Economic Area) Agreement. This framework allowed for the continuation, in 1995, of the JRC collaboration with Iceland, Liechtenstein and Norway.

## INSTITUTIONAL ACTIVITIES

The JRC institutional activities contributed to the objectives of the 4th Framework Programme for the EC and the EAEC Framework Programmes via the lines of Information and Communications Technologies (Information Technologies), Industrial Technologies (Industrial and Material Technologies, Measurements and Testing), Environment (Environment and Climate), Life Sciences and Technologies (Agriculture and Fisheries, including agro-industry, food technologies, forestry and rural development), Non-nuclear Energy, Targeted Socio-Economic Research, Nuclear Fission Safety and Thermonuclear Fusion.

## NEW CHALLENGES: COMPETITIVE ACTIVITIES

Following extensive preparations begun in 1994, the JRC responded to the challenge set by the new opportunities opened up in 1995 for competitive activities. Together with partners from industry, research centres and universities throughout the Union and associated countries, more than 300 proposals were made in response to the first call for proposals under the new Framework Programmes, with a success rate of 28%. The JRC also presented proposals for competitive support activities and for Community programmes outside the Framework Programmes, notably PHARE and TACIS, where contracts were won for nuclear safety work in the Central and Eastern European countries, Russia and other Newly Independent States (NIS).

Taking up these new opportunities required intensive marketing by the JRC. They were made possible by a series of legal, financial, budgetary and administrative decisions by the Community institutions (Council, Parliament, Commission). These included the necessary amendments to the Financial Regulation for the European Union budget, decided on in September 1995. Contractual work performed for external third parties was also notable and new contracts signed during 1995 amounted to well above 18 Mioecu.

## VISITS BY THE COMMISSIONER

On 20 July 1995 Commissioner Mrs. E. Cresson, made her first visit to the JRC, starting with the Institutes at Ispra, followed by a visit to ITU in Karlsruhe in September and IPTS in Seville in December, where Mrs. Cresson inaugurated the new technological watch function of the Institute. In her address to the personnel during these visits, she encouraged the JRC to continue its mission for Research and Technological Development in Europe. She outlined the views of the Commission on the contributions to be made by the JRC to the policies of the Union and on to engagement in competitive activities.

In 1995 the Commission announced that it had established several task forces on industrial research in the areas of new-generation aircraft, multimedia educational software, the car of tomorrow, vaccines and viral diseases, the trains and railway systems of the future, intermodal transport, maritime systems of the future and environmentally friendly water technologies. JRC staff have participated in most of these task forces and, in parallel, the JRC management has planned reorientations within the JRC institutional research areas, in order to match research to the new priorities set by the Commission.

## NEW DIRECTORS

During the year, four new Directors of JRC Institutes, namely ISEI, EI, IRSA and IAM, took up their posts, after appointment by the Commission acting on the advice of the Board of Governors.

## COMMUNICATION INITIATIVES

Links between the JRC and industry, research centres and universities were also reinforced through the organisation of Information Days in London, Athens, Copenhagen, Milan and Vienna, on the initiative of Members of the Board of Governors. The Institutes were presented, while workshops outlined new perspectives for collaboration. Likewise, members of JRC management and staff have given a number of seminars throughout the Member States on JRC activities in

general and in particular those aimed at stimulating concrete collaboration with industry and research conducted at a national or regional level. JRC availability in support of Union policies was further publicised by information activities directed to other Commission services, including a Newsletter and targeted seminars.

## STRATEGY

The programme period 1995-1998 will see the JRC, on the one hand, build on experience acquired from the previous programme period and, on the other, meet the challenges that rapidly and continuously changing world markets impose on European industry and the new demands facing the European Union, with an emphasis on the commercialisation of research results of



value to industry and society. To this end, each year the JRC organises a number of conferences, workshops and seminars at its five sites in Europe. The number of visitors shows the constant interest of the scientific community in the contributions to research and development made by the JRC.

In order to consolidate the new approach of the JRC as prescribed by the Council, the Parliament and the Commission, the Board of Governors and the JRC management have, during the year, discussed strategies for the eight institutes and the JRC as a whole, leading to an emphasis on customer-driven, high quality research of real utility for the European Union, executed in an efficient way with a flexible responsiveness to changing market needs.

JRC activities have the effect of creating links between teams in Member States situated at different levels of scientific and technological development. They thus contribute to reinforcing cohesion between laboratories and research institutes in all the Community regions.

# INSTITUTIONAL ACTIVITIES: JRC SPECIFIC RESEARCH PROGRAMMES

The major task of the JRC in 1995 was to contribute to the implementation of the JRC specific programmes under the Communities' Framework Programmes in their first year of existence. This contribution was carried out through institutional research activities and through institutional scientific and technical support activities for the services of the Commission.



nologies, carried out by the Institute for Advanced Materials (IAM), and to standardisation of photovoltaic devices, carried out by the Institute for Systems Engineering and Informatics (ISEI).

## INSTITUTIONAL RESEARCH ACTIVITIES

In 1995, institutional research activities accounted for 73% of the JRC's institutional activities; they are carried out under the following Programme lines:

- ▶ The *Industrial Technologies and Materials Technologies* programme is carried out by the Institute for Advanced Materials (IAM) and encompassed research projects on advanced materials, on surface engineering, on new ecofriendly materials and on Non Destructive Evaluation techniques for the inspection of industrial structural components.
- ▶ The *Measurements and Testing* programme encompassed research projects on reference measurements and materials, carried out by the Institute for Reference Materials and Measurements (IRMM); and on the assessment of the reliability of structures, carried out by the Institute for Safety Technology (IST).
- ▶ The *Environment and Climate* programme consisted of research projects on atmospheric, soil, water and waste pollution, executed by the Environment Institute (EI); on the gradual setting up of the Centre for Earth Observation, a decentralised European data management and information system, and on applications of remote sensing techniques, carried out by the Institute for Remote Sensing Applications (IRSA); and on industrial hazards carried out by the Institute for Safety Technology (IST) and by the Institute for Systems Engineering and Informatics (ISEI).
- ▶ The *Non-Nuclear Energy* programme consisted of research projects related to materials for clean tech-

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

- ▶ The *Controlled Thermonuclear Fusion* programme (Technology and Safety) is carried out by the Institute for Safety Technology (IST), the Institute for Systems Engineering and Informatics (ISEI), and the Institute for Advanced Materials (IAM).
- ▶ The *Targeted Socio-Economic Research* programme includes the Science and Technology Observatory function and prospective work, the activities of the Institute for Prospective Technological Studies (IPTS). The essential role of the Institute is to harvest the available contributions from experts, consultants, research organisations and institutes in Member States and when possible in third countries, in order to analyse, process and integrate them impartially and in depth and, more importantly, to distil clear trends or needs for action in a usable form for decision makers.

While Part two of this document reports on the evolution in 1995 of these research activities, Institute by Institute, some salient results are highlighted here in order to illustrate how institutional research enables the JRC to develop scientific knowledge and to acquire specific installations in order to make a valuable contribution to the advance of science, to provide scientific evaluations, to spread know how and expertise in areas

where new innovative applications could be of interest to coordinate scientific cooperation throughout Europe and sometimes, to develop European scientific networks centred on its own facilities.

❖ Novel activities, making valuable contributions to science and technology for the benefit of European industry:

A new composite material, made of a silicon nitride matrix reinforced with long silicon carbide fibres, has been elaborated at IAM Petten, using a liquid infiltration technique followed by sintering. An investigation of its mechanical properties demonstrated the effectiveness of the fibre reinforcement in increasing both the strength and toughness of the otherwise brittle silicon nitride matrix, due largely to the formation of weak interphase bounding (the SiC fibres are precoated with a 400 nm thick layer of pyrolytic carbon). *Figure 1* illustrates the typical stress-displacement curves for the composites with and without an interphase; the composite fabricated with coated fibres exhibits a much better performance than the one elaborated with uncoated fibres. This new composite is a first-rate candidate for high temperature applications of structural components in a number of advanced industrial applications, such as gas turbines.

A project for the synthesis of carbon nitride, a new product, has been set up within a network. The multiple aims of the project were: to assess the thermal, optical, mechanical and tribological properties of the material and to evaluate its functional characteristics for industrial use in optical applications, magnetic storage, hard disk techniques and advanced mechanical components. The network has aroused the interest of 22 research institutes and 11 industrial partners from 9 different countries. The experimental contribution of the IRMM will be the characterisation of the material by nuclear techniques. The IRMM will perform the analysis of materials layers for the light elements (H, B, C, N, O) using charged particle beams of the 7 MV Van de Graaff accelerator. Nuclear reaction analysis of carbon and nitrogen by (d,p) reactions as well as Rutherford backscattering will be performed.

❖ The JRC has exploited spin-offs from its research activities in areas where a new Community policy could be emerging:

For example, the European Commission, together with the Member States, is currently strengthening its policy on natural risks, in particular on the monitoring and prevention of floods. Flooding is a major threat in many regions of Europe, both north and

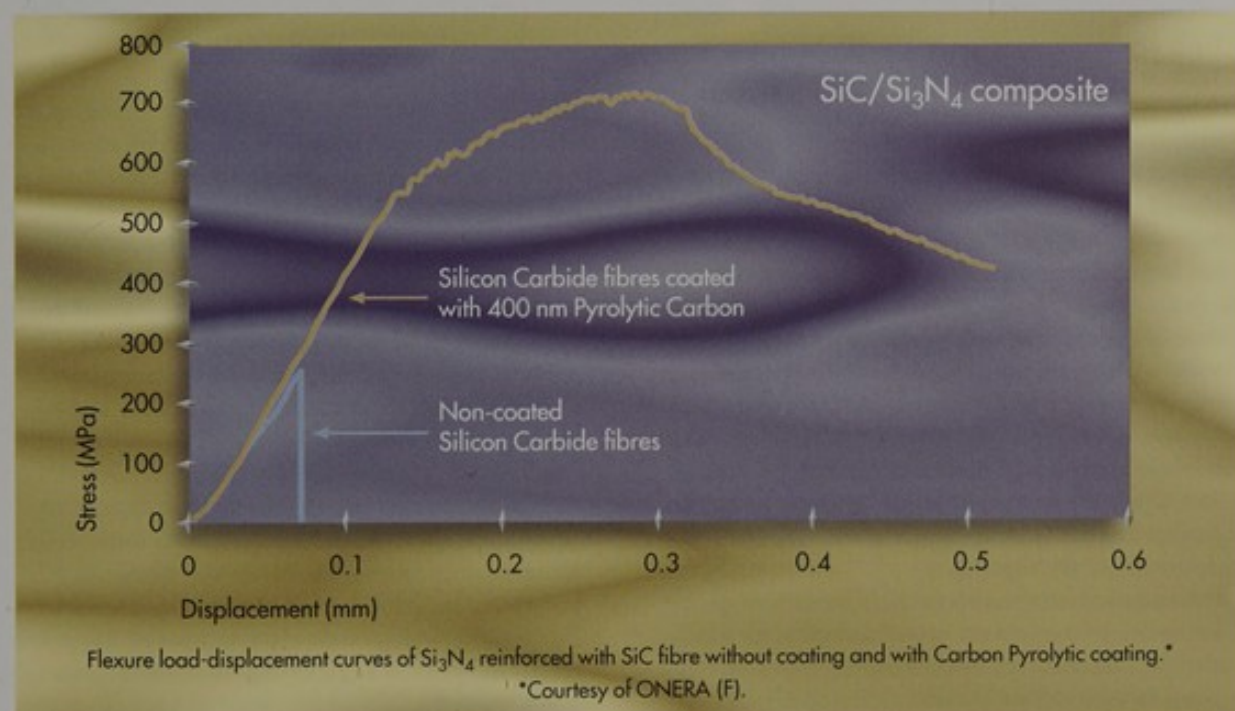


Fig. 1. Stress-displacement curves.



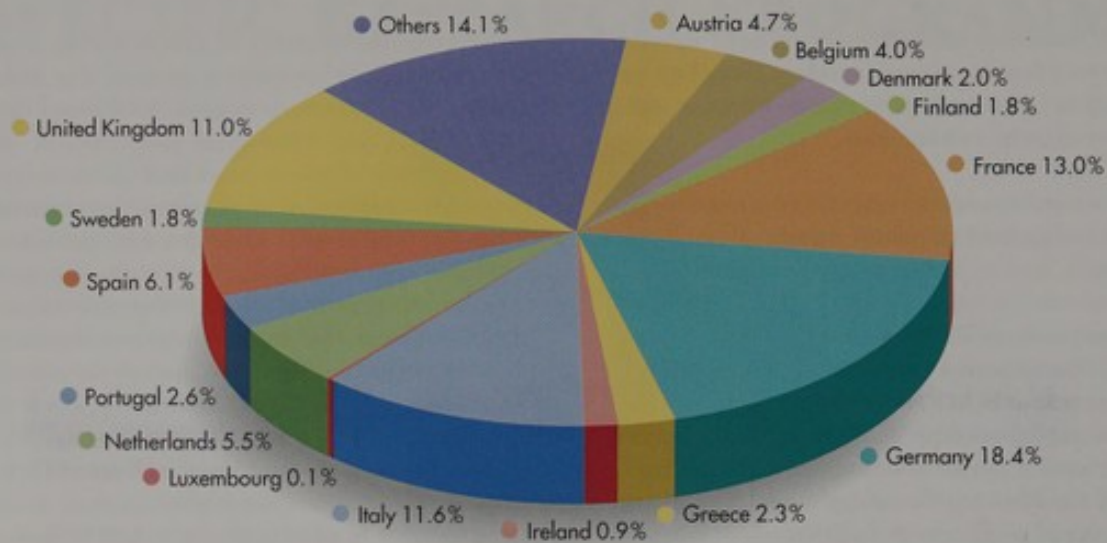


Fig. 2. Distribution of JRC Cooperation by Country.

south, and involves river basins that need monitoring in more than one country. The exchange of prevention and monitoring knowledge among Member States could thus be beneficial, even for events such as flash floods which have only local consequences.

IRSA initiated a uniform land cover data base obtained with remote sensing techniques from most of Europe. Harmonised digital terrain models can be obtained with a sampling scheme of 20 by 20 m spatially and 6-7 m in elevation through optical sensors such as SPOT. New techniques using microwave sensors are being developed in order to reach a higher degree of accuracy.

Specific projects carried out for specific users have also allowed IRSA to develop an expertise in hydrological modelling. A project called WETLANDS has improved our understanding of the hydrology of catchments (research conducted in 1995 on two test sites, in England and in Greece, both in collaboration with local organisations), and our ability to assess the impact of major proposed changes (such as river diversion or reservoir building) or to develop water management strategies. Another project, HYDRE, developed for a consortium of Mediterranean regions, allowed IRSA to study the evolution and hydric stress of the vegetation.

Geocoded information on land cover is of prime importance for upstream runoff, as well as for downstream vulnerability assessment. In mountainous areas, forests can slow runoff by a factor of 10 as compared to bare soil. Modelling runoff using land cover information is important for advance warning of

floods during risk periods and for assessing mitigation measures. It can also be important in deciding on agricultural policies of fallow (set-aside) or afforestation which have indirect consequences on floods.

The Institute for Remote Sensing Applications (IRSA) is in the process of setting up a scientific and technical support capacity for emerging Community policies concerning floods, thanks to its in-house expertise and the benefit of ongoing institutional research.

❖ Institutional research activities also fostered spin-offs to specific applications. Two significant examples in the field of surface engineering at the Institute for Advanced Materials:

In the framework of a Eureka project led by IAM (IPACERC project), the development of a new processing technique for production of multilayer coatings has greatly increased (up to 500 times) resistance to erosion. These coatings will have applications in the aeronautics field, particularly in helicopter engines.

