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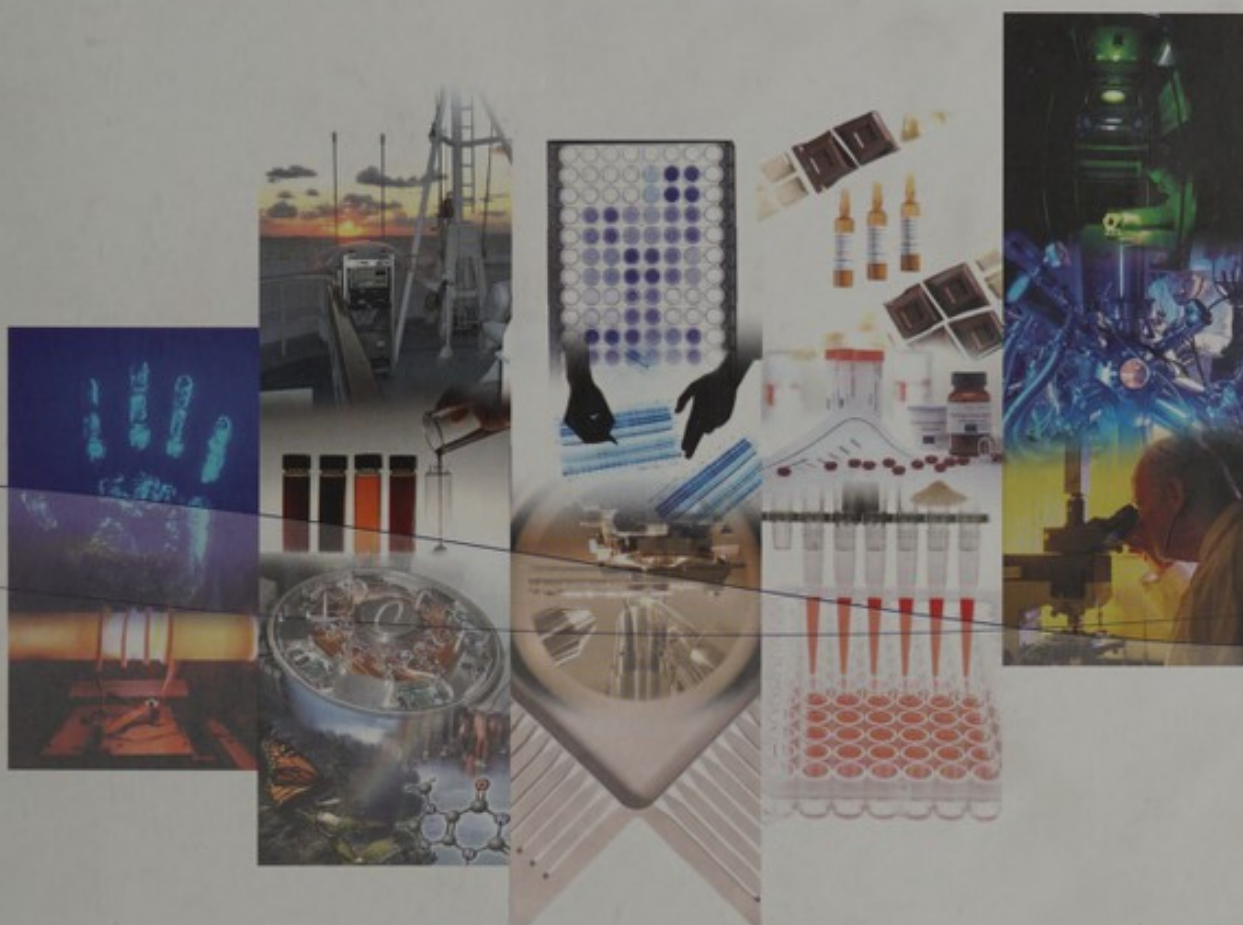
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DG JRC

Directorate-General

Joint Research Centre

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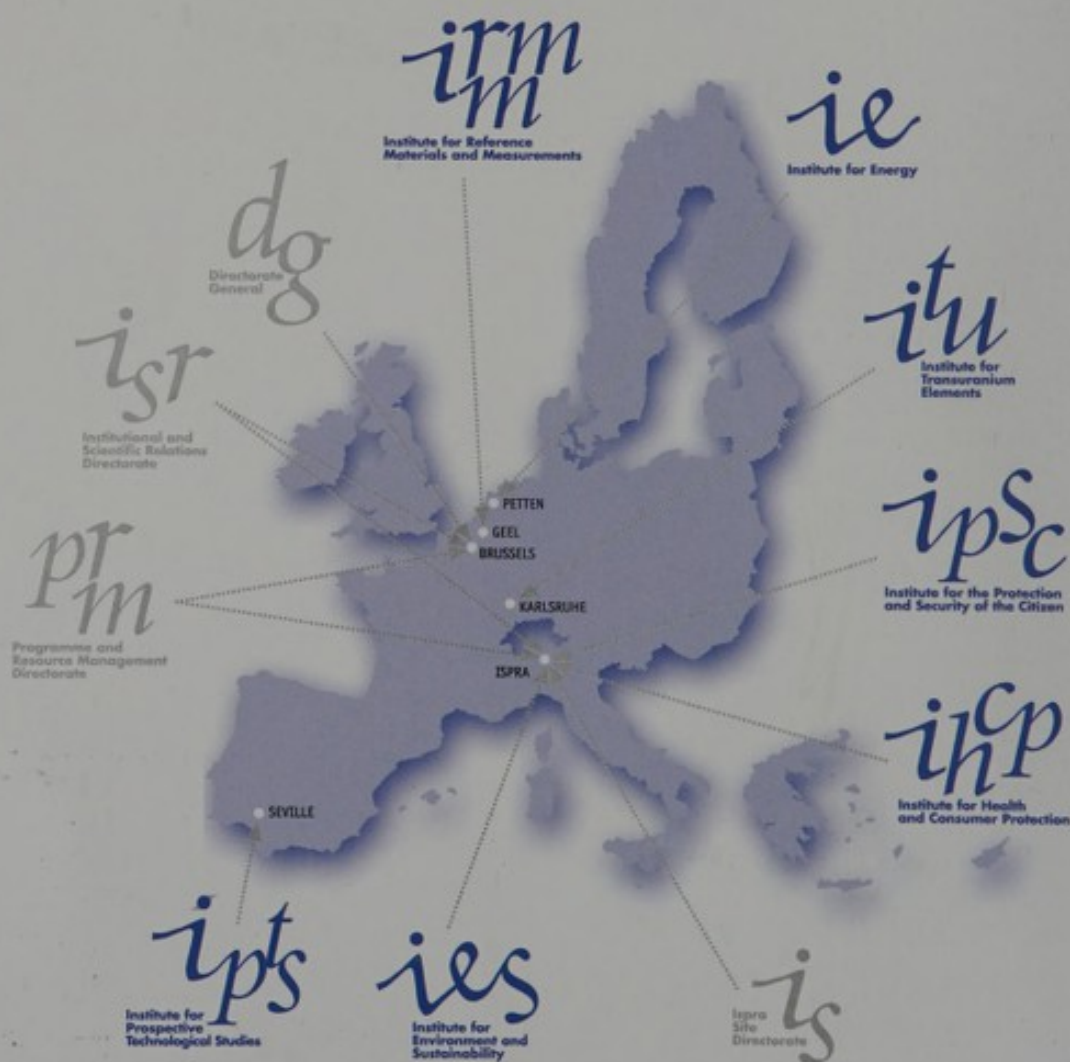
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Mission

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

DG JRC Structure



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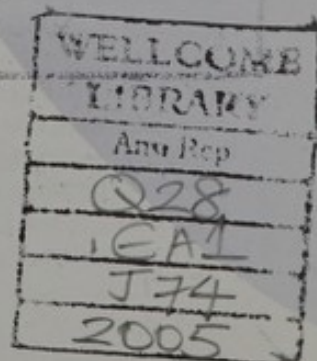
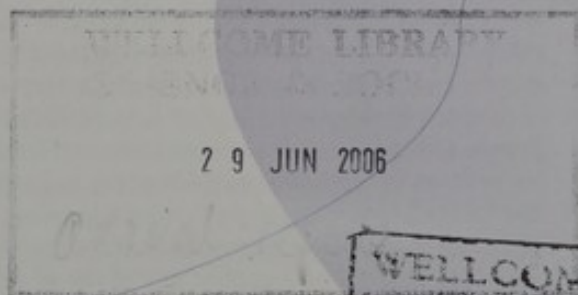
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Foreword from the Commissioner for Science and Research

European research has gained increased impetus over the past 50 years, creating a vast European Research Area covering a wide range of scientific domains. The 7th Framework Programme for Research, proposed during 2005, is designed to further promote the integration of EU research, boost excellence and foster competition. The Lisbon agenda and its goal to create a knowledge economy has been re-invigorated.

Throughout 2005, the Directorate-General Joint Research Centre (JRC) affirmed its position as an independent provider of scientific and technical support to EU policies. I welcome the efforts to strengthen scientific-technical support to the Commission, the European Parliament and opportunities to also support the Council.



Inauguration of the JRC event in the European Parliament, April, 2005

The report provides useful insight into the manifold initiatives carried out by JRC. Let me quote some important examples of the experience I gained during 2005. Last April, at the JRC exhibition in the European Parliament, the first Soil Atlas of Europe was launched. Tools such as this are an invaluable aid for policy-makers when considering measures to protect our soil. In July, I attended the opening of the New Hydrogen & Fuel Cell Test Facilities in Petten, which will provide governments and industry with an independent evaluation of hydrogen and fuel cell technologies performance in terms of efficiency, safety, environmental friendliness and reliability. In October, I opened one of the world's largest storage buildings for reference materials in Geel. Reference materials are the cornerstones for reliable, comparable and traceable measurements and are imperative for sound scientific and technical support to the EU legislative process and the functioning of the Common Market.

My objective remains the same, namely to make European science the best and to have the world's best scientists working for its development for the benefit of European competitiveness and prosperity. Via its work programme, visiting staff and exchange programmes in tandem with its scientific expertise, facilities and networks, JRC plays a role in achieving this. I want to extend my thanks to all JRC staff for their quest towards scientific excellence.



Visit to the JRC exhibition, European Parliament, April, 2005

In the coming year I look forward, together with the JRC and Research DGs, partners and customers, to putting European science centre stage, where it belongs.

JANEZ POTOČNIK

Observations from the **Board of Governors**



Board meeting in Ispra, November, 2005

This report illustrates the diversity of the contributions of DG JRC to the effectiveness of EU policies, both in their formulation and implementation. The DG JRC's understanding of the policy process combined with its wide range of technical expertise and relevant experience are reflected in the quality of the contributions. The Board offers strategic advice to DG JRC on maintaining and enhancing its capability for providing scientific support to the Commission.

The report provides examples of this scientific support work. They range from launching of the first Soil Atlas of Europe representing the fruits of collaboration across the Union and the immediate activation of the JRC crisis response mechanism following the Indian Ocean Tsunami of 26 December 2004, to the publication of the second EU Industrial R&D Investment Scoreboard in support of the EU's Investing in Research Action Plan. Examples such as these capture attention but they rely on programmes of research and on the organisation of networks to ensure scientific and operational relevance.

During 2005, the Board gave favourable opinions on the annual work programme, the execution of the budget, the planned response to the 5 Year Assessment, the Annual Management Plan, the preparations for the 7th Framework Programme and the nuclear decommissioning activities. It also made suggestions for the future, including the DG JRC interaction with European Agencies.

The Board advised DG JRC on strategic issues. It also reflected on its own activities and procedures, particularly the need to ensure an effective interaction with the individual JRC Institutes and for a more proactive role in providing advice on strategic issues. It constituted an ad hoc group of Board members for the purpose. Its recommendations were agreed by the Board and welcomed by DG JRC and are now being implemented with an already noticeable improvement in the quality of the Board's deliberations.

The Board warmly welcomed the confirmation of Roland Schenkel as the new Director General. It sees this as a vote of confidence in DG JRC and a positive endorsement of the management initiatives of recent years.

The Board is much encouraged by the progress made by JRC in 2005 and by the support given by the Commissioner, Mr Janez Potočnik. We wish to record our appreciation of the work of JRC staff in fulfilling the DG JRC mission and in deepening the interaction with the Board.

FERNANDO ALDANA
Chairman of the Board



Message from the Director-General

2005 was a year of further consolidation for DG JRC as regards its scientific work and service to policy makers. This is evidenced by increasing requests for support and positive feedback both from our customer DGs, Member States and the European Parliament. I am particularly delighted about the requests from the European Parliament to strengthen our scientific-technical support, and the new possibility to also support the Council. This type of work falls squarely into our mission. 2005 was also a year of strengthening the governance of our organisation. An ad hoc group of our Board of Governors analysed the effectiveness of our interactions and came up with a clearer role for the Board, emphasising, in particular, its strategic orientation.

Our role as a scientific-technical reference centre is expanding with two new Community Reference Laboratories (CRL) established for GMOs in food and feed and for the authorisation of feed additives. I plan to further expand this role in other core areas of our work.



JRC Press Conference on 'Nuclear Detectives' at the Royal Institution in London, October, 2005

Much of our work in 2005 went towards preparing our proposals for the 7th Framework Programme (FP7). We have had positive feedback on these. We foresee a strengthening of areas such as sustainable agriculture, support to the Lisbon agenda, environment and health and security.

In 2005, DG JRC has continued to provide customer-driven scientific and technical support, and selected examples are documented in the 'Support to Community Policies' section of this report. Highlights from the seven Institutes are also included as well as DG JRC's contribution to enlargement, the integration of new Member States, technology transfer, press and media actions and

the European Research Area (ERA). DG JRC's role in the development of ERA is exemplified not only through its extensive collaboration networks but also through its recruitment and exchange programmes for Europe's best scientists, its training programmes and use of DG JRC facilities. In line with this theme, a section of this report has been dedicated to young scientists' awards and their innovative achievements in 2005.



JRC exhibition at the European Parliament, April, 2005

To conclude, I wish to quote our Commissioner who wrote 'I would like to congratulate JRC staff for the fine work performed in 2005 and look forward to seeing this very positive development continue with your new DG'. As the new Director-General, I am fully committed to continuing this development. Finally, I wish to thank the Commissioner for his support and guidance, the Board of Governors for their constructive advice, our customer DGs and partners, for whom we provide S&T support, and all DG JRC staff for their dedication and commitment.

ROLAND SCHENKEL

Examples of Support to **EU Policies**



On request of the Safety and Consumer Protection DG, DG JRC drafted the technical guidelines of EC Regulation 21/2004 on the identification and registration of small ruminants in sheep and goats.

Published a scientific report for the diagnosis of transmissible spongiform encephalopathies (TSE) in sheep for the Safety and Consumer Protection DG to approve several tests under TSE regulation EC 999/2001.

Provided the basis for the Enterprise DG's Inter-service Consultations on textile labelling which addressed (a) a proposal to amend Directive 96/74/EC on textile names and (b) to amend Directive 96/73/EC on the analysis of fibre binary mixtures.

Published the full updated Annex I of Directive 67/548/EEC which contains a list of harmonised classifications of chemicals and labelling of substances which are legally binding within the EU.

Together with the Environment and Enterprise DGs, an explanatory note on 'Exposure Scenarios' was developed which was key to forming the draft legislation on REACH.

Upon request of the Environment DG, the impact of hurricane Katrina on the chemical and petrochemical industry in New Orleans was assessed and the results were distributed to the Committee of Seveso Competent Authorities.

In the aftermath of the South Asia earthquake, DG JRC, in cooperation with the Humanitarian Aid DG and the UN, sent out an alert and delivered space and disaster maps.

On behalf of the Legal Service with selected EC experts, helped prepare the official EU reply to questions and issues raised by the claimants through the WTO panel on the EU-US GMO litigation case.

Developed Guidelines on Land Use Planning in the vicinity of chemical installations as requested by the European Parliament - Seveso II Directive. DG JRC also helped in the preparation of a harmonised database on accident scenarios, failure frequencies and risk assessment data, as requested by Directive 105/2003/EC.

In support to the Regional Policy DG, flood hazard maps were delivered, European Flood Alert System (EFAS) simulations were provided to substantiate Austria's solidarity fund application and a European drought risk map was provided for drawing up a 2006 regulation.

Provided technical expertise to the Energy and Transport DG regarding the 'missing' plutonium at the THORP reprocessing plant. DG JRC's input contributed to both understanding and solving the problem.

Produced an 'Environmental Country Note' for Namibia, on request of the Development DG. This is the first of a series of 'country profiles' which will be produced to help EC services in planning, monitoring and evaluating EC funded development projects in Africa.

DG JRC supported the Enterprise DG in the Executive committee of the World Forum for the Harmonisation of Vehicle Regulations of the UN Economic Commission for Europe (UN-ECE) in Geneva.

The Environment DG presented DG JRC's Water Information System for Europe (WISE) to representatives of the Member States and Accession Countries. Most Member States already decided to use the WISE system.

Developed a new system, for the External Relations DG, to automatically create and distribute newsletters to EU delegations using RSS (Really Simple Syndication) technology.

Contributed to the Research DG's 'Identification of Information Society Key Technologies' for the future (till 2020). These technologies were assessed against their potential for European competitiveness (Lisbon Agenda).

Contributed, via sensitivity analysis, to the EC Impact Assessment Guidelines [SEC(2005)791], by identifying and assessing the likely economic, social and environmental impacts of a policy.



First Soil Atlas of Europe

Soil is an important natural resource that needs protection. Being a natural living system, crucial to human activities as well as ecological functions, soil forms over very long periods of time and once spoiled – for instance by pollution, intensive urbanisation or inadequate agricultural and forestry practices – its usefulness is reduced or even denied to future generations.

It is in this perspective that DG JRC has coordinated the creation of the first ever Soil Atlas of Europe by bringing together the experience and knowledge of scientists from soil institutes in over 40 countries, all of them represented in the European Soil Bureau Network which is located at DG JRC. Launched in April 2005, by Janez Potočnik and Stavros Dimas, European Commissioners for Science and Research and Environment, respectively, the Atlas is a unique, high quality and informative reference publication, designed to describe and explain the threats to our soil, and to raise awareness of its diversity and importance.

The Soil Atlas consists of high quality soil maps and easy to understand texts supported by unique photographs. It is based on the European Soil Information System developed by DG JRC, covering the whole European Union and neighbouring countries.

The Atlas attempts to illustrate the complex inter-linkages between soil degradation processes, and threats to human health and security, by describing and mapping major soil functions. The Atlas also discusses the principal threats to soil across Europe.

Europe is favoured with highly productive agricultural soil but the continent also has vast natural and semi-natural lands, in which soil plays a vital role by conserving biodiversity and supporting environmental functions. Highlighting the importance of soil as a non renewable resource to the public will support the development of protective measures that will incorporate local knowledge about each specific soil type and function. In this context, the Soil Atlas of Europe will serve as a key tool supporting future European policies for soil protection.