Surface engineering technology was applied successfully in the biomaterials field, with three major achievements: improvement of the integration of prostheses in living tissues (hip, teeth) due to biocompatible coatings; reduction of wear of hip prostheses by surface engineering of mobile parts of joints; control of the proliferation of bacteria on the prosthesis by incorporating disinfectant elements on the surface of the prosthesis. These activities are

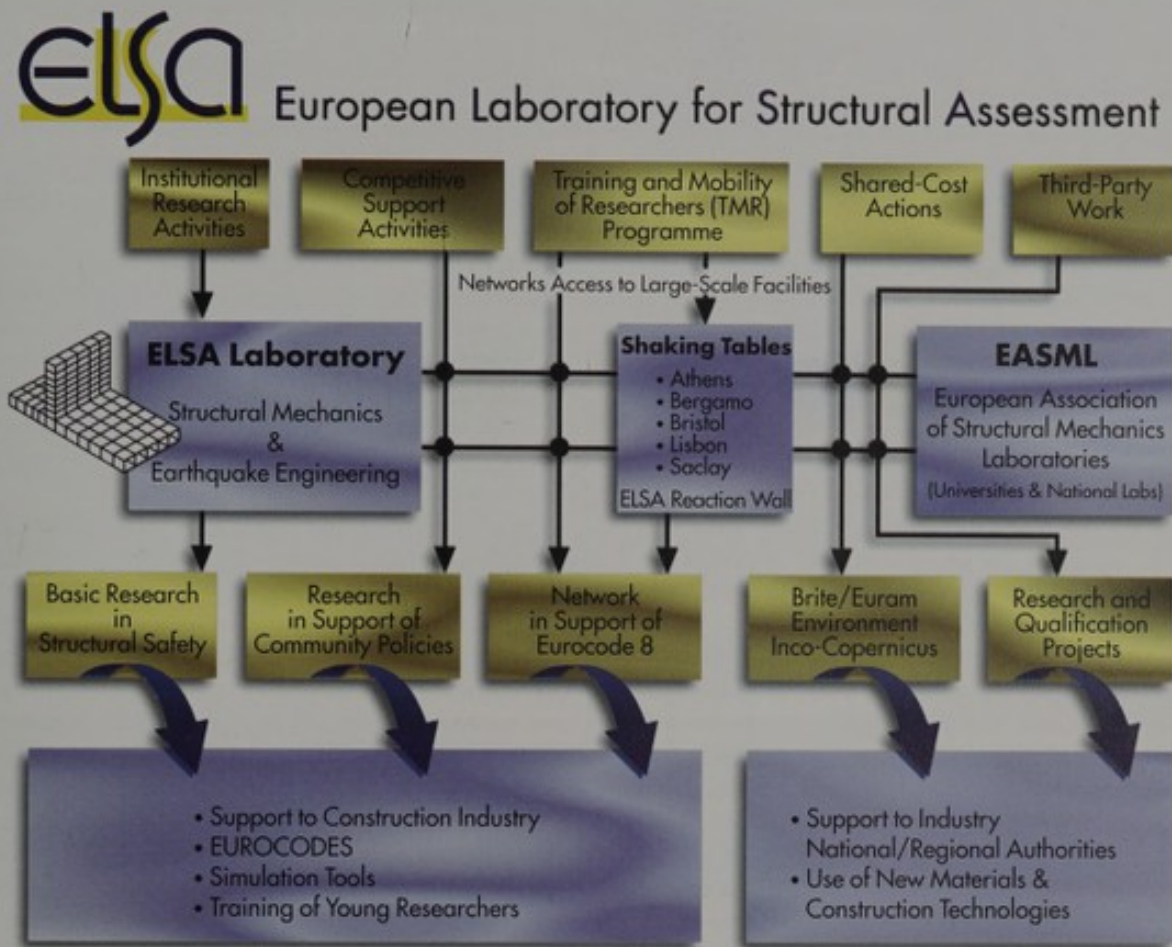


Fig. 3. European Collaboration in 1995 around the ELSA Facility.

conducted in conjunction with several medical institutes in Italy, in France and in Germany.

These two examples illustrate how institutional research can lead to applications useful to industry and society.

❖ Institutional research enabled the JRC to spread a web of scientific cooperation all over Europe. Indeed, through bilateral or multilateral cooperation, the JRC has set up more than 800 connections with various partners, mainly within the European Union but also in other European countries, the USA and Japan. This is illustrated in *Figure 2*.

❖ Finally, its institutional research has been one of the main factors enabling the JRC to develop European scientific networks centred on its own facilities. A vivid example can be found in the field of earthquake engineering:

In spite of important advances in earthquake engineering and seismic design over the last two decades, recent seismic events in Europe (e.g. in Greece and Italy) have shown how vulnerable developed societies still are to the effects of earthquakes, both in human and economic terms. Research aimed at decreasing this vulnerability which, to a large extent, depends on the seismic response of structures is thus clearly needed. High level expertise in seismic design of structures has long been available in the European Union, as have been specialised facilities for earthquake testing of structures, in particular shaking tables.

With the setting up in 1989, at the initiative of the JRC, of the European Association of Structural Mechanics Laboratories and the subsequent opening in 1992 of the ELSA reaction wall facility at Ispra, a new dimension was given to earthquake engineering research in Europe, and Community-wide and well

co-ordinated projects in seismic design of structures were set up around the new facility. At present, more than 20 specialised laboratories in Member States are involved with the JRC in a major programme of pre-normative research, in support of Eurocode 8 (EC8), the provisional European standards for designing civil engineering structures in seismic areas.

Established at the initiative of DG III (Industry) of the Commission and with the advice of the CEN experts in charge of EC8, the research project covers those priority topics which have to be addressed in order to improve the proposed European seismic design rules, and addresses new aspects of earthquake engineering insufficiently covered in the current, provisional version of the code. For the practical implementation of this Community-wide project, the institutional activity at ELSA is a key element allowing the implementation of validation experiments on large—and full—scale models of buildings and bridges.

However, equally important is the significant support which has been obtained, firstly, from the Human Capital and Mobility (HCM) programme and, more recently, from the new Commission programme on Training and Mobility of Researchers (TMR). This support, added to ELSA's own institutional funding, has made it possible to set up two research networks, grouping respectively 18 and 11 European laboratories with the ELSA facility of the JRC. Moreover, substantial funding has also been obtained from the "Large installations" chapter of HCM and TMR to let researchers to have access to a consortium of shaking tables (NTUA, Athens; ISMES, Bergamo; University of Bristol; LNEC, Lisbon; CEA, Saclay) and to the ELSA reaction wall.

In addition to the projects in support of Eurocode 8, organisations from the Member States grouped with the JRC in the European Association of Structural Mechanics Laboratories are participating jointly with the ELSA team in shared cost actions, competitive support activities for the Commission and work for third parties. Industry is involved in research actions aimed at developing and validating new construction technologies and introducing new materials with better durability properties for new constructions as well as for repair and strengthening purposes.

Figure 3 shows the operation in 1995 of European collaboration on earthquake engineering around the ELSA facility.

#### INSTITUTIONAL SCIENTIFIC AND TECHNICAL SUPPORT FOR COMMUNITY POLICIES

The JRC provided Scientific and Technical Support to Union Policies at the request of the relevant Commission services, in conformity with the Council Decisions of 15 December 1994 (which adopted the actual specific programmes of the JRC). These Scientific and Technical activities accounted for 27% of the JRC's Institutional activities.

The support activities are customer driven, in fulfilment of impartial and neutral scientific and technical requirements arising from EC Directives, decisions of the Commission and the Council, or obligations stemming from the Euratom Treaty.

The effective customer/contractor relationship between the requesting services of the Commission and the JRC Institutes is expressed in the elaboration and signing of inter-DG collaboration agreements.

General monitoring of such JRC services to the other Directorates General of the Commission has been exercised by an official inter-DG Committee, established by a Commission decision. This group met twice in 1995, with a high attendance. Its role is twofold: monitoring the work performed, so as to ensure a smooth, mutual exchange of information on the activities (over 100 abstracts related to these support activities were communicated in 1995 to all DGs), and planning activities for the following year, taking into account priorities, new requests and budget limitations.

These Scientific and Technical Support activities were related to the following Framework programme lines: *Information Technologies, Environment and Climate, Agriculture and Fisheries, Targeted Socio-Economic Research and Nuclear Safety and Safeguards.*

Table 1 shows the distribution of this support between the JRC Institutes and the Framework Programme lines.

The three main JRC support activities are:

- ▶ 1. *JRC Support for the Environmental Policy*, which accounts for 46% of the scientific and technical support budget, provides DG XI with scientific and technical assistance for the implementation of the legislation on chemical pollutants, atmospheric pollution, water quality, chemical waste, industrial risks and nuclear safety. The inter-DG collaboration agreement for the period 1995-1998 was signed in December 1995. This work is part of the 5th EC Action Programme in the field of the Environment, and includes:

| Framework Programme Lines  | Institutes |     |     |      |    |      |     |      |
|--|------------|-----|-----|------|----|------|-----|------|
|  | IRMM       | ITU | IAM | ISEI | EI | IRSA | IST | IPTS |
| <b>Information Technologies</b>  |            |     |     |      |    |      |     |      |
| Safety and Reliability of Systems                                      |            |     |     | •    |    |      |     |      |
| <b>Environment and Climate</b>   |            |     |     |      |    |      |     |      |
| European Reference Laboratory for Air Pollution (ERLAP)                |            |     |     |      | •  |      |     |      |
| European Chemicals Bureau (ECB)  |            |     |     |      | •  |      |     |      |
| European Centre for the Validation of Alternative Methods (ECVAM)      |            |     |     |      | •  |      |     |      |
| Support to the European Environment Agency (EEA)                       |            |     |     |      | •  | •    |     |      |
| Quality Control of Consumer Products (Consumer Protection)             | •          |     |     |      | •  |      |     |      |
| Alpine Observatory   |            |     |     |      | •  |      |     |      |
| Industrial Reliability: Major Hazards<br>Biotechnology Safety          |            |     |     | •    |    |      |     |      |
| Foodstuff Analysis in Support of Industrial Policy                     |            |     |     |      | •  |      |     |      |
| European Community Pharmaceutical Information Network (ECPHIN)         |            |     |     |      | •  |      |     |      |
| Methodologies for UCLAF  |            |     |     | •    |    |      |     |      |
| <b>Agriculture and Fisheries</b>                                       |            |     |     |      |    |      |     |      |
| Remote Sensing for Agriculture   |            |     |     |      |    | •    |     |      |
| Animal Identification  |            |     |     | •    |    |      |     |      |
| European Office for Wine, Alcohol and Spirit Drinks (BEVABS)           |            |     |     |      | •  |      |     |      |
| Reference Measurements and Materials for Quality Control of Foodstuffs | •          |     |     |      | •  |      |     |      |
| <b>Targeted Socio-Economic Research</b>                                |            |     |     |      |    |      |     |      |
| Prospective Technological Studies                                      |            |     |     |      |    |      |     | •    |
| <b>Nuclear Fission Safety</b>  |            |     |     |      |    |      |     |      |
| European Networks on Component Ageing and Inspection Techniques        |            |     | •   |      |    |      |     |      |
| Euratom Safeguards Support: General                                    |            |     |     | •    |    |      | •   |      |
| Euratom Safeguards Support: On-Site laboratories and ECSAM             | •          | •   |     |      |    |      |     |      |
| IAEA Safeguards Support  | •          | •   |     | •    |    |      | •   |      |

Table 1. JRC Institutional S&amp;T Support Activities.

❖ The European Reference Laboratory for Air Pollution (ERLAP) which was particularly active in the harmonisation of current EC Directives on air

pollution, in the organisation of Quality Assurance Control programmes and in the development and validation of new monitoring techniques.

- ❖ The European Tracer Experiment (ETEX), aimed at verifying the capability of atmospheric modellers to forecast the evolution of a cloud of an atmospheric pollutant in real time. ETEX was co-sponsored by the EC, the World Meteorological Organisation (WMO) and the International Atomic Energy Agency (IAEA).
- ❖ The European Chemicals Bureau (ECB), which is now handling all the technical and scientific tasks required for the notification of new chemicals, the risk assessment of existing chemicals, classification and labelling and export/import control of dangerous chemicals and testing methods for chemicals.
- ❖ The European Centre for the Validation of Alternative Methods (ECVAM), which, in collaboration with its advisory Committee, has defined criteria for identifying the Centre's priorities. Activities included pre-validation of non-animal test protocols, vaccine potency and safety testing, and integrated alternative approaches in toxicity testing studies which focussed on metabolism-mediated toxicity, and on in-vitro tests for teratogenicity in blood forming tissues.
- ❖ The European Technical Office for Medicinal Products, established at EI after a Memorandum of Understanding was signed between the European Agency for the Evaluation of Medicinal Products and the Joint Research Centre. This office is established in both London and Ispra and is part of the European Technical Office for Medicinal Products (ETOMEP) Unit of the Environment Institute of the JRC; it is dedicated to the development of technical systems necessary for the implementation of European Union legislation on medicinal products.
- ❖ The Major Accident Hazards Bureau, in support of the "Seveso" Directive. The activity of the Bureau resulted in the preparation of a second report on lessons learned from accidents notified to the Commission; in the distribution of a pilot data base of the Documentation Centre on Industrial Risk to the Competent Authorities; and in substantial progress made by the working groups established to produce guidance for safety reports and safety management systems.

- ❖ Support for the elaboration of methodologies for EU antifraud policy (UCLAF).

- ❖ Support services related to the Alpine Observatory (Alpine Convention), initiated in 1995.

The JRC also offers institutional support to the European Environment Agency (EEA-Council Regulation 1210/90).

► 2. *JRC Support for the Common Agricultural Policy*, accounts for 16.5% of the Scientific and Technical Support budget. The inter-DG collaboration agreement for the period 1995-1998 was signed on 17 July 1995. The work is mainly in the following research areas:

- ❖ Application of remote sensing to agricultural statistics, with the aim of developing and demonstrating methodologies which can integrate remote sensing data into the collection of statistics for the monitoring of crop acreage and agricultural production in the EC.

- ❖ Monitoring and control of the Common Agricultural Policy: research and development of new remote sensing techniques allowing for improved monitoring and control of the Common Agricultural Policy.

- ❖ Implementation of Community wine sector legislation through the operation of the "European Office for Wine, Alcohol and Spirit Drinks" (BEVABS); some 4000 EU NMR (Nuclear Magnetic Resonance) wine data have been validated to be stored in the pertinent data bank.

- ❖ Research and development of new methods for improved animal identification in order to prevent fraud.

- ❖ Quality control of foodstuffs, by supplying certified reference materials, by providing suitable analytical procedures and by supplying and/or coordinating laboratory intercomparisons.

► 3. *JRC Support for Nuclear Safeguards* (Euratom Safeguards DG XVII, IAEA Safeguards support programme DG I) accounts for 32% of the scientific and technical support budget. The inter-DG collaboration agreement for the period 1995-1998 is expected to be signed early in 1996.

Most of the work undertaken deals with the following tasks:

- ❖ training of inspectors, harmonisation of in-service nuclear safeguards inspection practices, providing state of the art equipment and reference analyses of nuclear materials samples;
- ❖ design of on-site laboratories for safeguards analysis at reprocessing plants such as Sellafield and La Hague; routine analysis of nuclear materials samples; examination of the purchase and testing of major equipment including the construction of two analytical boxes and the training of analysts;
- ❖ work on non destructive assay, sealing and identification techniques, surveillance techniques, testing of safeguards equipment, data information treatment, health physics and training.

Other institutional Scientific and Technical Support activities deal with:

- Safety and reliability of informatics systems
- Foodstuff analysis in support of the Industrial Policy
- Quality control of consumer products (Consumer Protection)
- Techniques for inspecting ageing nuclear components in support of DG XI and DG XVII.