The Soil Atlas of Europe has been awarded the prestigious Golden Sickle prize at the 2005 Agrokomplex International Agricultural and Food Fair held in the Slovak Republic, DG JRC being the first EU institution to be honoured at this important event.

For more information: http://eussoils.jrc.it/projects/soil_atlas/index.html



A soil map of Europe

Creation of the Africa Observatory for Sustainable Development

In 2005, DG JRC intensified its support to European engagement in Africa by launching the Africa Observatory for Sustainable Development. Using its longstanding experience on remote sensing, the interpretation of satellite imagery, mapping, statistics and computer models, DG JRC is providing support to a range of European Commission Directorates General in their policy-making, operations and identification of priorities for EU intervention in Africa. Furthermore, the African Observatory directly serves African governments (including authorities at local and regional level), non-governmental organisations and local EU Delegations and, more generally, the donor community.

Income in many regions of Africa is heavily dependent on natural resources and an increasing number of conflicts is driven by natural resource availability. DG JRC is gathering and processing information on forest degradation and deforestation, biodiversity use and conservation, land use patterns, desertification, and replenishment of water resources, supporting African efforts to manage the continent's rich natural resources effectively and to produce environmental information such as land resource maps for the whole of Africa. Research at DG JRC helps to understand how environmental changes in Africa – both natural and man-made – will affect Africans and the rest of the world.



Land cover map of Africa

In the field of food security, DG JRC's crop monitoring and forecasting system uses satellite imagery, agro-meteorological models and field statistics to monitor agricultural production in more than 30

countries vulnerable to crises and food shortages. Close attention is paid to the Horn of Africa due to the recurrence of food crises in this region and the absence of a local regional monitoring system. Monthly and every ten days, bulletins are issued from April to November describing current crop condition, yield prospects and the likelihood of food shortages. DG JRC also participates, as EU observer, to the FAO/WFP Crop and Food Supply Assessment Missions to help proper targeting of food aid and assistance.

The EU is the largest donor of development assistance in the world, and peace and security are essential pre-requisites for sustainable development. DG JRC's activities on conflict prevention and crisis response are helping to develop a comprehensive approach to address conflict resources, such as diamonds and illegal logging, management of refugee crises and other disasters (including natural), and enhancing security (assistance in landmine clearance).



Satellite image of refugee camps in Africa

Thus DG JRC is not only helping to solve short-term emergencies, but also supporting the long-term sustainable development of Africa.

For more information: http://www-gvm.jrc.it/tem/African_Observatory/index.htm



Indian Ocean **Tsunami** and South Asia **Earthquake**

Recent natural disasters have again shown that effective response measures are critical for saving lives.

The European Commission is a major front-line donor and coordinator of EU, civil protection and humanitarian assistance. Rapid financing procedures are in place to allow the EU to make emergency funding decisions within hours of a disaster. To facilitate this, DG JRC is often called upon to provide its expertise in space and information technologies to supply timely information, such as automatic disaster alerts, up-to-date situation assessments and disaster maps. These help indicate, for example, the existence of viable transport routes and damaged zones.

The DG JRC has been very active in addressing the Indian Ocean Tsunami of December, 2004 and South Asia Earthquake of October, 2005 by alerting and providing information products for emergency response, humanitarian relief and reconstruction. At the time of the Tsunami and Earthquake events, the Global Disaster Alert and Coordination System (GDACS – a joint Initiative of the United Nations and the European Commission) sent a 'Red Alert' about 30 minutes after the first news broke, triggering response in the Monitoring and Information Centre (MIC) of the Environment DG and the United Nations.



Tsunami wave propagation model developed by DG JRC

In support of emergency response and humanitarian relief operations, DG JRC produced for the two disasters, in conjunction with the RESPOND* partnership, timely space maps and synoptic assess-

ments of damage to support the Humanitarian Aid DG, the External Relations DG, and European and international aid agencies. These maps and assessments provided by DG JRC and its RESPOND partners have had a positive impact on relief operations. A novel methodology for rapid damage assessment has since been developed by DG JRC to support both humanitarian relief and reconstruction operations.



Map of the central city area in Balakot, Pakistan

DG JRC has also provided technical support to the post-tsunami reconstruction programme funded by the External Relations DG's Rapid Reaction Mechanism. This was done through the provision of technical assistance, and pre- and post-disaster high resolution satellite data of the tsunami affected coastlines, to the Indonesian and Sri Lankan authorities. The data are assisting these authorities in precise damage assessment, in rebuilding a reliable land registry, and in elaborating reconstruction plans.

* RESPOND is the Global Monitoring for Environment and Security Service Element funded by the European Space Agency to improve access of the international humanitarian community to maps, satellite imagery and geographic information. Core partners include UNOSAT, the provider of satellite data for United Nations agencies, Infoterra UK, German Aerospace Centre (DLR), MAPACTION UK, SERTIT France and DG JRC.

New **Hydrogen** and **Fuel Cell Test Facilities**

On 7 July, 2005, Commissioner Janez Potočnik opened two new hydrogen and fuel cell testing facilities at the JRC Institute for Energy (JRC-IE) in Petten, the Netherlands. The new facilities support DG JRC's mission to provide policy-makers and industry with independent evaluation of the performance of hydrogen and fuel cell technologies in terms of efficiency, safety, environmental impact and reliability, through simulating lifetime operational conditions of fuel cells and hydrogen fuel tanks. The Dutch Minister for Education, Culture and Science, Maria van der Hoeven, also attended the opening.



Visiting the new Hydrogen and Fuel Cell Test Facilities

The necessity to ensure a reliable and safe energy supply has become a matter of strategic importance for Europe, which is heavily dependent on imported energy. The EU currently imports 50% of its energy and this may rise to 70% within the next 25 years. This dependence leaves Europe vulnerable to shocks; for example, due to fluctuations in oil price or gas supply. There is also the environmental impact of fossil fuels to consider. When hydrogen is combined with fuel cell technology to generate electricity, the only emission product, besides heat, is water. Once hydrogen can be easily stored and transported, in combination with fuel cells, it will be able to provide energy in remote locations not served by the electricity grid.

The new facilities allow DG JRC to characterise fuel cell performance in terms of efficiency, reliability, durability and emissions under simulated opera-

tional lifetime conditions ranging from arctic to tropical, from motorway driving to forest tracks, and marine and aeronautical applications. In addition, realistic simulation of fast filling and slow emptying of hydrogen storage tanks can be investigated along with characterisation of leakage and permeation behaviour.

The facilities contribute to the development and harmonisation of standardised test procedures and methodologies for hydrogen and fuel cell transport and stationary applications. These are a key requirement for the successful take-off of the hydrogen economy and thus support the Union's global leading role in the pursuit of Sustainable Development.



From left to right, R. Schenkel, J. Potočnik, M. van der Hoeven and K. Törrönen

With DG JRC support, the Commission helped to establish the European Technology Platform for Hydrogen and Fuel Cells, which brings together industry, public authorities and the research community. During 2005, the Platform Secretariat, under the editing responsibility of JRC-IE, has published three strategic documents, which outline concrete steps and measures required to move towards a hydrogen economy.



New **Storage Building** for **Reference Materials**

The JRC Institute for Reference Materials and Measurements (JRC-IRMM) has constructed a new storage building for its reference materials. The new facility is an important upgrading of the JRC infrastructure in a key area of its mission – namely to promote a common and reliable European measurement system.



The new building has 1550 m² storage space

The importance of reference materials

Test results from control laboratories are the basis for several risk management decisions and for implementing and monitoring many policies whether they are in the field of environmental protection, food safety, health or competition. Many decisions in policy-making, in trade and in industry are influenced by these results. Therefore, they need to be reliable and comparable across borders.

One of the key elements of cross-border comparability and reliability of measurement results is the availability of reference materials. Reference materials are needed for developing, calibrating and validating the methods of analysis. Today, reference materials are also needed to fulfil the requirements of present standards for the accreditation of testing and calibration laboratories (e.g. ISO 17025).

The role of JRC-IRMM

The European Commission has recognised the importance of reference materials from the outset and has supported their development and distribution via the JRC. Today, DG JRC is one of the world's largest reference material distributors and offers a wide variety of certified reference materials for food and environmental analysis, for biotechnology, health related and industrial measurements, and nuclear safeguards. It is the world leader in the development of reference materials for the analysis of GMOs.

The new storage building

Producing a certified reference material may take many years to accomplish and the stock of a reference material has to remain stable for several years. During that time it has to be stored and monitored appropriately. DG JRC has invested in a dedicated building for the storage of its reference materials. The 1550 m² building houses over 580 different certified reference materials, in total around 500 000 samples. It has compartments to store materials at temperatures from -70°C to +18°C at controlled humidity. Some are stored even at -160°C in special containers. 170 of the 580 certified reference materials carry the new label ERM[®] (for European Reference Materials) marking products accepted in accordance with the latest international standards, ISO Guides 34 and 35.



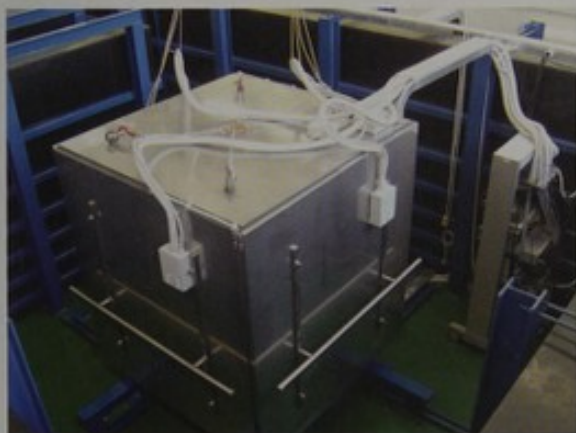
Guests at the opening ceremony, October, 2005

Commissioner Potočník officially opened the new storage building on 20 October, 2005. The opening was combined with an international conference on confidence in measurements at which the Nobel laureate, Mr Stanley Prusiner, gave a keynote lecture.



Nuclear Safeguards

Enhanced and extended collaborations resulted from the continued efforts in the field of combating illicit trafficking, nuclear safeguards, and nuclear forensics. Support was provided to a demonstration exercise in Slovakia and a portable high resolution gamma spectrometer was delivered to Bulgaria under the PECO (Pays d'Europe Centrale et Orientale) agreement. A sample of nuclear material seized in Poland was subject to nuclear forensic analysis by DG JRC and Polish experts. A meeting of the International Technical Working Group (ITWG) on Nuclear Smuggling in Prague was organised and sponsored by DG JRC and finally, cooperation with Russia in the framework of a TACIS project resulted in delivering measurement instruments to the Bochvar Institute in Moscow. DG JRC has also developed a Scrap Neutron Multiplicity Counter (SNMC) for verifying inhomogeneous plutonium samples and a new research facility for non-destructive assay methods – the Pulsed Neutron Interrogation Test Assembly (PUNITA) – was constructed in Ispra. This facility will be used for determining the mass of fissile material and for exploring the feasibility of detecting explosives in sealed containers.



The Pulsed Neutron Interrogation Test Assembly (PUNITA), a new research facility for non-destructive assay methods

Generation IV

In 2005, the Council of the EU approved the accession of Euratom to the Generation IV International Forum (GIF) Framework Agreement. In this process, DG JRC has been designated as the 'Implementing Agent' of the Community. It will coordinate the European contribution to GIF and integrate GIF-related R&D efforts from European research organisations.

Together with the Research DG and several national research organisations and industry, DG JRC ensures the representation of the Community in all GIF bodies. In particular, in 2005, it chaired the Valuation of Contributions Task Force and hosted the Policy Group and Experts Group, which are the major governance bodies in GIF.

DG JRC will participate in GIF R&D, either directly or through its involvement in FP6 Indirect Actions. Several of its activities (e.g. safety of advanced fuels and of innovative reactors) constitute valuable contributions. Examples of actions in 2005 are the experiments performed on the safety aspects of innovative fuel, e.g. for both the Sodium Fast Reactor and Gas Fast Reactor; the studies on molten fluoride salts and the quaternary fluoride system for the Molten Salt Reactor, and the analytical work on safety and feasibility issues of liquid metal cooled fast reactors.



Laboratories at the JRC Institute for Transuranium Elements



The New **Chemicals Policy** and **Alternatives to Animal Experiments**

Towards the end of 2005, and after more than two years of intensive discussion, the EU Competitiveness Council reached unanimous first-reading political agreement on the new chemicals policy (REACH). Key to the new proposal is the reversal of the burden of proof – from authorities to industry – for testing and risk-assessment of chemicals. REACH is an important policy for ensuring the health and well-being of the citizen as well as the protection of the environment.



The ECB is presently located at the JRC Institute for Health and Consumer Protection

Throughout the discussions, the European Chemicals Bureau (ECB) of DG JRC provided extensive scientific and technical input to the debate, based upon its competence derived from implementing current EU chemicals legislation. The challenges, however, are compounded by the number of substances (30,000) which are required to be assessed during the eleven years foreseen for the implementation phase.

DG JRC is responsible for the development of guidance documents as well as the IT tools which will enable the legislation to be implemented efficiently and cost-effectively. In tackling this task, DG JRC is working closely with the Member States, other Directorates-General of the European Commission, and the chemicals industry.

Whereas REACH will significantly reduce the unknown health threats of chemicals it will, nevertheless, require a considerable number of tests to be conducted on animals, unless viable alternatives can be found.

The European Commission is committed to reducing animal testing in Europe and DG JRC has been a pioneer in investigating alternatives to animal testing through the work of ECVAM (European Centre for the Validation of Alternative Methods).

Over the last five years, ECVAM-validated methods have successfully replaced several animal-testing methods in OECD member countries. The advantage of validated methods is that they allow improved quality control over traditional methods, quite apart from reducing financial costs and the suffering and deaths of animals.

In collaboration with the European Chemicals Bureau (ECB), ECVAM has validated methods that reduce acute fish toxicity testing by 60%. The lives of many hundreds of thousands of fish will thereby be saved in the implementation of REACH. ECVAM is currently in the process of validating some 40 different tests and continues to work closely with the ECB with the goal of reducing the number of animal tests needed in the assessment of chemicals.



Unexposed Balb/3T3 (control) – no DNA Damage



Balb/3T3, 5x10-6M CdCl2 high – DNA damage

The 2005 EU Industrial R&D Investment Scoreboard

Since 2004, the JRC produces annually, in close co-operation with the Research DG, the EU Industrial R&D Investment Scoreboard. The Scoreboard provides up to date comparisons between companies, sectors, and geographical areas, as well as the competitive situation of EU firms in the global R&D environment. This work feeds into the Commission's industrial R&D and innovation monitoring activities which is implemented in support of the 3% Investment in Research Action Plan, requested by the Barcelona European Council in 2002.



Three young visitors at the Communicating European Research Conference in Brussels, November, 2005

The 2005 Scoreboard reports on the worldwide research and development (R&D) of 1 400 companies: the top 700 R&D investors with registered offices in the EU and the top 700 registered elsewhere. Together, they invest €315 billion in R&D (i.e. just over half of the total R&D investment by the private sector world-wide).

The analysis of this year's Scoreboard reveals a reversal of the decline reported last year. One can observe a slight increase of R&D investment by EU companies (0.7 %). However, competitors outside the EU continue to grow faster (6.9 %) – thus, the R&D gap continues to increase.

The 2005 Scoreboard also highlights some other interesting findings:

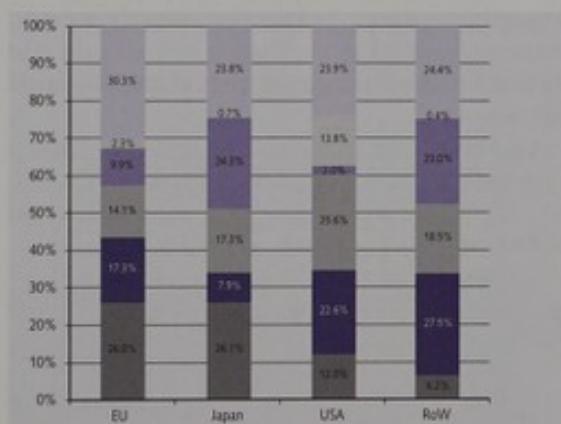
- Sector by sector, the average R&D intensity of EU companies is comparable to that of their counterparts worldwide. However, relatively few EU companies are found in high R&D intensive sectors. EU companies are much more active in medium R&D-intensive sectors, where they are heavily investing in R&D.

- The sectors with the highest rates of growth worldwide in R&D investment are in services and pharmaceuticals & biotechnology. However, EU companies are losing ground vis-à-vis their competitors in sectors with significant R&D investment and growth such as software & computer services, health services and media & entertainment.
- Individually, EU companies perform at least as well in R&D investment as their counterparts outside the EU. An EU firm, DaimlerChrysler, tops this year's world list of R&D investors. Furthermore, there are few sectors where there is not at least one EU Company in a leading position. However, the EU appears to be less successful in enabling medium sized companies to grow into large R&D investors.

For more information:

<http://eu-iriscorboard.jrc.es/> and

http://www.jrc.es/home/pages/action_4132.htm



Share of R&D investment of top scoreboard companies by major sectors

- other sectors
- software & computer services
- electronics & electricals
- equipment, IT hardware
- pharmaceutical & biotechnology
- automobiles & parts



J.-C. Griveau



F. Dentener



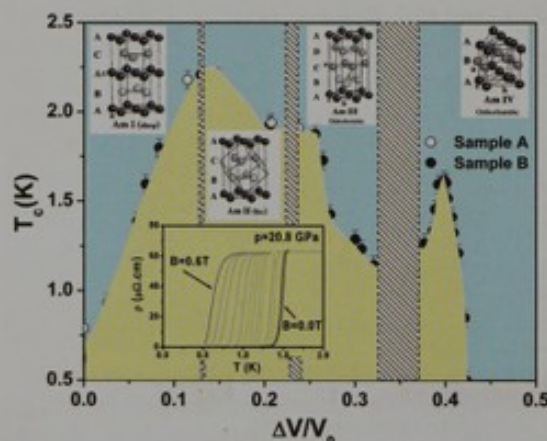
S. Heathman

Best Young Scientist

Jean-Christophe GRIVEAU, DG JRC-ITU

Understanding the fundamental properties of actinides (elements located at the end of the periodic table) is the ultimate aim of the Basic Actinide Research activity at JRC-ITU. By experimentally tuning composition, temperature, pressure, magnetic or electric fields, theoretical models can be developed to describe these materials especially at low temperature where fascinating phenomena happen (exotic long-range magnetic order, unconventional superconductivity, non-Fermi liquid behaviour, etc.). But because of their radio-toxicity, most actinides must be handled in glove boxes and self-heating prevents them from being cooled down easily.

Thanks to outstanding technical developments it is now possible to achieve measurements using electrical resistivity as a function of pressure up to 30 GPa on tiny samples (~100 µg and ~100 µm in dimensions) and at temperatures of 0.4 K, while magnetic field can be applied simultaneously. These developments are unique in the world and are much requested by scientists engaged in actinide research.