*Progress made in these programmes is reported in more detail in Part 2, dedicated to the activities of the individual JRC Institutes.*

## COMPETITIVE ACTIVITIES

The introduction, back in 1988, of Work for Third Parties, where the JRC carried out research on a contractual basis for external clients, was meant to provide a measure of the relevance of the JRC's work and its competitive position, to enhance the flow of technology transfer to the end users, and to let the European industry and research communities benefit from JRC

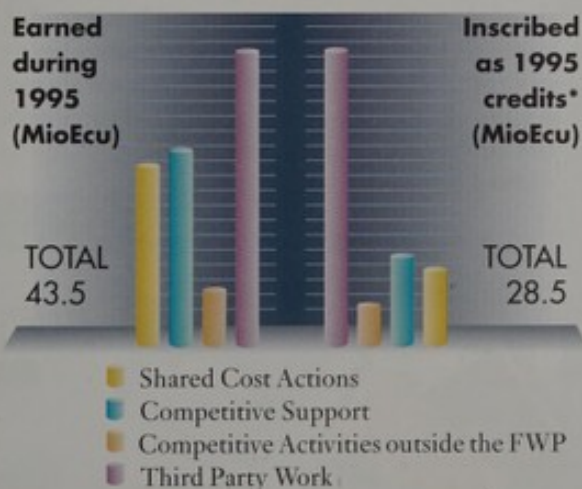
specialised facilities and competences. This was the first step in opening the JRC up to competition. The discussions in the Council and the European Parliament leading to the decisions on the Fourth Framework Programme and the EURATOM Framework Programme emphasised the need for the JRC to pursue and reinforce its move towards a more competitive approach on the basis of a genuine customer/contractor relationship as stated in the Council Conclusions on the role of the JRC in April 1994.

As noted by the Council, the implementation of its conclusions implied several measures and decisions on legal, budgetary, financial and administrative matters which, ideally, should have been in force from 1 January 1995.

The main decision concerned the modification of the Financial Regulation. This always involves a lengthy procedure, prior to the Council decision, and was only achieved in September 1995.

It is intended that this transition be introduced gradually; around 20% of the global JRC budget for 1995-1998 should be earned through competitive activities. As of the 1st of January, 1995, JRC competitive activities included:

- ❖ participation in shared cost actions, where the JRC, in association with partners in the Member States,



\*The balance will be, after conclusion of procedures, inscribed as 1996 credits.

Table 2. Competitive activities, amounts earned in 1995.

submits proposals in the context of call for proposals, or contributes to proposals submitted by other laboratories under the Framework Programmes;

- ❖ competitive scientific and technical support activities; under the Fourth Framework Programme, where the JRC may respond to specific requests from Commission Directorates-General which are allocated on a competitive basis in the context of invitations to tender;
- ❖ other competitive activities outside the Framework Programmes, where the JRC (alone or in a consortium arrangement) will be able to participate in various actions sponsored by the Community (e.g. PHARE, TACIS, assistance to developing countries, etc.) and in the context of a competitive approach, will seek Community funding in relation to those actions;
- ❖ research under contract, the original Third Party Work mode of operation mentioned above, now part of the overall JRC competitive portfolio.

Although preparations for this surge in competitive activities had already started early in 1994, 1995 has been for the JRC a year of learning from experience: learning to cope with new administrative and legal issues, learning to redeploy creatively its resources and personnel to face the competitive challenge, and adapting to a totally new internal and external environment. The JRC Institutes have shown a highly motivated, flexible and keen response to the competitive approach, stimulated by an internal task force on competitive activities. As far as JRC participation in shared cost actions is concerned, the JRC together with partners in the Member States submitted a total of 338 project proposals in response to the first calls for proposals from 15 specific Programmes; by December, 1995 the Commission had accepted 95 of those proposals for funding, bringing the overall success rate to 28%. The financial outcome for the JRC, although difficult to calculate precisely due to the ongoing contract negotiations on several outstanding projects, will be in excess of 10.5 MioEcu. It is important here to underline how both the proposal activity and the subsequent evaluation results have revealed to its full extent the relevance of the JRC's work and its deep roots in the European industrial and research communities.

In the area of competitive scientific and technical support activities, of the 128 MioEcu earmarked within the 4th FWP for funding this activity over the 4-year

period, 26.5 MioEcu were made available to the services of the Commission early in 1995, but only 20 MioEcu have been committed in 1995. Of these, the JRC Institutes have managed to win about 11.9 MioEcu of contracts, either alone or in a consortium arrangement.

Other competitive activities outside the Framework Programmes like TACIS, PHARE, etc., have seen a good 1995 level of activity on the part of the JRC Institutes. In this highly competitive sector of the market, the JRC has won around 2.3 MioEcu.

The record for Third Party Work shows, for 1995, new contracts (obtained on the market at large) in excess of 18 MioEcu. Considered in the context of the outstanding effort on the other fronts, this represents a remarkable hold on the previous positions. (Third Party Work earned in 1994 amounted to 18 MioEcu.)

Table 2 provides a summary of the amounts earned in 1995 for competitive activities.

#### HFR SUPPLEMENTARY PROGRAMME

The High Flux Reactor (HFR) at Petten is operated by the Commission in accordance with the Euratom/Netherlands agreement of 25 July 1961. On 29 April 1992, the Council adopted a four-year supplementary research programme to be implemented by the Joint Research Centre for the European Atomic Energy Community (1992-1995) concerning the operation of the High Flux Reactor (HFR) at Petten. Under the supplementary programme which was drawing to a close on 31 December 1995, the activities of the HFR were essentially the outcome of co-operation between two partners, Germany and the Netherlands, which provided its financing. Additional financing, which has steadily increased, came from external contracts. It is intended to pursue the operation of HFR under a new supplementary programme, which would see an even greater proportion of income coming from the industrial sector and a drastic reduction in costs.



# JRC INFORMATION DAYS

## PUBLICATIONS AND CONFERENCES

The new approach to the JRC activities calls for a closer collaboration between industry, research centres and universities in the Member States and the JRC. In order to stimulate this and to increase the awareness of the JRC, Information Days have been organised at the initiative of Members of the Board of Governors in London, Athens, Copenhagen, Milan and Vienna. JRC members have presented the Centre and in parallel workshops representing the Institutes have found grounds for new collaboration with the participants. These information days have thus supplemented the numerous presentations of the JRC given to visitors to the sites, visits made to national laboratories, representations of the JRC at specialised fairs and exhibitions, distribution of JRC literature, etc.

The JRC offers a vast array of publications on scientific matters ranging from papers and articles in scientific magazines, conference papers, EUR reports and reviews.

In 1995 the JRC published in total around 1,000 papers and their distribution by Institute is shown in *Table 3*.

The detailed list of JRC publications is published each year in the "Publications Bulletin". The last issue, No. 15, published in March 1995, gives all publications in 1994.

Most of these publications are available upon request to the Public Relations Unit, Ispra.

In addition to publications, the above mentioned Bulletin lists all patents obtained by the JRC. There were 26 patents granted in 1995.

Each year the JRC organises a number of conferences, workshops and seminars at its five sites in Europe. In 1995 there were 9 conferences, 94 international workshops and meetings and 135 visits to the various sites. The resulting total of more than 11 000 visitors shows the constant interest of the scientific community to the contributions in research and development made by the JRC.

| Institute                                       | EUR Reports | Conf. Papers | Articles   | Spec. Publicat. | Total       |
|---|-------------|--------------|------------|-----------------|-------------|
| General Management                              | 5           | 1            | 1          | 4               | 11          |
| Inst. for Reference Materials and Measurements  | 4           | 56           | 40         | —               | 100         |
| Institute for Transuranium Elements             | 2           | 77           | 53         | —               | 132         |
| Institute for Advanced Materials                | 18          | 129          | 42         | 3               | 192         |
| Inst. for Systems Engineering and Informatics   | 13          | 118          | 32         | 19              | 182         |
| Environment Institute                           | 22          | 131          | 69         | 6               | 228         |
| Institute for Remote Sensing Applications       | 17          | 114          | 28         | 11              | 170         |
| Institute for Safety Technology                 | 22          | 112          | 26         | 24              | 184         |
| Institute for Prospective Technological Studies | 17          | 3            | 1          | 2               | 23          |
| <b>Total</b>                                    | <b>120</b>  | <b>741</b>   | <b>292</b> | <b>69</b>       | <b>1222</b> |

Table 3. JRC Publications in 1995.



## HUMAN RESOURCES

The JRC statutory staff is made up of officials and temporary agents, including both scientific-technical and administrative staff.

By the end of December 1995 the statutory staff numbered 1786 agents, compared with 1845 in December 1994. *Table 4* gives the distribution of statutory staff in 1995.

| Institute  | Staff        |
|--|--------------|
| Directorate General  | 25           |
| Programmes Directorate   | 13           |
| Resources Coordination<br>Scientific & Technical Support Ispra | 347          |
| Institute for Reference Materials<br>and Measurements          | 169          |
| Institute for Transuranium Elements                            | 194          |
| Institute for Advanced Materials                               | 250          |
| Institute for Systems Engineering<br>and Informatics           | 187          |
| Environment Institute  | 219          |
| Institute for Remote Sensing<br>Applications                   | 101          |
| Institute for Safety Technology                                | 246          |
| Institute for Prospective<br>Technological Studies             | 26           |
| JRC seconded staff   | 9            |
| <b>Total</b>   | <b>1.786</b> |

Table 4. *Distribution of statutory staff as of December 1995.*

In addition to statutory staff, 319 scientists are also active in the JRC under various hosting schemes:

- senior scientists hosted as visiting scientists;
- national experts seconded to the JRC by Member States, to participate in selected scientific work;
- post-doctoral scientists and post-graduate students trained through a programme of fellowships.

*Table 5* gives the distribution, by Institute, of these scientists, working at the JRC at the end of December 1995.

In addition about 20 scientists each year come from a third country assisted by a grant within the framework of a Commission agreement with their countries or with the International Atomic Energy Agency (IAEA).

Besides the above mentioned scientists, several senior scientists and about 150 trainees work at the JRC Institutes at no cost to the EU budget, in general for short periods of time.

## FINANCES

The budget (commitments credits) as implemented by the JRC in 1995 is given in *Table 6*.

To these commitment credits one must add 0.564 MioEcu of credits carried over from the 1994 Budget for the execution of contracts related to research on the environment and on remote sensing from space, authorised in March 1995 (SEC(95) 400 final).

Total JRC committed financial resources amounted to slightly lower than 258 MioEcu:

- ❖ for the execution of the JRC specific programmes (Research and Institutional support activities for the services of the Commission)
- ❖ for the execution of JRC competitive activities within the framework of the EU budget (participation in shared cost actions, competitive support activities for the services of the Commission, JRC participation in other Community activities, contributions from the Dutch and German governments for the operation of the HFR and from JRC customers for the execution of work at their request.

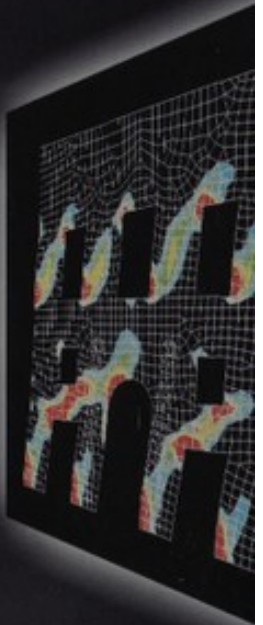
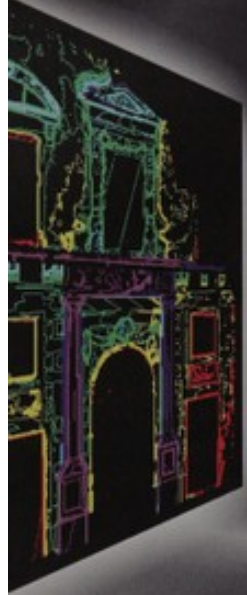
| Institutes   | Visiting Scientists | Seconded National Experts | Post-Doctoral Scientists | Post-Graduate Students | Total      |
|--|---------------------|---------------------------|--------------------------|------------------------|------------|
| Institute for Reference Materials and Measurements | 2                   | 2                         | 16                       | 16                     | 36         |
| Institute for Transuranium Elements                | 2                   | —                         | 14                       | 10                     | 26         |
| Institute for Advanced Materials                   | 4                   | —                         | 32                       | 15                     | 51         |
| Institute for Systems Engineering and Informatics  | 1                   | 2                         | 26                       | 15                     | 44         |
| Environment Institute                              | 5                   | 4                         | 17                       | 34                     | 60         |
| Institute for Remote Sensing Applications          | 7                   | 5                         | 21                       | 17                     | 50         |
| Institute for Safety Technology                    | 4                   | —                         | 17                       | 13                     | 34         |
| Institute for Prospective Technological Studies    | 2                   | —                         | 8                        | 8                      | 18         |
| <b>Total</b>                                       | <b>27</b>           | <b>13</b>                 | <b>151</b>               | <b>128</b>             | <b>319</b> |

Table 5. Visiting scientists, seconded national experts, grantholders as of December 1995.

It should be underlined that the figures in Table 6 refer to expenditure on work performed by the JRC in 1995. Shared cost actions and competitive scientific and technical support activities, as well as participation in other Community activities, were new types of JRC activity in 1995. In most cases contracts were only entered into at the end of 1995. As a result, only limited work was carried out during that year. Figures on contracts entered into during 1995 are provided in Table 2.

Table 6. 1995 Budget implementation (Commitments Credits).

| Institutional Activities                                | (MioEcu)       |
|---|----------------|
| EC Specific Programme                                   | 152.761        |
| EAEA Specific Programme                                 | 75.301         |
| Subtotal  | 228.062        |
| Competitive Activities                                  |                |
| Participation in shared cost actions                    | —              |
| Competitive Scientific and Technical Support activities | 0.027          |
| Participation in Community activities outside the FWP   | 0.045          |
| Work for third parties                                  | 10.460         |
| Subtotal  | 10.532         |
| HFR Reactor   | 18.548         |
| <b>Total</b>  | <b>257.142</b> |



# *Part 2: ACTIVITIES OF THE JRC* INSTITUTES IN 1995

|      |  |
|------|--|
| IRMM | The Institute for Reference Materials and Measurements |
| ITU  | The Institute for Transuranium Elements                |
| IAM  | The Institute for Advanced Materials                   |
| ISEI | The Institute for Systems Engineering and Informatics  |
| EI   | The Environment Institute                              |
| IRSA | The Institute for Remote Sensing Applications          |
| IST  | The Institute for Safety Technology                    |
| IPTS | The Institute for Prospective Technological Studies    |

◀ *Palazzo Geraci, an 18th century building located in the historic centre of the city of Palermo (Sicily, Italy), has been chosen as the test case for the application of numerical photogrammetry, 3D reconstruction and virtual navigation, seismic response analysis, experimental tests on a 1/2 scale model of the building, design of consolidation elements (Support to Regional Development, Sicily Project, Cultural Heritage: study of the degradation of monuments and works of art in stone material; development of protection and restoration methods).*

# THE INSTITUTE FOR REFERENCE MATERIALS AND MEASUREMENTS

The IRMM promotes European standards, reference materials and methodologies at the European level. In 1995, the Institute implemented its specific programme under the heading of Measurements and Testing and contributed to the Framework Programme line "Industrial Technologies". Early in 1995, IRMM took over responsibility for managing the BCR's (Community Reference Bureau) reference materials: this includes storage, stability control, distribution, sales administration and recertification of exhausted batches.

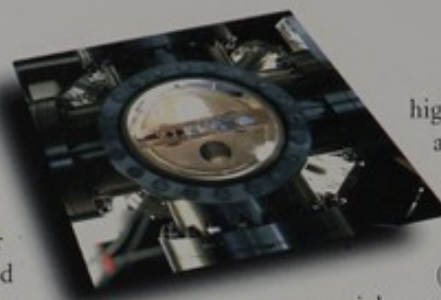
IRMM is engaged in support activities for Community policies, related to nuclear safeguards, the safety and quality control of consumer products, and reference measurements and materials for quality control of food-stuffs. It also provides services and reference materials to various customers from the European Member States.

## A. INSTITUTIONAL ACTIVITIES

### INSTITUTIONAL RESEARCH ACTIVITIES

One of the objectives of the work at the IRMM, within the Measurements and Testing programme, is harmonisation and standardisation in analytical measurements. To this end the available measurements expertise and the refined analytical techniques of the Institute have been applied to prepare, characterise and certify high quality reference materials for both nuclear and appropriate non-nuclear fields, to be used for establishing a coordinated analytical measurement system at European level. Within this framework, responsibility for the management of reference materials under the standards, measurement and testing programme (formerly BCR) has been taken over by IRMM.