The work reported this year for Americium (Phys. Rev. Lett. 94 (2005) 097002) and for Plutonium superconductors, PuCoGa₅ and PuRhGa₅ (Physica B: Condens. Matter, 359 (2005) 1093) has opened up a new field of research at low temperature. Focusing on Americium metal, Jean-Christophe et al showed, by direct measurement, that its superconductivity changes in nature – this is really unusual in elements and is not yet understood.

Jean-Christophe Griveau graduated in 1994 from the Institut National Polytechnique de Grenoble (INPG-France) with a degree in materials engineering and went on to complete his PhD in Physics at the Commissariat à l'Énergie Atomique of Grenoble (France). He joined JRC-ITU in 2000 and has been working as a grant holder and research assistant.

Three Best Peer-Reviewed Scientific Papers

1. Peter BERGAMASCHI and Frank DENTENER, JRC-IES, on 'Inverse modelling of national and European CH₄ emissions using the atmospheric zoom model TM⁵'

Methane (CH₄), after CO₂, is the second most important anthropogenic greenhouse gas and is covered by the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. Many CH₄ sources (e.g. landfill sites, coal mining, agriculture, gas leaks), however, are difficult to quantify and may be variable in space and time. Consequently, 'bottom-up' inventories (as used for the official reporting of signatory countries to UNFCCC) have considerable uncertainties.

In order to verify bottom-up inventories, the authors developed a 'top-down' methodology, using measurements of atmospheric CH₄ concentrations from European and global monitoring sites and inverse atmospheric model simulations. Using a novel atmospheric zoom model, the paper presents, for the first time, a high resolution regional inversion which is fully consistent with the global observations and simulations.

The inversion results suggest up to 50-90% higher anthropogenic CH₄ emissions in 2001 for Germany, France, and the UK compared to reported UNFCCC values. The author's top-down result was recently confirmed by an independent revision of the German inventory, which resulted in an increase of reported CH₄ emissions by 68.5%. The EU-15 totals are relatively close to UNFCCC values (within 4-30%) and appear very robust for different inversion scenarios. Reference: Atmospheric Chemistry and Physics, 5, 2431-2460, 2005.

Peter Bergamaschi works since 2001 as a research scientist in the Climate Change Unit of the JRC-IES, Ispra, Italy. His work focuses on inverse modelling of greenhouse gases based on surface and satellite observations. He is involved in several European research projects.

Frank Dentener works since 2000 as a research scientist and Action Leader in the Climate Change Unit at JRC-IES. His current research focuses on global and regional photochemical and aerosol processes, air pollution and climate. He works on optimising policy strategies to reduce both emissions of greenhouse gases and air pollution.

2. Stephen HEATHMAN, JRC-ITU, on 'A High-Pressure Structure in Curium Linked to Magnetism'

Basic actinide research plays a fundamental role with its contribution to effective safety and safeguards for the nuclear fuel cycle. The actinide elements are a fascinating series that are characterised by the progressive filling of the 5f-electron



S. Tarantola
A. Saltelli

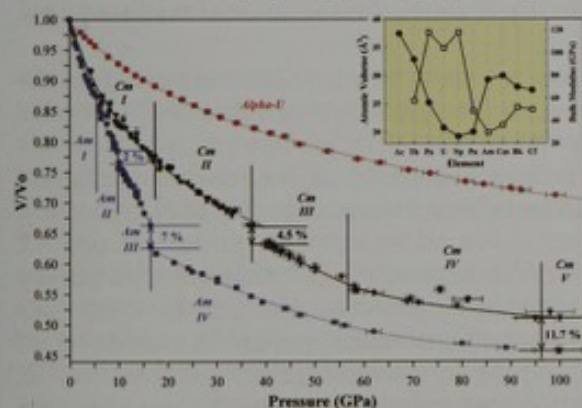


M. Ratto



F. Campolongo

shell. Under pressure, as these materials are compressed, the atoms move closer together and interactions increase, resulting in dramatic changes in crystal structure. Using diamond-anvil technology and a 3rd generation x-ray synchrotron source, Curium (Cm) metal was studied under pressure and found to exhibit 5 different crystallographic phases up to 100 GPa [See Figure below]. One of these phases found at intermediate pressures, (between 37 and 56 GPa) shows a completely new structure, Cm III which has been identified as being monoclinic, space group $C2/c$. In order to understand why this new phase should appear uniquely in Cm, theoretical electronic structure calculations were also performed. These agree with the observed sequence of phase transitions and establish that it is the spin polarisation of Curium's 5f electrons that stabilises the Cm III structure. The results reveal that Cm is one of only a few elements that have a lattice structure stabilised by magnetism and suggests that such effects may become prevalent in other f electron elements. This work was published in *SCIENCE* 1 July 2005 Vol. 309,110-113.



Stephen Heathman studied Crystallography and Analytical Chemistry from 1974 to 1978 at the University of London. Between 1978 and 1987, he worked at the Institut Laue Langevin, Grenoble and the European Molecular Biology Laboratory in Heidelberg on neutron powder diffraction and protein crystallography respectively. He joined the JRC-ITU in 1987 and is now responsible for high-pressure x-ray diffraction studies on actinides.

3. Marco RATTO, Andrea SALTELLI, Stefano TARANTOLA and Francesca CAMPOLONGO, JRC-IPSC, on 'Sensitivity Analysis for Chemical Models'

Sensitivity analysis is the study of how the uncertainty in the output of a model (numerical or otherwise) can be apportioned to different sources of uncertainty in the model input. New and old scientific theories compete with one another in terms of which one can best describe the evidence. This competition takes place in the space of uncertainties (otherwise there would be no competition).

Sensitivity analysis uses statistical tools to detect virtues and flaws in models, the formal structures in which theories are embedded. This may even lead to the falsification of one of the theories/models. Likewise, when scientific information feeds into the policy process and if involved parties try to manipulate uncertainty instrumentally, transparency can be offered by sensitivity analysis via a rigorous analysis of the soundness of the models being put forward by the negotiating parties.

This review paper (*Chemical Reviews*, 105(7) pp 2811-2828) distils out the best mathematical methods available today to perform this task and it applies to all models.

Andrea Saltelli graduated in Chemistry and today he leads the Econometric and Applied Statistics Unit of JRC-IPSC.

Stefano Tarantola, with a PhD in Science and Technologies for engineering from the Polytechnic of Milan, is a Scientific Officer at JRC-IPSC.

Marco Ratto received his PhD in Chemical Engineering in 1998 with a dissertation on the 'Sensitivity of dynamic predictions to parameter uncertainty'. Since 2000, he has been working at JRC-IPSC.

Francesca Campolongo completed her PhD in modeling and sensitivity analysis at the Faculty of Environmental Sciences of Griffith University, QLD, Australia. Since 1998 she has been working at JRC-IPSC.

Three Awards for Support to EU Policies

1. Wolfgang PHILIPP and Heinz SCHIMMEL, JRC-IRMM, on the 'European BSE/TSE monitoring programme'



This work supports the implementation and monitoring of the 'TSE Regulation' (EC) No 999/2001 laying down rules for the prevention, control and eradication of certain Transmissible Spongiform Encephalopathies (TSE). In 2005, seven new rapid post mortem BSE (Bovine Spongiform Encephalopathy) tests were approved by the EC and for the first time ever, eight rapid tests for the diagnosis of scrapie were submitted for EC approval.

The approval of these tests has a direct impact on consumer confidence and on the industrial compe-



A.-S. Heiskanen



Van de Bund



M. Maretti



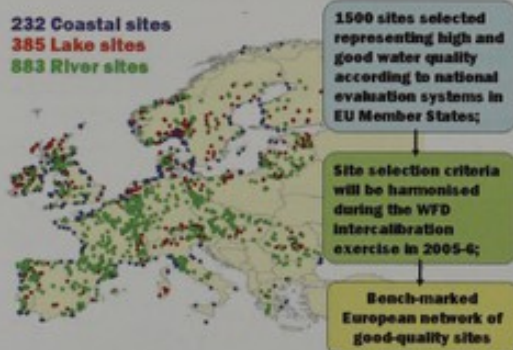
M. Mazzara

tition in the TSE diagnostics market. With 11 million tests performed annually, a massive drop in costs of testing devices has already been observed. Reference materials for the quality control of BSE and scrapie tests have also been developed – these are widely used by Member State authorities and test producers. These materials offer, again for the first time, a harmonised way to perform quality control of approved BSE and scrapie tests throughout the European Union. In summary, these activities have played, and continue to play, an essential role in implementing and monitoring a safe and reliable large scale BSE/TSE test monitoring programme in the European Union.

Wolfgang Philipp graduated in 1992 from the University of Mainz, Germany, with a degree in biology, did his doctoral studies at the Pasteur Institut, Paris, and received a PhD in microbiology and biochemistry from the University of Paris in 1995. He has been working as Scientific Officer in JRC-IRMM since 2001.

Heinz Schimmel graduated in 1988 from the University of Ulm, Germany, with a degree in chemistry, and received a PhD from the University of Ulm in 1992. He has been working as Scientific Officer in JRC-IRMM since 1995.

2. Anna-Stiina HEISKANEN and Wouter VAN DE BUND, JRC-IES, on the 'Support to the EU Water Framework Directive'



WFD Intercalibration network in 2005

The Water Framework Directive (WFD) requires intercalibration of the national surface water assessment systems to ensure comparable ecological quality across the EU. This requires comparable and consistent definition of the 'good ecological quality' for rivers, lakes, coastal and transitional waters across the geographic regions in Europe. The team has developed, coordinated, and facilitated the EU-wide intercalibration process as required by the Directive. The major deliverables were the register of the WFD intercalibration network (comprising 1500 surface water sites and associated metadata from all Member States, Norway, Bulgaria, and Romania; OJ, L 243, 48, 19/09/2005), report (EUR 21671 EN) on the composition of the network, the WFD Guidance Docu-

ment No. 14 and a detailed technical manual on the process of the intercalibration exercise. The scientific and technical work included developing a common typology framework for surface waters, a web-based reporting system, analysing the information delivered by the Member States, and reporting results to the Environment DG and to the Member States. The successful completion of these deliverables was based on extensive networking with Member States' experts, leadership and coordination of EU-wide expert groups, and training of experts from the new Member States and Accession Countries.

Anna-Stiina Heiskanen completed her PhD in hydrobiology at the University of Helsinki in 1998. Before joining the DG JRC in 2000, she worked as a senior scientist studying coastal eutrophication processes at the Finnish Environment Institute. At DG JRC, she has been working as a scientific officer and an Action Leader.

Wouter Van de Bund completed his PhD at the University of Amsterdam in 1994, after which he was a post-doctoral researcher studying ecological functioning of aquatic ecosystems at the University of Stockholm, and at the NIOO Centre for Limnology, The Netherlands. After joining DG JRC in 2001, he has been working as a scientific officer.

3. Marco MAZZARA and Matteo MARETTI, JRC-IHCP, on the 'Management of the Bt10 Crisis'

The Community Reference Laboratory (CRL) for GM Food and Feed has been the first CRL nomination for DG JRC. The mandate was granted following a co-Decision of the EC and the European Parliament as formulated in Regulation (EC) 1829/03.

The main tasks of the CRL include the testing and validation of detection methods for GMOs and the submission of full evaluation reports to the European Food Safety Authority (EFSA). The CRL is assisted in its tasks by the European Network of GMO Laboratories (ENGL), operating under the chairmanship of DG JRC. Within the first year and a half of its operation, the CRL received over fifty dossiers for method validation. The CRL managed, in all cases, to deal with this workload and delivered the required validation reports (for a list see: <http://gmo-crl.jrc.it>). During the so-called 'Bt10 crisis', concerning the diffusion of an unapproved type of genetically modified maize seed, the CRL, as requested by Decision 317/2005/EC, validated a method for the detection of Bt10 maize in maize shipments.

Marco Mazzara studied at the University of Bologna, Italy where he received a degree in Agricultural Sciences (1993) and he completed his PhD in Biology at the University of Basilicata (1998). He joined JRC-IHCP in 2001 and is currently Sector Head of the Community Reference Laboratory (CRL) for Genetically Modified Food and Feed.

Matteo Maretti, with a High School Diploma (Scientific College), joined DG JRC as Laboratory assistant in 1999. He is currently metrology officer of the Community Reference Laboratory (CRL) for Genetically Modified Food and Feed.



• V. Sequeira



• C. Chaves de Jesus

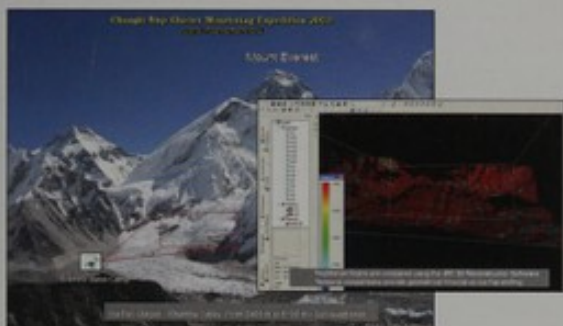


• T. Gamboni

Award for Technology Transfer

Vitor SEQUEIRA, JRC-IPSC, on '3D Reconstruction and Verification'

To ensure adherence of Member States to the Nuclear Non-Proliferation Treaty (NPT), safeguards authorities aim towards the earliest possible detection of all security-critical modifications in nuclear industrial installations, particularly nuclear reprocessing plants.



Glacier survey at Khumbu Valley (Himalaya) to evaluate temporal behaviour and possible correlation with climate changes (courtesy of University of Brescia, Italy)

Vitor led the development of algorithms and software tools for creating geometrically accurate and photo-realistic 3D models of large areas including objects and buildings. This is achieved by combining data from different sources and detecting changes between a reference model and a new model of the facility 'as-is'. These tools are now used on a routine basis by the International Atomic Energy Agency (IAEA) for the Design Information Verification (DIV) of a large reprocessing plant in Japan. The system allowed the Agency to carry out rapid and accurate DIVs, in a highly complex facility, far faster and more accurately than had been possible in the past.

The software is now commercially available through two licensee companies. It has been successfully used in a wide range of applications from studying changes in a glacier in the Himalayas and assessing post-earthquake damages to culture heritage sites with regard to accurate building documentation and change detection. In the last two years, the software has already generated more than €100K in royalties for DG JRC.

Vitor Sequeira has a degree in Electronics and Telecommunications Engineering from the University of Aveiro (PT) and a PhD in 3D Reconstruction Technologies from the Technical University of Lisbon. Today he works in JRC-IPSC as a scientific officer.

Award for Technical Support

Carlos Manuel CHAVES DE JESUS and Thierry GAMBONI, JRC-IRMM, on a new 'Van de Graaff high-intensity beam line'

The study of the interaction of neutrons with matter is of great importance when evaluating the safety and risks related to the operation of nuclear power plants, nuclear waste management, or new concepts of nuclear power production. JRC-IRMM measures neutron cross sections of the relevant nuclei to improve the existing neutron cross section data as smaller uncertainties can result in enhanced safety of both present and future plants.

The JRC-IRMM Van de Graaff accelerator laboratory uses high energy ion beams to produce intense, well characterised neutron fields by means of nuclear reactions. In 2001, a series of particular neutron data measurements needed higher beam currents and long-term stability than were available at that time. Consequently, a new high-intensity beam line was planned and the project task (i.e. design and construction) was allocated to Carlos and Thierry. During the years 2002-2005, the beam line was implemented and tested with successive refinements resulting in exceptionally good performance. Due to the increased stability of the beam, the throughput of measurements has since increased and the results are more reliable. Also, time consuming experiments requiring high intensities can now be carried out with good precision.

Carlos Chaves de Jesus graduated in Electronics in 1989 at Centro de Formação Profissional da Indústria Electrónica in Lisbon. Till 1996 he studied Industrial Electronics and Nuclear Instrumentation at the department of Physics, University of Liverpool, England. He joined JRC-IRMM in 1996 as electronics technician.

Thierry Gamboni graduated in Physical Measurements in 1983 from the Institut Universitaire de Technologie, Grenoble. Before working as geophysical prospector, he was a research laboratory technician in the area of high energy molecular beams. He joined JRC-IRMM in 1997 as an accelerator technician.



Group picture with R. Schenkel, Excellence Awards Ceremony in Ispra, 2005



2005 Highlights from the DG JRC Institutes

Towards the 7th Framework Programme (FP7)

The nuclear and non nuclear Specific Programmes were structured according to the policy priorities of the Commission, thus facilitating the link between our activities and our customers' needs. The structure of the FP7 specific programme will be split into policy themes (as outlined below).

JRC non nuclear programme

Policy Theme 1: Prosperity in a knowledge intensive society

Policy Theme 2: Solidarity and the responsible management of resources

Policy Theme 3: Security and freedom

Policy Theme 4: Europe as world partner

JRC EURATOM programme

Policy Theme 1: Nuclear waste management, environmental impact and basic knowledge

Policy Theme 2: Nuclear safety

Policy Theme 3: Nuclear security

Integrated Scientific Areas for the 6th Framework Programme

Safety and quality of food and feed
Food chain: from agriculture to consumer protection
GMOs in food, feed, seeds and the environment
Assessment of chemicals and exposure
Alternative methods to animal testing
Technologies for health applications
Health and Environment: addressing exposure
via human envirogenomics

IRMM
IPSC, IPTS
IHCP, IRMM, IPTS
IHCP
IHCP
IE, IRMM, IHCP, ITU, IPTS
IHCP

FOOD, CHEMICAL PRODUCTS and HEALTH

ENVIRONMENT and SUSTAINABILITY

IES, IRMM
IES, IRMM
IES, IRMM
IES
IPTS, IES
IES, IPTS
IES
IE, IES, IPTS

IE, IES

Air quality and environmental radioactivity
Water quality and aquatic ecosystems
Soils and waste management
Land resources
Integration of sustainability into other policy areas
Climate change: the Kyoto Protocol and beyond
Monitoring and assessing ecosystem sustainability
The Sustainable Energy Technologies
Reference & Information System
Renewable energies and advanced energy
conversion technologies

Management of spent fuel and
of radioactive waste
Nuclear security (safeguards and
non proliferation)
Reactor and nuclear fuel safety
Radiation monitoring
Basic actinide research

ITU, IE

ITU, IRMM, IPSC

IE, ITU
ITU, IRMM
ITU

NUCLEAR SAFETY and SECURITY

HORIZONTAL ACTIVITIES

IPTS
IPTS
IPSC, IPTS
IRMM
IRMM, IHCP
IRMM
IRMM
IPSC, IHCP

IPSC, IPTS
IPSC, IES
IPSC

ISR Directorate, Brussels

Technology foresight in other DG JRC priorities
Cross-cutting techno-economic foresight
Statistical methods for analysis of economic indicators
Reference materials and methods in other DG JRC priorities
BCR and industrial certified reference materials
Metrology in chemistry and radionuclide metrology
Metrology in physics: neutron data measurements
Antifraud and monitoring compliance with EU Regulations
in selected policies
Support to cybersecurity
Technological and natural risks
Contribution to Commission objectives in humanitarian
aid and assistance
Promotion of innovation, technology transfer and management
of intellectual property rights



DG JRC Institute for Reference Materials and Measurements

The mission of JRC-IRMM is to promote a common and reliable European measurement system in support of EU policies.