Research on biological and environmental materials included attempts to isolate and stabilise chloroplast material suitable for the bio-assay of pesticide traces in drinking water control. Analytical research was pursued on metallothionein characterisation by electrochemistry and liquid chromatography, and on heavy metal traces of environmental or bio-medical relevance. The modern Ultra Clean Chemical Laboratory was used for the sub-boiling preparation of batches of



high purity water and of acids for high accuracy analytical work.

The IRMM also contributed to the improvement of the neutron interaction standards data sets (which serve to determine, inter alia, partial cross-sections) as collected in the High Priority Request List by the NEA Working Party on Evaluation Cooperation, under the auspices of the NEA Nuclear Science Committee and in collaboration with IAEA.

For quality control in the preparation of certified reference materials, a neutron activation analysis facility was set up in collaboration with the SCK/CEN at Mol (Belgium).

The proceedings of the International Multiple Group Analysis Users' Workshop were published.

### LINAC REFURBISHED

*IRMM's electron linear accelerator LINAC, with its unique high energy-resolution potential, was refurbished from September 1994 to April 1995. The neutron measurement programme was resumed at the accelerator in collaboration with CEA scientists in the fields of neutron capture and transmission experiments. Measurements of the total and radiative capture cross-sections of  $^{99}\text{Tc}$  in the low resonance region were started in collaboration with the CEA at Saclay (France). Low energy resonance in uranium and uranium oxide was studied at low temperatures in order to investigate solid state effects on resonance shapes, in collaboration with the CEA at Cadarache (France).*



*The refurbished LINAC; view of the new accelerating sections.*

Work related to nuclear matters included, inter alia, the supply of targets for neutron cross-section measurements, fission fragment studies and other applications; the preparation and characterisation of 10B reference layers to be used in high accuracy neutron flux measurement; the setting up of an improved electrodeposition method for the preparation of thin uranium and plutonium layers; the determination of uranium in environmental samples.

Also at the LINAC, high energy resolution measurements of the inelastic scattering cross-section of iron were made using a 60 m flight path. The spontaneous fission processes of plutonium isotopes and of  $^{252}\text{Cf}$  have been further investigated.

At the 7 MV Van de Graaff accelerator, neutron inelastic scattering was measured on natural molybdenum. In collaboration with KFA Jülich (Germany), cross-sections for various activation reactions were measured on chromium isotopes. Improved experiments to determine the ratio of the reference cross-sections  $^{235}\text{U}(n,f)$  and  $\text{H}(n,n)$  have been initiated.

In radionuclide metrology, an intercomparison of computer codes used for the analysis of  $^{239}\text{Pu}/^{240}\text{Pu}$  alpha particle spectra has been pursued. Ultralow-background  $\beta$  spectrometry was used to characterise human bones for low radionuclide content in the underground laboratory of HADES (High Activity Disposal Experimental Site) at Mol (Belgium) in a European effort to obtain a natural matrix reference material. Similarly, detection limits for  $^{210}\text{Pb}$  in a biological matrix were determined.

For the materials research projects two complementary experimental setups for hydrogen profiling have been installed at the 7 MV Van de Graaff. At the 3.5 MV Van de Graaff machine, the stopping power for helium ions and protons of polyimide and VVNS (trade name of vinyl chloride/vinyl acetate co-polymer) foils has been determined, as well as the uniformity of trace metals on filters for an aerosol reference material.

#### INSTITUTIONAL SUPPORT ACTIVITIES

IRMM's support activities in 1995 were mainly related to Nuclear Safeguards, on request from DG I (External Relations), for the International Atomic Energy Agency (IAEA) and DG XVII (Energy, Euratom Safeguards Directorate). Non-nuclear certified reference materials were also prepared for other DGs.

IRMM acted in general as a Commission laboratory offering scientific/technical support to services which do not dispose of their own measurement back-up.

Work on dried nitrate or metallic spike material was continued to improve safety at large reprocessing plants, and uranium and plutonium isotopic reference materials were prepared on behalf of DG I for IAEA. Low concentrations implied meticulous chemical work in IRMM's ultra clean chemical laboratory.

IRMM provided DG XVII with solutions for detector calibration needed in non-destructive assays of uranium and plutonium. Certified reference materials of soils, sediments and foodstuffs were prepared for DG III (Internal Market) and DG VI (Agriculture), for quality control to assist enforcement of European legislation. These activities were complemented by providing suitable analytical procedures and by initiating and/or coordinating laboratory intercomparisons. For DG VI, new activities were initiated on selenium speciation and sugar analysis. Cosmetics analyses and a product safety data bank were under development for DG XXIV (Consumer Policy).

## B. COMPETITIVE ACTIVITIES

### SHARED-COST ACTIONS

In its field of competence, IRMM has contributed in 1995 to 8 SCA proposals, 3 of which have been accepted so far; these deal with:

- ❖ the design, production and certification of sets of synthetic polymer reference materials consisting of a polyolefinic base material doped with heavy elements Cd, Cr, Hg and Pb at two different concentration levels;
- ❖ the preparation and certification of calibrant solutions and fly ash samples for measurements of polychlorodibenzo-p-dioxins (PCDD) and polychlorodibenzofurans (PCDF) contaminations in emissions at levels of  $0.1 \text{ ng/m}^3$ ;
- ❖ the preparation and characterisation of catalytic converters with respect to Pt, Rh, Zr and Ce.

### FLY ASH REFERENCE MATERIALS AND SYNTHETIC POLYMER REFERENCE MATERIALS

*One of the successful Shared-Cost Action proposals dealt with the preparation and certification of solutions and fly ash reference materials for measurements of dioxine or furane compounds at low concentration levels. A proposal related to the design, production and certification of two consumable synthetic polymer reference materials doped with heavy elements at two concentration levels, has been launched with a view to promoting environmental protection and supporting the European polymer industry in the materials development, production control and quality management.*



*Multipurpose mixer with filling equipment. Heat treatment and homogenisation of large amounts (up to 200 kg) of soils and sediments. Filling bottles with well homogeneous powders.*

### WORK FOR THIRD PARTIES

IRMM services and reference materials are available on a commercial basis. As IRMM now manages the BCR's reference materials, these are also being made commercially available for non-nuclear applications.

The International Measurement Evaluation Programme (IMEP) is arousing interest in a growing number of laboratories. The most recent IMEP round on trace elements in water attracted about 250 laboratories in 28 countries. The Regular European Interlaboratory Measurement Evaluation Programme (REIMEP), an external quality control exercise, recently brought together 20 laboratories worldwide in rounds on uranium oxide powder and two uranyl nitrate solutions.

The supply of nuclear samples to external customers, in particular for reactor neutron dosimetry, was continued. Four new neutron dosimetry reference materials for reactor pressure vessel surveillance (titanium metal and three Al-Co alloys) have been prepared.

# THE INSTITUTE FOR TRANSURANIUM ELEMENTS

ITU performs activities in the field of the safety of the nuclear fuel cycle. The Institute contributed to the Framework Programme line "Nuclear Fission Safety" with a particular emphasis on the safety of actinides in the nuclear fuel cycle. Other research themes were the safety of nuclear fuels, through the measurement and modelling of fuel properties, and the characterisation of spent fuel with a view to its long term storage.

ITU also provided scientific and technical support for Community policies in the area of "Nuclear Fission Safety", mainly in on-site laboratories at Sellafield and La Hague (Euratom Safeguards) and for the IAEA (International Atomic Energy Agency). In addition, it is engaged in several contracts at the request of various customers.

## A. INSTITUTIONAL ACTIVITIES

ITU performs its activities under the "Safety of nuclear fuels" part of the programme; it contributes to the Commission's sectorial policies on "Safeguards" and "Fissile Material Management", through research and development of techniques and instruments, analytical services and expertise, and direct in field measurement support.

### INSTITUTIONAL RESEARCH ACTIVITIES

**Fuel Cycle Safety:** Basic actinide research is being carried out to elucidate the electronic structure of actinide elements and their interest for chemistry and solid-state physics. Important results have been obtained in the understanding of uranium-based heavy-fermion superconductors doped with neptunium (Np) and plutonium (Pu). Other themes include the theory of light/solids interactions; neutron experiments with Np compounds and neutron inelastic scattering, to better understand electron interactions in the  $5f$  and  $3d$  electron shells; X-ray synchrotron experiments on uranium oxide single crystals and uranium arsenide crystals, to help understand magnetic behaviour.

In the area of safety nuclear fuel, ITU is measuring and modelling fuel properties and fuel/cladding inter-

actions in order to be able, in a few years, to design very high burn-up MOX (mixed U- Pu oxide) fuel pins that would be as reliable as present-day uranium fuel. Fission product release from irradiated fuel as used in the PHEBUS reactor safety programme was measured up to

complete evaporation of the fuel. The TRANSURANUS code was successfully used to describe high burn-up phenomena (rim effect). For the first time, the use of high resolution electron microscopy clearly revealed dislocation lines in  $UO_2$  and the subgrain boundary formation as the first step in the formation of the rim-structure.

In the area of the mitigation of long-lived actinides and fission products, in order to help further minimise the radiotoxicity of spent fuel and highly active waste, ITU collaborates with leading national laboratories, nuclear industry and Member State authorities to prepare samples for fuel irradiation, transmutation and recovery of actinides, for example, technetium (Tc) samples for irradiation, pins with high Pu and Np content and a Pu-cerium inert matrix based pin within the EFTTRA (Experimental Feasibility of Targets for Transmutation) and TRABANT (Transmutation and Burning of Actinides in Triox) programmes. The feasibility of recovering actinides from irradiated fuel targets with 20% Am (americium) and 20% Np was demonstrated. Extraction chromatography was investigated for the separation of U and Pu from such fuels. A patent application was made for a method burning weapon-grade Pu in a Light Water Reactor with high proliferation resistance. Studies were carried out on fabrication procedures and the physical and chemical properties of inert matrix materials for the transmutation of actinides. Pellets of mixed oxide reference material and fuel pins with metallic fuel have been fabricated and characterised.





In the area of spent fuel characterisation with a too long term storage, analyses were performed to provide reactor operators, the fuel cycle industry and licensing authorities with the necessary, relevant safety data, including those on radiotoxicity. For instance, the leaching and corrosion behaviour of natural uranium oxide and irradiated high burn-up fuel was investigated using solutions simulating groundwater and salt brine, with attention paid to the mechanisms and kinetics of leaching. The structure of oxidised layers on leached uranium oxide was determined by the Rutherford backscattering/channeling techniques. The porosity in the outer rim of irradiated high burn-up fuel was quantitatively analysed in detail.

#### INSTITUTIONAL SUPPORT ACTIVITIES

In support of the energy policy (DG XVII), in the area of "Safeguards and Fissile Materials Management", on-site laboratories were designed for safeguards analysis at reprocessing plants such as Sellafield and Cap de la Hague, and major analytical equipment such as robots, titrators, alpha-spectrometers, non-destructive measurement devices and detectors, was purchased and tested. In addition, two analytical boxes were constructed, analysts were trained and routine analyses of nuclear material samples were performed. Some other examples of 1995 support activities: a performance evaluation of the MGA method (Multiple Group Analysis) for K-edge and neutron-gamma counting applications; a comparison of plutonium assay techniques; a detailed evaluation of isotope correlation techniques for the determination of Pu-242; samples preparation and measurements technology for safeguards samples with trace amounts of radionuclides in soils, vegetation and sediments from contaminated areas.

As before, ITU staff provided significant analytical in-site support to the Safeguards Directorate in reprocessing and in fuel fabrication plants. The characterisation of vagabonding nuclear materials was continued whenever necessary.

#### ANALYSIS OF ENVIRONMENTAL SAMPLES

*During 1995 the corner-stone was laid for the new ARTINA Laboratory. With this laboratory fully operational, the Institute can provide ultra sensitive analysis of radio-isotope traces for the identification of undeclared nuclear activities. This capability will be used for safeguards applications.*

*The ARTINA laboratory consists of a class 100 clean laboratory for sample preparation and pre-treatment and a range of highly sensitive equipment for the measurement of a range of radioisotopes which are "indicators" for clandestine nuclear activities.*

*ITU has asked to become a network laboratory of the IAEA for environmental samples and has already participated in test campaigns for the analysis of bulk samples and particles.*

### B. COMPETITIVE ACTIVITIES

#### SHARED-COST ACTIONS

8 proposals (made with EU partners) for the Nuclear Fission Safety programme were accepted in 1995. The projects concern:

- ❖ evaluation of partitioning and transmutation strategies
- ❖ new partitioning techniques
- ❖ impact of accelerator based technologies on nuclear fission safety
- ❖ thorium cycles as a nuclear waste management option
- ❖ revaporisation tests on samples from PHEBUS FP
- ❖ source term for performance assessment of spent fuel as a waste form
- ❖ supporting nuclear data for advanced MOX fuels
- ❖ joint experiment on Americium transmutation.

These Cost-Shared Actions will contribute about 1 MioEcu.

#### COMPETITIVE SUPPORT FOR COMMUNITY POLICIES

Following a call for tender from DG XIII, ITU has submitted, together with other partners, a project on "Enhanced Gas Cleaning by Infra-Sonic Particle Agglomeration and Deposition". The project was accepted at the end of 1995; the Institute's share is about 0.1 MioEcu.



*Preparation of specimens in the 100 class clean laboratory ARTINA for the analysis of particles in swipe samples.*

#### WORK FOR THIRD PARTIES

As in previous years, the Institute has carried out work for third parties, with major contracts in the areas of post irradiation examination of irradiated fuels, fabrication and characterisation of fuels for transmutation, and examination of high burn-up uranium oxide and mixed oxide fuels for different customers.

During 1995, new contracts worth about 2.1 MioEcu have been signed, while work from previous contracts continued.

#### OTHER COMPETITIVE ACTIVITIES

The following offers submitted to the TACIS /PHARE programmes were accepted during 1995:

- ❖ Measurement of radionuclide release from Chernobyl reactor debris samples (TACIS-Ukraine)
- ❖ Transfer of the nuclear safety code TRANSURANUS to the Bulgarian licensing authorities (PHARE-Bulgaria).

A study proposal, concerning the establishment of a data bank on nuclear materials in the framework of illicit trafficking, was accepted by DG I. The contract will permit collaboration with two Russian experts at ITU for 12 months. The overall scope of the approved projects is about 0.6 MioEcu.

# THE INSTITUTE FOR ADVANCED MATERIALS

IAM performs research on advanced materials. The Institute contributed to the Framework Programme lines "Industrial Technologies and Materials Technologies" and "Measurements and Testing", with an emphasis on standards for applications, development of new and improved coatings, structural component integrity and materials for clean technologies and fusion materials. IAM also contributed to the Framework Programme lines "Non-nuclear Energy", "Nuclear Fission Safety" and "Controlled Thermo-nuclear Fusion".

It also operated in 1995 the High Flux Reactor (HFR) for the Dutch and German authorities and was engaged in work on a contractual basis for industry.

## A. INSTITUTIONAL ACTIVITIES

### INSTITUTIONAL RESEARCH ACTIVITIES

Within the Industrial Technologies and Materials Technologies programme, research activities performed in 1995 can be sorted approximately into four clusters:

### THE EUREKA IPACERC PROJECT

*Helicopter engines are usually submitted to extremely hard erosion conditions, leading to rapid failures of their components. The engine manufacturer Turbomeca has developed a new type of multilayer coating deposited by Physical Vacuum Deposition, showing an improvement by a factor of over 500 compared to conventional hard coatings already available. The new challenge is to apply this coating to the very complex shapes to be protected in a helicopter engine.*

*Accordingly, the JRC has proposed, in the frame of a EUREKA project, the development of a new Induction Plasma Assisted Chemical Vapor Deposition (I-PACVD) machine specially designed for this application. Plasma Chemical Vapor Deposition will allow deposition at low temperatures. Induction plasma Chemical Vapor Deposition will ensure good process homogeneity, which is an absolute must in this case.*

- ❖ "Standards for Applications" area: research on mechanical performances of materials, corrosion, components' integrity testing, neutron scattering, joining of ceramics and brittle materials. Also, activities linked with information technologies: high temperature materials data bases; the Information Centre on Materials Activities.

The typical end-users are the energy production and aeronautics industries.

- ❖ "Development of New and Improved Coatings": wear and corrosion resistance improvement, chemical sensors, fatigue resistance, superhard surfaces and biomedical applications; new composite materials, with an emphasis on interfaces in fibre composites, and electrophoretic processing of ceramic matrix composites. Exploratory research projects included laser spallation testing methodology and high temperature superconductors.

The typical end-users are in manufacturing industry, the car industry, aeronautics and electronics.

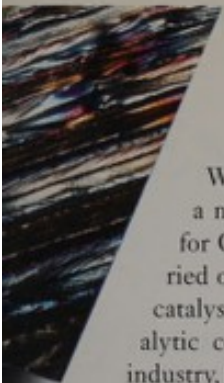
- ❖ A new line for IAM will be support for industry through the provision of information and pre-normative know-how on eco-friendly materials, materials studies and an ECO materials database.

Research work was done on coatings for waste incineration and coatings for dry machining in manufacturing technologies.

The end-users are the waste management industry, the recycling industry and, in particular, the car industry and manufacturing industry.

- ❖ Two projects focused on "Structural Component Integrity": application and qualification of non-destructive evaluation (NDE) techniques to assess defective and/or deteriorating industrial components; NDE and testing of structural components.

The end-users are mostly the energy production industry, both conventional and nuclear, and the transport industry including aeronautics, rail and car manufacturers.



Within the Non-Nuclear Energy programme, a new topic was introduced in 1995: "Materials for Clean Technologies". Two projects were carried out: microstructural engineering and ceramic catalyst support, both focusing on automotive catalytic converters. The potential users are the car industry, but also energy producers using conventional fuel sources.

#### THE EUROPEAN PRESSURE EQUIPMENT RESEARCH COUNCIL (EPERC)

*The European Pressure Equipment Research Council (EPERC) is an association of industries, laboratories, engineering associations and government bodies, the purpose of which is to promote European cooperative research in the domain of pressure equipment. EPERC is concerned with research and development problems linked to construction and in-service activities. It deals with all types of pressure equipment, nuclear equipment excluded.*

*EPERC acts as a clearing-house to define and coordinate the research programmes and exchange experience. It has an important role in the dissemination of the results of research to industry, and works in close contact with the European Commission with regard to shared-cost action proposals and support to CEN and DG III.*

*JRC IAM Petten is the operating agent.*

*In the international domain, there are plans to cooperate with the American Pressure Vessel Council and the Japanese Pressure Vessel Council.*

Within the Nuclear Safety and Safeguards programme, and specifically the section on reactor safety, IAM is the operating agent for the already established European networks dealing with "Nuclear Components and Inspection". Projects in operation include an experimental study on ageing, degradation of steel properties and subsequent annealing, and the Networks Reference Laboratory.

Within the Controlled Thermonuclear Fusion programme, the development of fusion technology focused on the design of the International Thermonuclear Experimental Reactor (ITER). The IAM contributed to this effort and supported ITER's technological needs through its selection and characterisation of adapted materials. IAM also participated in the European longer term programme for the development of low activation materials. In parallel, irradiation experiments were performed in the HFR in support of NET/ITER.

#### INSTITUTIONAL SUPPORT ACTIVITIES

Projects with the same range of scientific content as above were carried out in support of DG XI (Environment) through the European networks AMES, ENIQ and NESC, and DG XVII (Energy). An information and management transfer structure was set up to improve the technology transfer process.

#### THE EUROPEAN NETWORK FOR INSPECTION QUALIFICATION (ENIQ)

*The Steering Committee of ENIQ in which the EU nuclear power plant operators are the voting members, has approved a reference methodology for inspection qualification. This methodology has aroused great interest from industry in its field and is considered of prime importance for future development.*

### B. COMPETITIVE ACTIVITIES

#### SHARED-COST ACTIONS

IAM took part in 49 proposals, of which 17 have been accepted so far. 9 of these will have immediate funding. The distribution of proposals among the programmes is: 33 to BRITE/EURAM, 6 to Standard Measurement and Testing, 4 to Nuclear Fission Safety, 2 to Biomed-2, 1 to Environment and Climate, 1 to ESPRIT, 1 to Training and Mobility of Researchers and 1 to JOULE.

#### COMPETITIVE SUPPORT FOR COMMUNITY POLICIES

Two successful proposals were made to the Valorisation programme of DG XIII (Telecommunications, Information Industries and Innovation). The first deals with an "Autonomous Solar System", the second with neural network techniques for non-destructive evaluation (NDE) applications. This last proposal is a joint venture of both IAM and ISEL.



*Test assemblies used for the pilot study on the application of the European Methodology for Qualification of inspection procedures.*

#### WORK FOR THIRD PARTIES

New contracts signed in 1995 deal with the following topics: PC based High Temperature Materials Data Base Software, Non Destructive Evaluation Techniques, Aero-engine components, coatings, corrosion studies on advanced materials for power generation.

The overall turnover was comparable to last year's.

#### OTHER COMPETITIVE ACTIVITIES

IAM is a partner in a PHARE consortium dealing with the installation of a qualification system for in-service inspection of Nuclear Power Plants in the Czech Republic. IAM is also a partner in proposals made to TACIS in the fields of NDE, inspection and materials ageing.

#### HIGH FLUX REACTOR (HFR)

The High Flux Reactor at Petten continued its operation in 1995 and its utilisation reached about 75% of the practical limits. The HFR noticeably strengthened its leadership as a supplier of radioisotopes for the radio-pharmaceutical industry: nearly 65% of European production took place at HFR. The recent launching of the on-site molybdenum factory will further enhance HFR's role as a key facility for nuclear medicine, vital for millions of patients.

The HFR also maintained its role as irradiation test bed for the Fusion community: six new experiments on first wall structural materials (mainly martensitic steels) and plasma facing components have started. The irradiation embrittlement project, part of the European Network AMES (Ageing of Materials and Evaluation Studies), was launched. A new experiment series was started on the transmutation of actinides and fission products to reduce the long term radiological impact of high level waste, as part of the European collaboration EFTTRA (Experimental Feasibility of Targets for TRANsmutation).

# THE INSTITUTE FOR SYSTEMS ENGINEERING AND INFORMATICS

The ISEI performs research on systems engineering and informatics. It contributed in 1995 to the Framework Programme lines "Environment and Climate", "Non-nuclear Energy", "Nuclear Fission Safety" and "Controlled Thermonuclear Fusion", carrying out research on methodologies for environmental management and assessment of environmental quality, on solar energy by photovoltaics, on fission reactor safety and fissile material control as well as on fusion reactor operational safety.

In addition, ISEI provided scientific and technical support for Community policies: in the field of the environment, among others on industrial safety and the reliability of systems including biosafety; in the field of agriculture, on animal identification; and in the energy sector, on nuclear safeguards for the Euratom safeguards and for the IAEA. ISEI is also currently engaged in work carried out at the request of external customers.

## A. INSTITUTIONAL ACTIVITIES

The Institute carries out research on the reliability and performance of complex systems; on socio-technical systems and risk management; on expert systems; on parallel computing; on data bases; and it operates a major computer and network facility. Areas of expertise include: aviation safety, human factors, non-nuclear energies, fusion, fissile materials safeguard, industrial safety, environmental risk assessment and emergency planning.

### INSTITUTIONAL RESEARCH ACTIVITIES

Within the Environment and Climate programme, ISEI contributed to studies on:

- ❖ "Global Change": an on-line information service called "European Wide Service Exchange" (EWSE) was developed for the Centre for Earth Observation (CEO). Other contributions include software engineering, user interface, quality assurance, satellite image compression techniques and network support.

A pilot study related to a specific decision maker and the availability of data through EWSE was carried out.

- ❖ The "Integrated Assessment of Environmental Quality" approach: aims to provide decision makers with alternative options for action, via a synthesis of information and understanding from a wide range of sources and perspectives. A set of criteria for "good practice" in the field is now being developed.



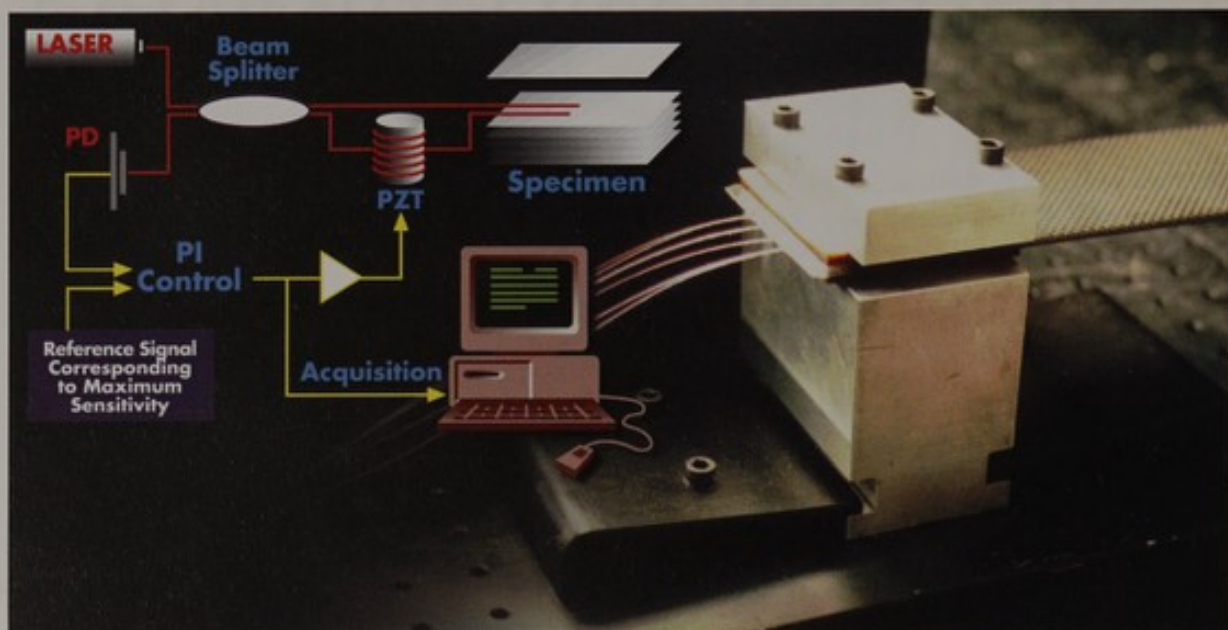
### EUREKA-ADAGE

*ADAGE is a EUREKA project between French and Portuguese companies and the JRC-ISEI. The aim of the project is to develop a decision-support system for integrated environmental management. Its principal objective is to provide a thorough assessment of alternative decisions related to environmental matters. The main features of the project are: the development of a distributed information system networking various sources of information represented by the stakeholders concerned with the decision process; the integration and fusion of different types of information; the integration of diverse perspectives including environmental constraints, socio-economical factors and technical issues; a highly interactive system for information updating and navigation, as well as scenario testing. The project is scheduled over a three-year period.*

- ❖ "Innovative Environmental Technologies": the application of decision support systems has been refined and a promising new method based on object-oriented programming has been implemented, which will also be of use in ongoing work for external clients. ISEI joined the EUREKA project "ADAGE", which aims to develop a decision support system for comprehensive environmental management via the thorough assessment of alternative decisions.

Within the Non-Nuclear Energy programme, the following activities were performed:

- ❖ Photovoltaic: using a climatically controlled solar simulator, irradiation was carried out at various tem-



Composite laminate with embedded sensing optical fibres: schematic of the experimental set-up with the optic and electronic system.

peratures to study the effects of light-induced degradation on amorphous silicon modules. Results have been leading to a revision of the CEC ESTI 701 specification. An analysis of the spread in the characterisation results for World Photovoltaic Scale samples (WPVS) has also been performed.

Within the Nuclear Fission Safety programme, work was carried out on:

- ❖ Nuclear fission safety and reactor safety: a benchmark exercise has been launched on expert judgment in probabilistic safety assessment (PSA), level 2. A questionnaire has been distributed to a network of more than 50 European institutions (research laboratories, regulators, industries, etc.). The first phase, parameter estimation, also involves the Institute for Safety Technology (IST), whose facility FARO has been adopted as a reference experiment.

#### SMART COMPOSITE MATERIALS

The use of fibre optics in transducer systems for measurement of physical parameters has recently attracted much interest. The possibility of embedding optical transducers into new composite materials has boosted research in the field of smart materials which allow real time structural monitoring from inside the structure itself. In continuous fibre composites materials, the proper positioning of the reinforcement allows the material to

host optical fibres without an increase of the notch factor. Along this line of research, a smart composite material laminate was produced at ISEI (24 ply graphite/epoxy beam and Michelson based fibre optic strain transducers embedded in it) and tested.

Both static and dynamic tests were performed and results compared to theoretical predictions and to strain values measured by conventional strain gauges bonded to the external surface of the laminate; the correspondence was very good, particularly in the dynamic response. Results supplied by the embedded sensing net of fibres confirmed its diagnostic capability and allowed the planning of future research steps.

- ❖ Several types of activity have been carried-out within the research on Nuclear Safeguards. The activities on remote verification and surveillance included: distributed surveillance systems based on smart digital cameras and industrial field bus; remote control of a robotic arm for simple manipulation tasks; and the application of new compact laser range finders. In the field of international remote monitoring systems, various methods for digital image compression and encryption over public communications networks were tested.

The LaSCo (Laboratory for Surveillance and Containment) has been equipped with testing equipment for electromagnetic studies, to check the compliance of instruments with the new European legislation in this area.

The SILab (Seals and Identification Techniques Laboratory) has successfully helped develop specific ultrasonic boards and software to be used in the next generation of ultrasonic sealing systems at JRC Ispra.

A design study was performed in collaboration with ITU for the establishment at Obninsk of the "Russian Methodological and Training Centre" in the field of nuclear safeguards. This study has led to the conclusion of a TACIS contract.

- ❖ Research activities related to Controlled Thermo-nuclear Fusion have been focused on ITER (International Thermonuclear Experimental Reactor) as follows:

Remote handling: computer simulation and tests on the ROBERTINO facility of the maintenance by remote operation of the blanket components placed inside the reactor have been completed.

Safety studies: the mechanical integrity of the vacuum vessel of the reactor and blanket components under plasma disruptions has been investigated. Thermal transient analyses after a reactor accident have been pursued.

#### INSTITUTIONAL SUPPORT ACTIVITIES

- ❖ For the Commission Secretariat General, scientific and technical projects were completed in support of UCLAF, the Commission antifraud service: a study of UCLAF's customers and the services they require; a requirement study of the investigative process; an inventory of information resources; and an exploratory data analysis of fraud case data. New projects are under way: a feasibility study for IRENE 95 (the integrated information management system of the UCLAF); pattern recognition in databases of fraud cases; estimating the rates of commission vs detection/communication of fraud; harmonising fraud case information flows across all sectors.
- ❖ Support to DG III (Industry) included a contribution to the Information and Communications Technologies programme through R&D projects, industrial workshops, seminars and conferences (SAFE-COMP 95).
- ❖ Support to DG VI (Agriculture): research, development of new methods and performance tests were

carried out for the identification of animals by means of tags and their measurement systems, in the framework of a major (antifraud) European animal tagging project.

- ❖ Support to DG XI (Environment): the memorandum of understanding for the creation of the Major Accident Hazard Bureau in support of the "Seveso" Directive has been implemented. This Bureau, linked mainly to DG XI and subsequently to national authorities and industry, operates a Major Accident Reporting System (MARS) and a Community Documentation Centre for Industrial Risk (CDCIR).

In 1995 the Bureau dealt with the production of reports on lessons learned from accidents notified to the Commission, with distribution of a data base on accidents as well as with coordination of technical groups on safety reports and management systems. The Bureau also organised a seminar on the implementation of the Seveso Directive, "Accident Scenarios and Emergency Response".

In the field of safe applications of biotechnology, a high level EU-US meeting took place in June, dealing with field tests of genetically modified organisms.