JRC-IRMM develops and validates analytical methods and is one of the largest reference materials producers in the world. It carries out international inter-laboratory comparisons and measurements and evaluates neutron data for international databases. In addition, JRC-IRMM operates a Community Reference Laboratory for feed additives authorisation that evaluates the reliability of testing methods used for feed analysis. The work at JRC-IRMM addresses measurement issues from screening level to high precision reference measurements. All these activities are supported by high quality research and development work.



The community reference laboratory for feed additives authorisation stores reference samples

In 2005, JRC-IRMM opened a new reference materials storage building to house its stock of 580 products and 500 000 samples. For nuclear measurements, external research teams can now apply for funding to carry out measurements at the JRC-IRMM accelerators and as regards feed safety, the Community Reference Laboratory is fully operational supporting the authorisation process of feed additives in the EU.

Testing peanut allergens

As food allergens can cause severe symptoms in persons who are allergic, European legislation sets rules for labelling of food products containing known allergens. But the present means to detect and quantify them are still very limited. To develop better analytical methods and harmonise them across the world, appropriate test materials are needed.

Besides validation of appropriate analytical methods, JRC-IRMM has introduced a new concept in its range of products in 2005 with the production of a set of peanut test materials. The IRMM set contains four varieties of peanut powder pre-treated in five different ways. Instead of a certified reference material, the set provides a reference matrix for analysts who wish to conduct research on similar samples. No parameter in this material is certified but a gravimetrically prepared mixture of the five different materials is also provided.



The peanut test material kit is a new product of JRC-IRMM

Smoke flavourings

During the last three decades smoking of food has been progressively replaced by adding liquid smoke flavourings. Smoke flavourings are produced on industrial scale and are used in a variety of food products like meat and dairy products. Today, European legislation lays down an EU-wide system for safety assessment and authorisation of the primary products, which are the raw materials for the production of smoke flavourings. The regulation on smoke flavourings sets maximum permitted concentrations in primary products for two polycyclic aromatic hydrocarbons (PAHs) and requires thorough characterisation of those primary products.

To assist the Directorate-General for Health and Consumer Protection in preparing the minimum performance criteria for the analytical methods used in generating data for the authorisation process, JRC-IRMM has reviewed the analysis of the composition of smoke flavourings. In 2005, JRC-IRMM developed and validated methods for the analysis of the 15 EU priority PAHs in liquid smoke flavourings by organising a collaborative trial. JRC-IRMM also assists a specific working group of the European Food Safety Authority (EFSA) in evaluating applications of the smoke flavouring producers.

Nitrogen isotopes for environmental studies

Nitrous oxide (N_2O) is one of the greenhouse gases targeted by the Kyoto protocol. The predominant N_2O sources are known but the knowledge about individual sources is poor and lacks experimental proof. To better quantify the atmospheric nitrous oxide budget, many research groups are now investigating the possibility of measuring the stable isotopic composition of nitrogen and oxygen in N_2O .

Due to the lack of a reliable international measurement standard, however, progress has come to a halt. Therefore, in 2005 JRC-IRMM has produced an isotopic reference gas that provides a possibility to link the measurement scales used by the research groups. JRC-IRMM is also studying the analysis of position of isotopes of oxygen and nitrogen in the N_2O molecule. The site preference could be used to differentiate processes of production and consumption of N_2O to eventually estimate the contributions of nitrification and denitrification processes to the total N_2O budget. As a result of this feasibility study, the measurement techniques have been improved.



JRC-IRMM develops new isotopic methods for environmental analysis

Improved neutron data help in transmuter design

Irradiating nuclear waste with neutrons converts certain long-lived isotopes into short-lived ones by transmutation and could help minimise nuclear waste. One of the possible technical solutions is an accelerator driven system (ADS). Various studies have concluded that the uncertainties in the prediction of the neutron flux inside an ADS target are largely due to the lack of accurate data for inelastic neutron scattering and $(n,2n)$ cross-sections of lead and bismuth isotopes. Modelling of ADS would then result in unnecessarily large safety margins in the first demonstration facilities.

In 2005, IRMM has completed new measurements on bismuth for inelastic neutron scattering and $(n,2n)$ cross sections at neutron energies up to 18 MeV with very high energy resolution. This work has been carried out within the European project EUROTRANS, which aims at designing an experimental demonstration facility and developing a reference design for a European facility for industrial applications.



DG JRC Institute for Transuranium Elements

The mission of the JRC-ITU is to protect the European citizen against risks associated with the handling and storage of highly radioactive elements.

Sustaining enlargement and educational activities

JRC-ITU continued to work closely with scientists in the new Member States, especially in the areas of nuclear safeguards, radioactivity in the environment, and the safety of nuclear fuels. In May, 2005, a group of scientists participated in the gathering of samples near the Dudvah River in the Slovak Republic and sample analyses were performed.



Visit of the Scientific & Technical Committee to JRC-ITU on 24/25 October, 2005 (from left to right: M. Wallenius, E. Sinner, V. Esteban, B. Barré, M. Poireau)

Two in-house courses were held on 'Radioactivity, Radionuclides, and Radiation Training' in 2005 with a total attendance of over 70, and almost all from the new Member States. In addition, to enhance information dissemination, in September, the course was held outside of JRC-ITU at the Josef Stefan Institute's Training Centre in Ljubljana, Slovenia.

From 15 to 18 June the third 'Summer School on Actinide Science and Applications' was held, co-sponsored by the network of excellence for actinides sciences (ACTINET). The programme consisted of morning lectures on general topics in actinide science and nuclear technology and afternoon demonstrations in the laboratories. The school was attended by 77 students, 28 of them coming from the new Member States and Candidate Countries. The average age was 27 years with an almost even gender balance. The participants confirmed that the mix of lectures and laboratory demonstrations was most constructive.

Safeguards

JRC-ITU experience on the installation and operation of on-site laboratories (OSL) in Sellafield and La Hague has been made available to the International Atomic Energy Agency (IAEA) in the framework of the Commission's support programme to the Agency. Specific measurement instrumentation was developed, built and tested at JRC-ITU and then delivered, installed and calibrated at the IAEA's on-site laboratory at the Japanese reprocessing plant in Rokkasho (Japan). A vulnerability assessment was carried out on the measurement procedures intended for the OSL.

The increased attention to nuclear security issues was reflected in cooperative programmes on combating illicit trafficking of nuclear and radioactive material with the new Member States and with Russia.



Collecting samples for nuclear forensic analysis

Safety of nuclear fuel

An important result in 2005 was the determination of the radial temperature variation across the so-called 'high burn-up structure' that forms at the outer part of the fuel. There has been concern as to whether this structure can act as a heat barrier and compromise safety after moderate lifetime of the fuel. New experiments on irradiated fuels using a laser technique at JRC-ITU have shown that the thermal conductivity is raised by about 80% due to the occurrence of re-crystallisation, whereas the formation of pores leads only to a 15% reduction. Thus, the overall effect of the formation of this new nanostructure is more positive than previously thought.

Partitioning and transmutation of nuclear fuels

The CAMIX/COCHIX project with the Commissariat à l'Energie Atomique (CEA) involves the fabrication of special fuels containing Americium, one of the long-lived actinides. This project was successfully completed in the Minor Actinide Laboratory at JRC-ITU. The material will be irradiated in the Phénix fast reactor in France to test theories about the transmutation of Americium.

Progress continued in the electrochemical separation of actinides from lanthanide fission products. JRC-ITU's efforts concentrated on using molten chloride salts and by applying the correct electrochemical potentials, a grouped separation of actinides from fission products was achieved. The actinides were deposited onto porous aluminium cathodes.

Basic research in the actinides

A major success in 2005 was the award of a Research DG 4-year grant, starting in 2006, for the operation of the Actinide UserLab at JRC-ITU. The programme allows users who do not have access to equipment and samples, such as those available in JRC-ITU, to be funded for their visits. The programme also funds educational activities with all proposals having to pass a selection panel. Two well attended Workshops were held in 2005, one in July on hyperfine interactions and the other in December, on theory with special emphasis on the electronic structure of plutonium.



Visit of Mr. Bigot (left) high commissioner of the CEA (Commissariat à l'Energie Atomique) to JRC-ITU on 17 February, 2005

The collaboration with the Japanese Atomic Energy Agency at Tokai, signed in 2004, has continued successfully and the first major joint paper on results from both JRC-ITU and Japan on the material NpCoGa_5 was published in 'Physical Reviews' in 2005.

Medical applications

A phase I dose-escalation trial for the treatment of malignant melanoma was conducted in collaboration with the Centre for Experimental Radiation Oncology in Sydney, Australia. Two patients with subcutaneous secondary melanoma have shown complete tumour regression even at low doses (less than 10% of the expected maximum tolerated dose) without incidence of complications of any type.

Radiobiological studies at the gene expression level yielded fundamental data comparing the effects induced through alpha and gamma radiation in human leukemic cells.