- ❖ In support of the Nuclear Safety Unit of DG XI, a first version of the European earthquake catalogue has been prepared and its further development is under consideration.
- ❖ Support provided to the EURATOM Safeguards Directorate, DG XVII (Energy): ISEI contributed to the fulfilment of Treaty requirements in the following areas: sealing and identification techniques, surveillance techniques, testing of safeguards equipments, data and information treatment, health physics and training. A new system for the automatic reviewing of recorded surveillance images has been developed. A remote monitoring link between the JRC Ispra and the EURATOM Safeguards Directorate in Luxembourg has been installed. A contribution to long-term energy scenarios, including the evolution of the nuclear energy industry, has been considered.
- ❖ Technical support is provided to the EURATOM Safeguards Directorate and IAEA for the procurement and measurement of several hundred ultrasonic sealing bolts, installed on spent fuel transport and storage containers at a European fuel reprocessing plant.



## B. COMPETITIVE ACTIVITIES

### SHARED-COST ACTIONS

ISEI has been selected for 17 projects under the following lines: "Advanced Communication Technologies & Services" (ACTS); "Environment and Climate"; "Industrial and Materials Technologies" (BRITE-EURAM III); "Non-Nuclear Energy" (Joule R&D); "Nuclear Fission Safety"; "Technology Validation and Technology Transfer"; "Telematics"; "Training and Mobility of Researchers" (TMR).

### COMPETITIVE SUPPORT FOR COMMUNITY POLICIES

ISEI has been selected for 36 projects launched by various DGs, namely: three projects from the Secretariat General, Antifraud Unit; three from DG III-F on High Performance Computing Networks; two from DG XI on Environmental problems; twelve from DG XIII-D on Technology transfer; thirteen from DG XVII on solar and rational use of energy; three from EUROSTAT on neural networks and other applications to statistical problems. The effective work will begin early in 1996.

### WORK FOR THIRD PARTIES

Four institutes from the JRC (ISEI, IST, IRSA and EI) are taking part, together with 79 departments from the universities of Catania, Messina and Palermo, in a vast regional development project for Sicily which started in December 1994. ISEI was granted the general management and technical leadership of the project. A first six months report has been sent in July 1995 to the Sicily Region, and the second one is in preparation. Results

have been achieved in all major sub-projects. They deal with: a decision support system for water supply management; winter and summer campaigns for NO<sub>2</sub> monitoring with 300 detectors in Catania, Messina and Palermo; a mobile unit to measure pollution and the erosion of the soil; safety and reliability of chemical and petrochemical installations; optical inspection methods for an historic building in Palermo with 3-D representation and structural analysis; sampling the Sicilian population for an analysis of trace elements in human body tissues.

Three new contracts have been established on risk analysis and information to the public. A project to analyse the causes and consequences of stress at work in air traffic control has been carried out for the Consiglio Nazionale delle Ricerche (Italy).

The European Solar Test installation has landed 10 new contracts, 8 for photovoltaic module qualification testing and 2 for reference device calibrations.

In a contract with PNC Japan (Power Reactor and Nuclear Fuel Development Corporation), good results have been obtained with new ultrasonic identification equipment and associated compact instruments, for among other things, the sealing of plutonium transport containers at the PNC facility at Tokai Mura.

### OTHER COMPETITIVE ACTIVITIES

Portable equipment has been provided to IAEA for volume/mass determination in large tanks in bulk handling facilities.

A design study is being performed for the establishment at Obninsk of the Russian Methodological and Training Centre, in the field of nuclear safeguards. It has led to the conclusion of a TACIS contract.

Two 1994 actions in the Copernicus programme have started.

# THE ENVIRONMENT INSTITUTE

EI research contributed to the Framework Programme lines "Environment and Climate" and "Life Sciences and Technologies". The emphasis of EI's research was on global change, e.g. biogenic emissions and aerosols, and on the management of soil and groundwater pollution sources, together with contributions in the field of the working environment, such as indoor air quality and trace metals impact on human health in the EU.

A large part of the Institute's work has been devoted to support activities for Community policies: environmental policies, the agricultural policy, quality control of medicinal products and quality control of foodstuffs.

## A. INSTITUTIONAL ACTIVITIES

The Environment Institute is actively involved in the research programmes "Environment and Climate" and "Life Sciences and Technologies". The respective proportions of R&D activities vs. support for the Commission's sectoral policies are approximately 30 and 70 percent.

### INSTITUTIONAL RESEARCH ACTIVITIES

❖ "Climate Change": Understanding the formation of tropospheric ozone (an important greenhouse gas) and its impact on atmospheric pollution is of major importance for the Mediterranean region. The BEMA project (Biogenic Emissions in the Mediterranean Area) intends to assess the role of plant biogenic emissions in that area and is being developed at EI, in collaboration with 17 European laboratories, under JRC coordination. Two major research campaigns were led in 1995, focused on citrus fields near Valencia (Spain) and on the natural vegetation near Montpellier (France). EI participated also in the EUPHORE project to build and exploit a large outdoor photochemical reactor, completed in 1995 at CEAM (Centro de Estudios Ambientales del Mediterráneo) in Valencia, Spain.

The role of natural and anthropogenic aerosols in the mitigation of the greenhouse effect was investigated, both in the field and on models. Field studies involved characterising the aerosol pollution drifting from the European continent, in preparation for the

1997 campaign of the ACE-2 (Aerosol Characterisation Experiment-2), in which over 40 European and US laboratories will participate.

Laboratory experiments were also begun, to investigate isotopic effects on the uptake by soils of methane, a greenhouse gas. Analytical techniques and sampling devices are also being developed for field measurements on  $N_2O$  and  $CH_4$ .



## AEROSOLS AND CLIMATE PROJECT

*The Project aims at understanding the chemical and physical processes leading to aerosols in both the clean and anthropogenically influenced marine environment. These aerosols are thought to have an important effect on the Earth's radiative balance and climate. The programme combines modelling, field work and laboratory studies, in collaboration with other European and international research teams.*

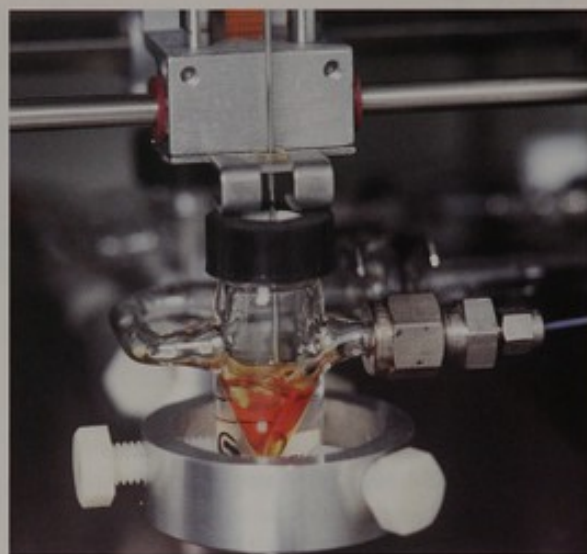
*Most aerosols effectively scatter sun light back into space, leading to a cooling of the Earth. A study has been undertaken into the role of black carbon (BC) aerosols in the global radiative balance. Black carbon is the main light-absorbing aerosol and would thus enhance greenhouse warming. BC is mainly emitted by fossil fuel burning and by biomass burning.*

*A major aspect of the Project is the study of aerosol dynamics of sulfate aerosols, i.e. the study of formation and growth processes that determine the size distribution of these aerosols.*

*The basic mechanisms of aerosol formation are studied in the laboratory. A facility, unique in Europe, has been built in which  $SO_2$  is photochemically transformed into sulfuric acid, which subsequently nucleates and grows to form a sulfate aerosol.*

❖ "Pollution": Work on the management of soil and groundwater pollution sources was scaled up to include catchment areas. The evaluation of several alternative land use management strategies should allow the identification of critical subareas in an agricultural ecosystem.

The MITO project aims, inter alia, to monitor algal blooms in the Mediterranean sea. The performance of fast, easy-to-use flow cytometers was tested in order



*Automatic device for the determination of aldehydes and ketones in air.*

to detect, enumerate and characterise phytoplankton populations at the cellular level. This will lead to a real-time monitoring system which quantifies the algal species responsible for red and green tides.

Test materials were prepared (AQUACON project) for laboratory performance tests for waste (sewage sludge) and soil analysis, waste water analysis and the determination of metals in surface waters.

The European Collaborative Action (ECA) on "Indoor Air Quality and its Impact on Man" now involves 15 countries, and EI participates in its management and scientific secretariat. Research activities have included experiments on human exposure to volatile organic compounds (VOCs), for the first time in a 30 m<sup>3</sup> test chamber (Indoortron). A study of the impact of ad-/desorption phenomena, and the scaling up of small to large test chamber experiments have also been carried out.

#### AUTOMATIC MEASUREMENT OF POLLUTANTS

*The continuous automatic measurement of pollutants is very important for two reasons: in order to follow concentration variations over certain time periods, and in order to understand particular phenomena, such as the identification of the source of the actual pollutant(s). Until recently no instrument existed with such an automatic capability to measure, for example, formaldehyde, a very harmful and widespread pollutant used*

*widely in industry. The gap has now been filled at the Environment Institute, where a device for the automatic sampling and analysis of formaldehyde, heavier aldehydes and ketones, has been set up. This instrument can operate unattended for one week, carrying out sampling and analysis of ambient air every 15 minutes. A very interesting feature of this instrument is that it can be used for the monitoring of different pollutants. Negotiations are underway with a company for the commercial production of the monitor, which has received much attention at two exhibitions: HELECO '95 in Athens and RICH '95 in Milan.*

Establishing baseline values for trace metals in human body tissues for clinical, epidemiological and toxicological assessment studies, and studying the impact of trace metals on the health of EU human populations in their living/working environment, are the objectives of the EURO TERVIHT project. Prenormative research was carried out on exposure impact on health. Attempts were made to further understand the biochemical mechanisms of trace metal toxicity at low exposure, by identifying critical organs and molecular targets, with emphasis on the potential impact on cardiovascular, immunological and reproductive systems, which might show up later in life.

#### INSTITUTIONAL SUPPORT ACTIVITIES

In 1995, EI has been involved in issues of concern to Directorate General XI (Environment), DG III (Industry), DG VI (Agriculture) and DG XXIV (Consumer Policy), and has organised a large number of relevant meetings, workshops and task forces.

The European Reference Laboratory for Air Pollution (ERLAP) has been particularly active in the harmonisation of current EU directives on air pollution, organising Quality Assurance Control programmes and developing and validating new monitoring techniques. Activities included field intercomparison ("round robin") exercises, as well as the development and validation of diffusive sampling techniques for measuring benzene and ozone in the air.

ETEX, the European Tracer Experiment, aims at selecting atmospheric models able to forecast the evolution of a pollutant cloud in real time. Several thousand previously collected air samples were analysed at EI via a special chromatographic technique. Results show that only a few diffusion models, even when coupled with meteorological models, are accurate enough to describe the pollutant cloud's evolution. ETEX was co-sponsored by the EC, the World Meteorological Organization (WMO) and the International Atomic Energy Agency (IAEA).



*Partial view of the vertical laminar flow reactor (bottom).  
Facility to study the formation and the properties of  
submicron aerosol particles.*

The European Chemicals Bureau (ECB) has become fully operative 9 months ahead of schedule. It is now handling all the technical and scientific tasks required of the Commission for the notification of new chemicals in the areas of "Classification and Labelling", "Testing Methods", "Risk Assessment of Existing Chemicals" and "Export/import of Certain Dangerous Chemicals" (Directives 67/548/EEC and 92/32/EEC; Council Regulations (EEC) 2455/92 and (EEC) 793/93). A second phase of data collection for the Council Regulation on the Risk Assessment of Existing Chemicals was concluded, data was transmitted to competent authorities in the Member States, and a public version of IUCLID (International Uniform Chemicals Database) (excluding confidential data files), was made available on CD-ROM to the industry and general public.

The European Centre for the Validation of Alternative Testing Methods (ECVAM), inaugurated in October 1994, has defined its priority criteria with its advisory Committee. Studies have been launched on the pre-validation of non-animal testing protocols, vaccine potency and safety testing, and integrated alternative approaches in toxicity testing, focusing on metabolism-mediated toxicity and on *in vitro* tests for teratogenicity in blood-forming tissues.

The feasibility of collaboration with the European Environment Agency's Topic Centres on Air Quality (RIVM, NL) and on Inland Waters (Water Research Centre, UK) has been explored, preliminary activities (mainly on Air Quality Monitoring, Alpine Observatory, Inland Waters, Contaminated Sites and Mobile Laboratories) having been carried out.

A European Technical Office for Medicinal Products was established at EI after a Memorandum of Understanding was signed between the European Agency

for the Evaluation of Medicinal Products and the Joint Research Centre. This office is now called the ETO-MEP Unit of the Environment Institute of the JRC, and is dedicated to the development of technical systems necessary for the implementation of European Union legislation on medicinal products.

Other work carried out by EI included analytical work related to wine, food and cosmetics, and preparatory work in support of the Ecological Directive for surface bodies of water.

## B. COMPETITIVE ACTIVITIES

### SHARED-COST ACTIONS

22 proposals have been accepted so far. The majority of these concern the Environment and Climate Programme, covering a wide range of activities closely related to the ongoing JRC Research Programme. However, projects within the Standard, Measurement and Testing, the Telematics Applications and the Nuclear Fission Safety programmes have been approved as well.

### COMPETITIVE SUPPORT FOR COMMUNITY POLICIES

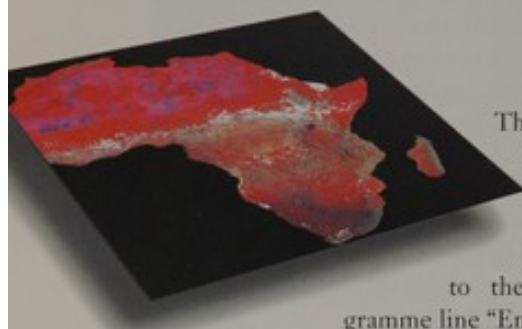
EI has answered calls for tender issued by several DGs of the Commission, and 11 proposals have been selected for funding, which may reasonably be expected to start early in 1996. The topics covered include:

- ❖ prenormative research, standardised as well as special analytical methods for foodstuffs analysis (DG III);
- ❖ information and communication systems within the framework of the European Medicinal Evaluation Agency (DG III);
- ❖ development of analytical methodologies for dairy products (DG VI);
- ❖ support to CORDIS information system (DG XIII);
- ❖ analytical procedures for custom control of special products, and for products classified according to their chemical composition (for DG XXI).

### WORK FOR THIRD PARTIES

A series of activities has been performed, mainly to provide local and regional authorities with appropriate tools for the management of surface bodies of water, toxic waste pollution problems and air pollution monitoring techniques.

# THE INSTITUTE FOR REMOTE SENSING APPLICATIONS



The IRSA performs research activities on applications of remote sensing and contributed to the Framework Programme line "Environment and Climate" with its specific activities on the Centre for Earth Observation (CEO), remote sensing techniques and monitoring, and advanced Earth observation techniques.

Through the use of satellite Earth observation data it also provides important scientific support for agricultural statistics.

## A. INSTITUTIONAL ACTIVITIES

### INSTITUTIONAL RESEARCH ACTIVITIES

One of IRSA's important R&D fields is the exploitation of satellite data for the mapping of land cover and land degradation in Europe and in the world, and for the monitoring of bush and forest fires, under the research programme "Environment and Climate". IRSA is also developing and validating capabilities for remote detection, e.g., of oil slicks or antipersonnel landmines.

The Centre for Earth Observation (CEO) project completed its "pathfinder phase" in 1995. Throughout the year the project ran a number of studies and workshops aimed at defining a final CEO concept and at establishing a design and implementation plan for the coming years. This involved in-house research and consultation with present and future Earth observation data users and service providers throughout the European Union (EU) and the European Economic Area (EEA). The CEO project worked in close collaboration with a Pathfinder Phase steering committee, consisting of experts from all EU and EEA countries, nominated by the Board of Governors. The work was done in cooperation with European and global partners, including the European Space Agency (ESA), EUMETSAT, the European Environment Agency (EEA), the United States' NASA and National Oceanographic and Atmospheric Administration (NOAA), and the National Space Development Agency (NASDA) of Japan. The concept should include the promotion of access to

Earth observation data and services to scientific, commercial and governmental customers.

Monitoring the state and evolution of terrestrial vegetation cover involved the creation of vegetation maps, which indicate both land cover change and functional vegetation parameters, such as seasonality or fire on a continental and, ultimately, global scale.

### FOREST INFORMATION SYSTEM

*1995 saw the completion of the Forest Information from Remote Sensing (FIRS) projects Planning Phase in cooperation with consortia of organisations from France, Germany, Sweden, the Czech Republic, Russia, Poland, Spain, Ireland and Finland.*

*The major objective of the project is to contribute to the development of a Unified European Forest Information System, providing both production related and environmental forest information. In 1995 the project developed a regionalisation and final stratification of European forest ecosystems and finalised the unified European Forest Nomenclature System.*

Using a ten year archive of satellite images, land cover maps and daily fire counts were prepared for Africa, and the same work has begun for South-East Asia. Portable stations receiving satellite data were also used in Central Africa and Madagascar to map and monitor bushfires, as part of local and regional environmental management programmes. Data obtained from instruments on the European remote sensing satellites ERS-1 and ERS-2 are being evaluated as aids to detection of fire scars and to measurement of burned areas. A database describing the entire tropical forest belt was interfaced with remote sensing data to provide the Tropical Forest Information System, which will be produced as an interactive CD-ROM for general dissemination.

The mapping of land degradation linked to fire, soil erosion and land use changes in the Mediterranean Member States of the EU, and the monitoring of forests on a pan-European scale under the FIRS project (Forest Information from Remote Sensing) were associated with fundamental research on image understanding techniques, which will facilitate the use of data from future European space borne sensors.

The bidirectional reflectance properties of the Earth's surface have been studied thanks to advanced models of surface radiation interactions, to help in de-

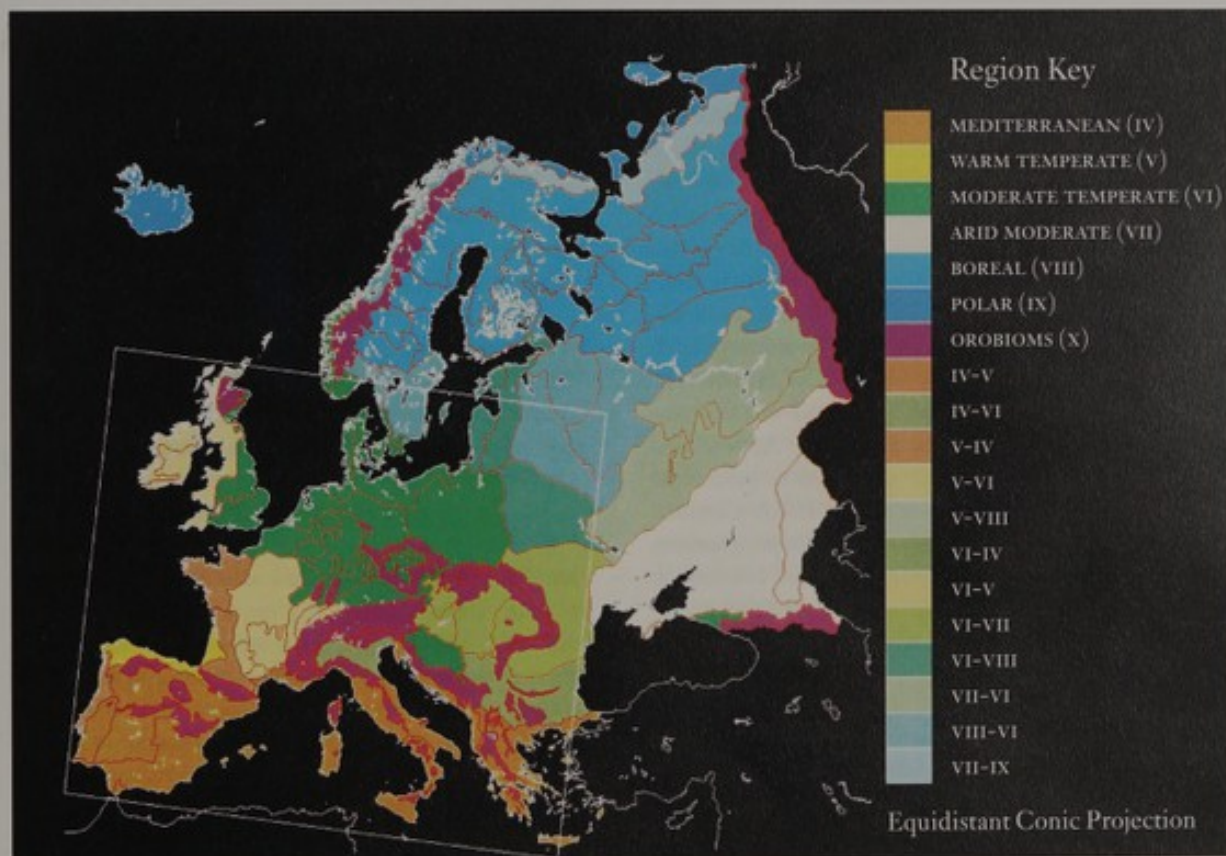
veloping the next generation of satellite image processing algorithms and in exploiting data from future high performance sensors.

Satellite based observations of sea surface temperatures and ocean colour over large areas provided information for the study of the marine biosphere. Image interpretation, data processing and the use of dynamic models were developed as means of assessing biomass production and carbon dioxide exchange by phytoplankton, ocean thermal dynamics, and the implications of both on the global climate system. The use of Earth observation data archives was coupled with new approaches to data management and analysis, and to strategy development for processing data from new

sensors. Neural networks and virtual reality systems were tested as means of extracting information from future multidimensional data sets.

In the European Airborne Remote Sensing Capability (EARSEC), tests on sensors and the development of the Synthetic Aperture Radar geophysical processor were finalised. The validation of EARSEC focused on developing oil slick detection at sea and ship routing applications.

Advanced experiments defined by the European Microwave Signature Laboratory (EMSL) user group included in 1995 test series on "The scattering properties of non-vegetated soils" and "Imaging techniques".



*Regionalisation and stratification of European Forest Ecosystems (AVHRR image region shown).*

Plastic antipersonnel land mines are numerous in some heavily populated regions of the world, and detection of these dangerous objects is a high risk, yet vital, operation. In addition to the humanitarian threat, these objects can be seen as an environmental threat as their presence prohibits effective land use in 'contaminated'

areas. A 1995 report based on EMSL results evaluated possible improvements in the capacity to detect dangerous objects manufactured from plastics by the application of remote sensing techniques using, for instance, remote sensing devices on land based vehicles or low flying remote controlled platforms.

INSTITUTIONAL SUPPORT ACTIVITIES

- ❖ Support for the European Environment Agency (EEA) focused on the creation of EEA's Land Cover Topic Centre, in collaboration with various European organisations active in the field of Earth observation.
- ❖ Support for DG VI (Agriculture) consisted in the application of remote sensing to agricultural statistics, with the aim of developing and demonstrating methodologies for integrating remote sensing data into the collection of statistics for the monitoring of crop acreage and agricultural production in the EU (Council Decision 94/753/EC No. L299 of 22.II.1994).

The Monitoring of Agriculture with Remote Sensing (MARS) project includes two components. Firstly, MARS STAT, involving research on the development of an advanced agricultural information system which integrates the various methods of crop production monitoring developed by the MARS project, the development of techniques for agricultural production monitoring in non European Union countries, and the development of new techniques for monitoring Europe's agricultural land, using data from the European remote sensing satellites ERS-1 and 2. Secondly, MARS CAP, which deals with the verification of farmers' land use declarations, as governed by the Common Agricultural Policy. In 1995 MARS CAP devolved to individual Member States. For MARS STAT, IRSA provided both technical support and a research programme, and for MARS CAP, technical support centred on quality control, and training and assistance for Member States' personnel and national companies.

B. COMPETITIVE ACTIVITIES

SHARED-COST ACTIONS

IRSA submitted 40 proposals, together with national partners, on a range of specific scientific subjects, of which 10 have been accepted. A proposal on imaging spectroscopy was also made, under the programme Training and Mobility of Researchers. If it is successful, IRSA will host 20 post-doctoral researchers over the next three years.

COMPETITIVE SUPPORT FOR COMMUNITY POLICIES

IRSA answered calls for tender issued by several DGs of the Commission. Proposals were accepted in a number of key areas. For example:

- ❖ application of the MARS project for wine and olive production modelling (for DG VI);
- ❖ an operational tropical forest monitoring programme, submitted by the Monitoring of Tropical Vegetation Unit (for DG XI);
- ❖ two joint bids with ISEI dealing with neural network applications, one to EUROSTAT concerning neural networks for land use classification, the other to DG III for the benchmarking of neural network systems.

WORK FOR THIRD PARTIES

Five contracts were carried out for customers in Belgium, France and Italy, on topics ranging from microwave measurements to regional environmental resource inventories and marine pollution monitoring.

OTHER COMPETITIVE ACTIVITIES

A four year multi-country project for rapid environmental and agricultural monitoring and statistics was accepted by the PHARE programme. Another project, on the development of systems for crop assessment and monitoring in Russia, was accepted by TACIS.

# THE INSTITUTE FOR SAFETY TECHNOLOGY

Research on Safety Technology, performed at IST, contributed to the Framework Programme lines "Measurement and Testing", "Environment and Climate", "Nuclear Fission Safety", and "Controlled Thermonuclear Fusion". The overall mission of IST is to perform research contributing to safe civil engineering structures, nuclear reactors, fusion tests as well as relating to particular problems of the chemical industries and power utilities.

The Institute is also engaged in several support activities related to Community policies in the field of energy, in the area of Nuclear Safeguards (Euratom Safeguards and IAEA).

## A. INSTITUTIONAL ACTIVITIES

Under the Nuclear Fission Safety programme the IST's investigations deal essentially with defining safe operation conditions for industrial installations and for research, existing or planned. In particular, the Nuclear Safety and Safeguards programme covers a major part of IST's activity. Major support is provided to the Euratom Safeguards Directorate of DG XVII and of DG I for the International Atomic Energy Agency (IAEA). IST's support activity is generally closely blended with institutional research.

### INSTITUTIONAL RESEARCH ACTIVITIES

New results were obtained from an important corium melt experiment on melt quenching in the TERMOS test vessel. The experiment simulated an in-vessel situation during a severe accident.

The first version of the COMETA code for calculating fuel/coolant interactions is now completed and is used for routine pre- and post-test calculations of the FARO tests. External users include IKE, ENEA, and the University of Wisconsin. IKE introduced the fuel breakup model into the code.

The experimental programme on the STORM facility started in June 1995. The advanced instrumentation for characterising aerosols was validated. The thermohydraulic behaviour in the mixing vessel and the deposition in pipes of Sn-aerosols under varying thermohydraulic conditions were tested (four tests with pre-calculations, analysis, and post-tests calculations). The

documentation of these tests is nearly complete. The 4th and 5th meetings of the international STORM user

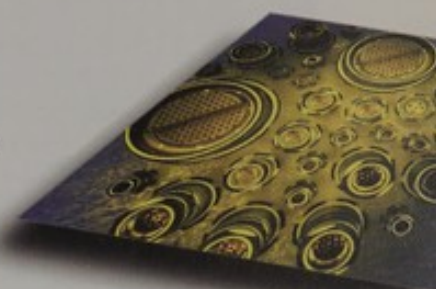
group were held in March and December. Five sets of aerosol problems are proposed as benchmarks for codes currently used for modelling thermohydraulics and aerosol physics in nuclear plants. Large discrepancies have been highlighted in the results for turbulent aerosol deposition and resuspension as calculated by various codes. To improve and assess these mathematical models, reliable measured data are needed for comparison purposes.

Work in support of Phebus FP was jointly performed by a team of IST analysts and on-site staff at CEA Cadarache (F), to interpret the wealth of on-line and post-test measurements available from a first test (late 1993) with lightly irradiated fuel, and to prepare for the next test with irradiated fuel. The first test yielded some unexpected results, such as the advanced state of degradation of the fuel rods, the low deposition in the experimental circuit, and the persistence of gaseous radioactive iodine in the containment vessel.

New and updated models were added to the ESTER (European Source Term Research Code) system. A new, extended version of ESTER was formally released at a User Group meeting in October. An extensive validation was carried out with the User Group.

Non destructive testing instruments are being developed: a new PIN monitor now used in Mol (Belgium); a scanner for MTR fuel plate inspection at Romans sur Isère (France); a new gamma detection device to control fuel elements stored under water; and a new Plutonium scrap monitor. An unattended system for safeguarding low enriched U installations includes specific software and a novel neutron collar.

Under the Controlled Thermonuclear Fusion programme, IST participated to the world-wide development of fusion technology focused on the design of the International Thermonuclear Experimental Reactor (ITER). The overall system testing for the ETHHEL tritium safety laboratory was completed. The various laboratory systems were tested and the necessary documentation prepared to carry out the necessary cold commissioning phase prior to nuclear tests with tri-





tium. The Fifth Topical Meeting on Tritium Technology was hosted and the proceedings were published in the Fusion Technology Journal.

R&D activity focused on fusion materials, waste studies, tritium control approaches and new measurement techniques. IST hosted a number of experiments on tritium, e.g. on the behaviour of inbuilding characteristics, the reduction of tritiated water on regenerable hot iron beds, and the performance of a tritium gas monitor based on scintillation principles. Within ETHEL, work continued on: characterising tritium recycling and outgassing from potential first wall materials under fusion reactor conditions; studying large scale gaseous detritiation techniques; and measuring the performance of various permeation barriers. An experimental plant for detritiating and conditioning activated/tritiated solid fusion wastes is being assembled.

Work under the Measurements and Testing programme concentrated on assessing the reliability of structures. Major pseudodynamic tests were performed in the ELSA facility on a large composite steel/concrete frame under conditions simulating severe earthquakes, in support of the validation and further improvement of Eurocode 8 (which applies to the design of civil engineering structures in seismic areas) and Eurocode 4. The dynamic properties of materials and critical structural components were studied in the LDTF facility, mainly in collaboration with industry.

Tools were developed to simulate the seismic behaviour of complete civil engineering structures. Significant progress was made in model prediction and comparison with experimental results, on the behaviour of masonry infills, and of reinforced concrete beam-to-column joints. A full documentation set (manuals and model description reports) has been completed for PLEXIS-3C, a large computer code for transient dynamic analysis of general 3D coupled fluid-structure systems, developed in collaboration with CEA (France).

Facilities and calculation tools for industrial reliability research within the Environment and Climate programme became fully operational. The FIRES facility was used for, amongst other things, complex polymerization tests as a service to the chemical industry. Control system development was supported and experimentally verified, in collaboration with TU Stuttgart (Germany), to demonstrate Kalman filter based control and for the application of neural network control algorithms. Venting tests were performed in the COLUMBUS facility to simulate horizontal vessel discharge and situations in heat exchangers. The DRACULA facility produced reference data for the design of emergency pressure relief systems in large plants.

The first commercial version of the RELIEF code for emergency pressure relief design was completed, including industrial verification. It combines complex modelling with extreme user friendliness. In an application test, a plant manager was able to install the software on his PC and to simulate various venting scenarios for his plant in less than two hours.

The advanced simulation software for detonation/deflagration modeling, REACFLOW, was released in a 2D version. New software modelling of two-phase flow and for the dispersion of heavy gas releases was further developed.

#### INSTITUTIONAL SUPPORT ACTIVITIES

In the way of support activities for the harmonisation of in-service nuclear safeguards inspection practices, training courses were given in PERLA to safeguards inspectors, including Russian inspectors and operators and industrial experts, and in-field support was given to safeguards inspectors during physical inventory verifications (PIV). State of the art equipment and reference analyses of nuclear materials samples were also provided. Non destructive assays were also performed.

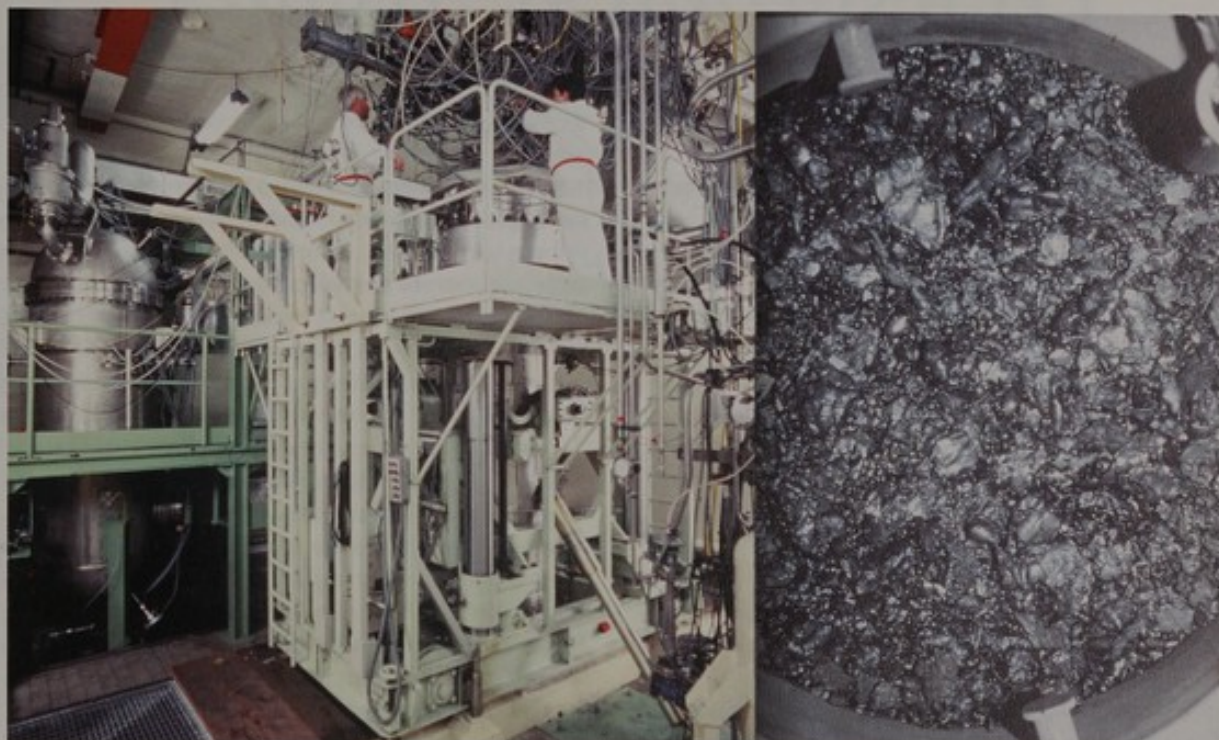
## B. COMPETITIVE ACTIVITIES

#### SHARED-COST ACTIONS

18 out of 52 proposals were successful. They refer to the BRITE programme, the Environment and Climate programme, the ESPRIT HPCN programme, the Nuclear Fission Safety programme and the Technology Transfer programme. ELSA, the European Laboratory for Structural Assessment, has been recognised as a Large-Scale Facility for European users within the Training and Mobility of Researchers programme. A research network of 12 European organisations has been approved for research in support of Eurocode 8.

#### COMPETITIVE SUPPORT FOR COMMUNITY POLICIES

IST has answered calls for tender from several Directorates-General. Some proposals are at an advanced stage of discussion, in particular, support for the development of Eurocode 8 for DG III.



*View of the FARO Installation and of corium debris in the melt catcher.*

#### WORK FOR THIRD PARTIES

Work was requested from IST by various industries, authorities and associations. Developments include simulation of the response of plain and reinforced concrete structures to impulsive loading. Major contracts were also signed with the USNRC, for severe accident studies with FARO, and with the Portuguese General Directorate for Monuments (DGEMN) for an experimental investigation of the structural reliability of the monastery São Vicente de Fora in Lisbon.

Sizeable marketing efforts focused on advancing new competitive activities and promoting the results achieved on industrial reliability.

IST activities were displayed at three exhibitions: the Loss Prevention Symposium in Antwerp, INCHEM 95 in Tokyo, and RICH in Milan. Initial sales and third party contracts point to a successful and positive trend for the future.

#### FARO

*The high-pressure melt quenching test series in FARO, using up to 150 kg molten corium, were successfully concluded in 1995.*

*Important results were obtained concerning Fuel-Coolant in Interactions in severe accident scenarios for Light Water Reactors. In particular:*

*All tests showed considerable melt breakup and quenching in water. Mean debris size ranged from 2.5 to 5 mm. This shows the debris bed should be coolable by water.*

*Early thermal load to debris collecting structures was found to be mild.*

*Steam explosions did not occur.*

# THE INSTITUTE FOR PROSPECTIVE TECHNOLOGICAL STUDIES

The role of IPTS is to be constantly aware of all relevant, significant and outstanding scientific and technological events and trends in Europe, particularly those that call for action at EU level. The Institute contributed to the Framework Programme line "Targeted Socio-Economic Research". The essential tasks of IPTS are: to harvest available information; to analyse, process and integrate it impartially; and to identify clear trends or calls for action for decision makers.

The main current tasks at IPTS are setting up the European Science and Technology Observatory (ESTO), and carrying out technological prospective studies.

## A. INSTITUTIONAL ACTIVITIES

IPTS moved to Seville in 1994 and under the Targeted Socio-Economic Research line of the Fourth Framework Programme was given a reinforced objective and corresponding human and financial resources. A large part of 1995 has thus been devoted to the preparation of an operational work plan. The general purpose is to harvest available contributions from experts, consultants, research organisations and institutes in the Member States where possible, also in third countries, to be able rapidly to analyse, process and integrate them impartially and in depth and, even more importantly, to distil clear trends or calls for action in a form usable by decision-makers.

Although IPTS's activities and resources are formally broken into specific research on the one hand, and support of EU policies on the other, all projects address directly or indirectly the public need for knowledge and understanding. Unavoidably, the distinction between the two types of activities may be somewhat blurred.

### INSTITUTIONAL RESEARCH ACTIVITIES

The Observatory at IPTS forms an integral part of the Institute's work and is currently focused on selected fields, but a network of similar organisations operating at national level is being set up to extend its range and to satisfy the much broader function of a truly European Science and Technology Observatory. All interested partners share the responsibility of carrying out a "technology watch" as a joint venture. The technology

watch function has been designed to support decision making and is complemented by specific in-depth prospective analyses aimed at shedding light on the interface between scientific & technical aspects, on the one hand, the economy & society, on the other.

Since employment is one of the major preoccupations of EU institutions and society, the driving force behind all of IPTS' activities is the compound notion "Technology-Competitiveness-Employment" (TCE).

In 1995, IPTS undertook prospective studies on specific subjects related either to a technology (e.g. biotechnology), a field (e.g. individual mobility) or a cross-cutting issue or aspect. For instance, work relevant to the regional dimension more specifically, the Mediterranean area was carried out, within the framework of both integrated development and specific sectors (renewable energies, water problems).

### INSTITUTIONAL SUPPORT ACTIVITIES

Prospective technological studies on materials, chemical feedstock recycling and energy recovery from municipal plastics waste, launched in 1994 on behalf of DG XI (Environment), resulted in four preliminary surveys:

- ❖ current projects on mechanical recycling of municipal plastics waste;
- ❖ current legislative activity in plastics waste management;
- ❖ current projects on plastics recycling by chemolysis;
- ❖ current projects on energy recovery from municipal plastics waste.

Three new families of energy technologies were studied in 1995 and joined the series of prospective analyses launched in 1994 for DG XVII (Energy): photovoltaics, CO<sub>2</sub> disposal and storage technologies, and CO<sub>2</sub> biological sequestration.

A new update of the report on Climate Change Research and Policy (Forward Studies Unit and DG XVII) covers the monitoring and assessment of recent research results on climate sensitivity, with emphasis on past climate changes and on modelling as well as a synthesis of the results of the Climate Change Convention in Berlin, in 1995.



Two new case studies for the "Business and the Environment" series have been completed for the Forward Studies Unit, one on "Waste Minimisation", the other on "Cleaner Technologies in an SME". This series is designed to give an accurate measure of some aspects of competitiveness and employment in companies eager to respond to environmental pressures.

In the context of work carried out for DG XVI (Regional Policy), cooperation with the Japanese agency NISTEP has continued, aimed at comparing the European and Japanese experiences in regional development from an RTD policy perspective. This project will be completed in 1996.

In response to requests from the STOA (Scientific and Technical Option Assessment) panel of the European Parliament, IPTS has launched the three following projects:

❖ "The role of biotechnology in the competitiveness of the European pharmaceutical industry": Scientific, economic, legal and social considerations are to be reviewed in comparing the EU position with its major competitors. The project provides a factual overview of R&D and innovation efforts in the pharmaceutical sector, and a prospective description of the priorities in research for new drugs and the prospects and expectations for new medical therapies. The expected socio-economic benefits of new drugs in the context of European health care systems are analysed.

❖ "The Car of the Future, the Future of the Car": Key issues for future transport systems are linked to achieving sustainable conditions from an environmental, social and economic point of view. The project focuses on technological, social and economic aspects of issues related to individual mobility. Its objectives are to develop strategies for solving the conflict between demand for mass individual mobility on the one hand, and ecological pressure, safety problems and congestion on the other hand. Its first stage concentrates on technological aspects such as new engine concepts, with focus on zero-emission/e-cars and the related potential energy storage systems, light-weight materials, recycling aspects and telematics for increased road use efficiency. The results are presented in a set of reports. Socio-economic-political aspects are also dealt with, e.g. driver behaviour/mentality and acceptance problems related to various technological options.

❖ "Multimedia Information Superhighways": The project focuses mainly on issues arising from the rapid development of these technologies and the services they provide, such as access devices, pricing/billing to users, priority systems, interconnection and interoperability issues, contents and security concerns, etc. A first report also deals with the direct and indirect effects on employment: as with most innovative technologies, a loss of jobs will be felt in the short term while in the medium/long term, the increased general economic performance will have positive effects. This entails recycling the labour force, the costs of which are, at this stage, difficult to estimate. Aspects linked to social and individual aspects such as exclusion or changes in human relations are also discussed.

## B. COMPETITIVE ACTIVITIES

For the first time IPTS has entered the competitive market for research contracts. Its proposals relate mainly to non-nuclear energy (5 proposals submitted, 3 funded), agro-food, the environment, international cooperation on water resources, and biomass (for various Mediterranean programmes managed by DG I B). Most of the work will be carried out in 1996.



Fig. 4. *The Monthly Report of IPTS.*

# Annex: JOINT RESEARCH CENTRE

## ORGANISATION CHART (NOVEMBER 1995)

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B 1040 Bruxelles  
Tel. +32 2 238 35 14  
Fax +32 2 238 37 00

Dr. Hans BJERRUM MØLLER  
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Risø National Laboratory  
P.O. Box 49  
DK 4000 Roskilde  
Tel. +45 46 77 46 00  
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Valhallavägen 79  
S 100 44 Stockholm  
Tel. +46 8 790 70 01  
Fax +46 8 24 54 35

Drs. H.F.G. GEIJZERS  
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Ministerie van Economische Zaken  
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NL 2500 EC Den Haag  
Tel. +31 70 379 64 70  
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Mr. Michael Francis FAHY  
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Office of Science & Technology  
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Department of Enterprise  
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Kildare Street  
IRL Dublin 2  
Tel. +353 1 676 35 23  
Fax +353 1 676 97 89

Dr. Werner GRIES  
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Bundesministerium für Bildung,  
Wissenschaft, Forschung  
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Heinemannstraße 2  
D 53175 Bonn  
Tel. +49 228 57 31 70  
Fax +49 228 57 36 12

Professor COSTAS KIPARISSIDES  
Department of Chemicals  
Engineering and Chemical Process  
Research Institute  
Aristotle University of Thessaloniki  
P.O. Box 472  
GR 54006 Thessaloniki  
Tel. +30 31 99 62 11 / 44 29 32  
Fax +30 31 99 61 98

Mr. Lucien LAUBIER  
*Conseiller pour la Science et Technologie*  
Représentation Permanente de la  
France auprès de l'Union Européenne  
Place de Louvain 14  
B 1000 Bruxelles  
Tel. +32 2 229 82 90  
Fax +32 2 229 82 82

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Ministère de l'Éducation Nationale  
et de la Formation Professionnelle  
1 rue de la Libération  
L 5632 Mondorf-les-Bains  
Tel. +352 478 52 19  
Fax +352 46 09 27

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*Direttore*  
ENEA  
Viale Regina Margherita 125  
I 00198 Roma  
Tel. +39 6 362 72 704  
Fax +39 6 36 27 27 33

Dr. Martti MÄENPÄÄ  
*Director General*  
Technology Development Centre  
Malminkatu 34  
FIN 00101 Helsinki  
Tel. +358 0 693 67 700  
Fax +358 0 694 91 96  
*Replaced Dr. Jubani Kuusi on 20.05.1995*

Dr. Julio MONTES PONCE DE LEÓN  
*Consejero Técnico Principal*  
CICYT-CIEMAT  
Av. Complutense 22  
E 28023 Madrid  
Tel. +34 1 346 63 07  
Fax +34 1 346 60 05

Dr. Kurt PERSY  
Bundesministerium für  
Wissenschaft und Forschung  
Minoritenplatz 5  
A 1014 Wien  
Tel. +43 1 531 20 63 50  
Fax +43 1 531 20 64 80

Prof. José CARVALHO SOARES  
*Presidente*  
Instituto Tecnológico e Nuclear  
Estrada Nacional 10  
P 2688 Sacavém  
Tel. +351 1 955 00 21  
Fax +351 1 955 01 17

## EEA PARTICIPANTS

Dr. Axel BJÖRNSSON  
*Director*  
Nordic Volcanological Institute  
University Campus  
IS 101 Reykjavik  
Tel. +354 5 25 44 92  
Fax +354 5 62 97 67

Dr. Tore OLSEN  
*Director General*  
Department of Science Policy  
Royal Norwegian Ministry  
of Education  
Research and Church Affairs  
P.O. Box 8119 Dep  
N 0032 Oslo  
Tel. +47 22 24 66 01  
Fax +47 22 24 66 29

European Commission  
JOINT RESEARCH CENTRE

DIRECTORATE-GENERAL  
200 Rue de la Loi · B 1049 Brussels  
Tel. +32 2 295 85 27  
Fax +32 2 295 01 46

INSTITUTE FOR REFERENCE MATERIALS AND MEASUREMENTS  
Reieseweg · B 2240 Geel  
Tel. +32 14 571 292  
Fax +32 14 584 273

INSTITUTE FOR TRANSURANIUM ELEMENTS  
Postfach 2340 · D 76125 Karlsruhe  
Tel. +49 7247 951 350  
Fax +49 7247 951 591

INSTITUTE FOR ADVANCED MATERIALS  
P.O. Box 2 · NL 1755 ZG Petten  
Tel. +31 2246 5401  
Fax +31 2246 33 93

INSTITUTE FOR SYSTEMS, INFORMATICS AND SAFETY\*  
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ENVIRONMENT INSTITUTE  
I 21020 Ispra (VA)  
Tel. +39 332 78 9601  
Fax +39 332 78 9222

SPACE APPLICATIONS INSTITUTE\*\*  
I 21020 Ispra (VA)  
Tel. +39 332 78 9765  
Fax +39 332 78 9536

INSTITUTE FOR PROSPECTIVE TECHNOLOGICAL STUDIES  
Isla de la Cartuja s/n · E 41092 Seville  
Tel. +34 5 448 82 73  
Fax +34 5 448 82 74

\* The Institute for Systems Engineering and Informatics and the Institute for Safety Technology have merged, in 1996, into the Institute for Systems, Informatics and Safety.

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ISBN 92-827-7310-8



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