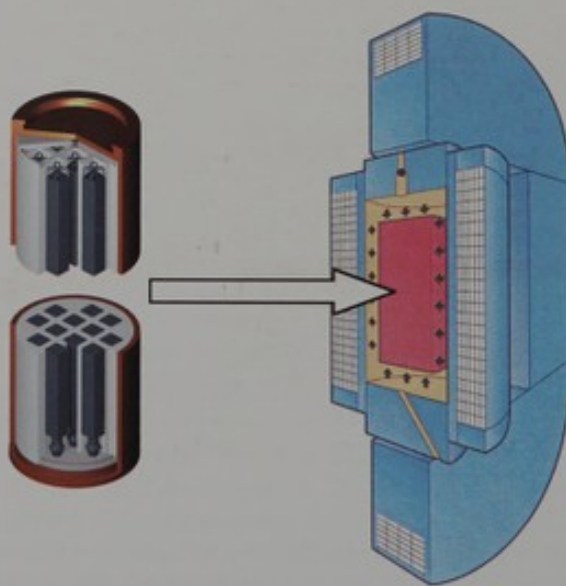


The mission of JRC-IE is to provide scientific and technical support for the conception, development, implementation and monitoring of community policies related to energy.

In 2005, significant highlights included starting the conversion of the High Flux Reactor (HFR) from highly enriched to low enriched fuel and the transfer of the HFR licence to the Nuclear Research and Consultancy Group (NRG) after a 10 year safety evaluation period resulting in some 4450 pages of technical documents. Also, following intense preparation, the Fuel Cell Testing and the High Pressure Hydrogen Gas Tank Testing facilities were added to JRC-IE's scientific infrastructure.

Large-scale pressure test for nuclear waste canister

The integrity of canisters for the geological disposal of high level nuclear waste must be assured for very long periods of time and must take potential future climate change into account. The Scandinavian concept, KBS-3, is basically a copper cast iron canister disposed in a crystalline rock formation. The copper protects the canister against corrosion whereas the cast iron provides the mechanical strength. However large cast iron components may contain defects and engineers need to determine the probability that a canister could fail under the large pressure loads of a 3 km ice-sheet.



Schematic illustration of cold isostatic pressure test of KBS-3 mock-up

To answer this question, the Swedish nuclear waste management organisation, SKB, JRC-IE and other Swedish and Finnish organisations initiated an analytical and verification project in 2003. By 2005, based on probable material property and defect data, a probabilistic failure analysis of KBS-3 canisters at high loads showed that the failure probability is extremely low (10^{-8}) even under ice age conditions which are equivalent to 44 bar pressure. Using two large-scale mock-up tests in a cold isostatic press, failure occurred at loads between 132 MPa and 139 MPa indicating a safety margin of at least three for the extreme loads that could occur during an ice-age.



Mock-up after plastic collapse at pressure load of 139 MPa

Advanced adaptation algorithm for the hydrogen combustion modelling program

JRC-IE has studied and developed a code for numerical simulations of hydrogen combustion in nuclear environments, which can predict the consequences of hydrogen explosions during a severe accident. Recently extended for full scale nuclear reactor containments, the models and the numerical algorithms have been successfully transferred to non-nuclear safety investigations such as the analysis of an explosion due to an accidental hydrogen release from a fuel tank of a bus travelling in a tunnel (see picture). These numerical simulations contribute to the determination of both active and passive safety measures needed for a successful introduction of hydrogen as an energy carrier.

Support to nuclear safety of Russian designed reactors

Dissemination of Russian TACIS and PHARE project results has been a major challenge in 2006 with achievements presented at seminars held in Mos-

cow and Brussels. A common WEB-enabled Database http://www.jrc.nl/_dissem/ has been developed which has the objective to allow the Nuclear Community, as well as anybody interested, to get a better visibility of the scope, status and results of these nuclear safety programmes. In the context of the forthcoming phasing-out of PHARE and TACIS nuclear safety programmes, this information tool has its importance and should also serve for preparing, at least partially, the foundations of the follow-up assistance programme on Nuclear Safety for Russia, and Ukraine and Armenia.

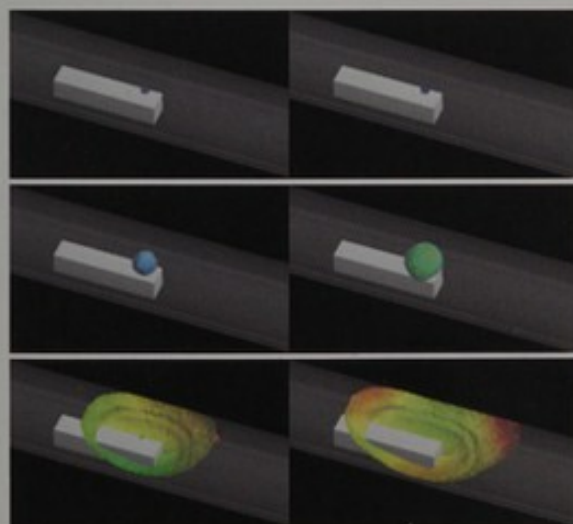
Furthermore, DG JRC is taking part, together with the External Relations, Europeaid and Energy and Transport DGs, in the preparation of a specific project involving also the IAEA, aiming to re-assess the remaining safety issues on the operating VVER in the TACIS countries.

New dedicated hydrogen sensor test facility

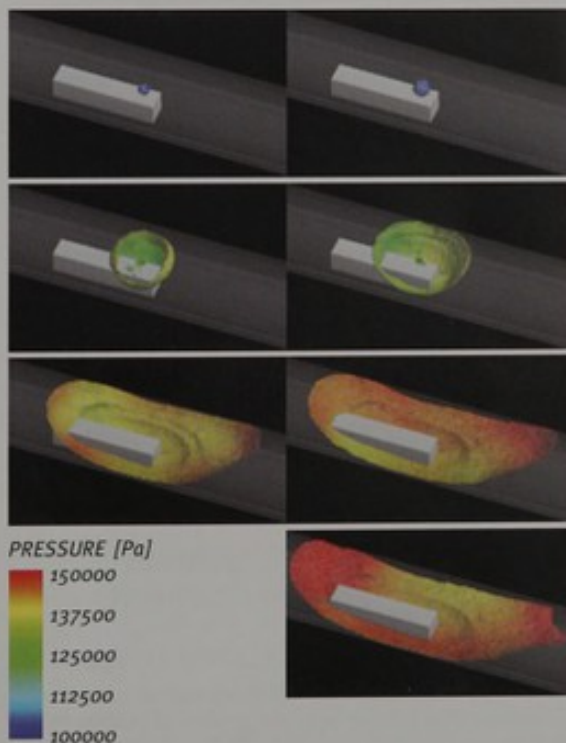
In addition to the two large hydrogen and fuel cell test facilities, a new dedicated hydrogen sensor test facility also became fully operational in 2005. The test set-up allows performance evaluation of a range of sensors of different types in terms of

reliability and repeatability of the measurements, response time, sensitivity to the presence of other gases, etc, both under static and cyclic conditions. The required capabilities of the facility were agreed within the HySafe Network of Excellence, the main body for hydrogen safety research in the EU. The facility is now involved in round robin testing within HySafe and a cooperation agreement with a national research institution has been signed.

The realisation that fossil fuels will remain a major energy source for the EU economy for decades to come, combined with the need to reduce the negative environmental impact of energy generation and use, particularly greenhouse gases, has led to a renewed EU-wide, and indeed global, interest in clean coal technologies. The cost-effective application of carbon capture in power generation is greatly facilitated by gasifying the coal prior to combustion. The post-capture fuel gas consists mainly of hydrogen, which can be fed to a gas turbine for power generation or directly used as a fuel for transport. JRC-IE has critically assessed and published the technological and economical issues of the co-production of hydrogen and electricity via coal gasification.



Hydrogen explosion in a tunnel, following a release of hydrogen from a bus tank at 350 bars. The isosurface is a temperature surface (350 k) that shows the propagation of the flame. The colour on the surface describes the pressure, according to the values in the legend





DG JRC Institute for the Protection and Security of the Citizen

The mission of JRC-IPSC is to provide research-based, systems-oriented support to EU policies so as to protect the citizen against economic and technological risk. In the context of the European Security Agenda, JRC-IPSC has two key objectives:

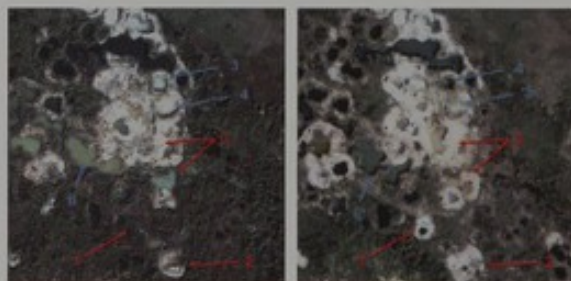
- Supporting the development of a European area of Freedom, Security and Justice.
- Contributing to the development of global stability and security.

The JRC-IPSC is developing specific technologies to pursue these objectives and some key results are presented here below.

Support to the Kimberley Process

In support to the External Relations DG, under the EC Rapid Reaction Mechanism, JRC-IPSC was asked to evaluate the feasibility to monitor, by means of very high resolution satellite imagery, presumed illegal mining activities in rebel-held areas in an African country, in order to provide support to the Kimberley Process (KP)*.

The work of JRC-IPSC in this area has confirmed the validity of very high resolution satellite imagery as a means for detection, assessment and monitoring of diamond mining. As a result of the technical work of JRC-IPSC, a strengthened sanction regime and an action plan to enforce both the arms and diamond trade embargo was imposed on that country by the UN Security Council and the KP.



Satellite imagery is used for the detection, assessment and monitoring of diamond mining

→ Increasing activity: 1 - 2 - 3
→ Decreasing activity: 4 - 5 - 6

* The KP has nowadays 45 participants comprising all major diamond producing, trading and processing countries (incl. EC) and its principal objective is to stem the flow of conflict diamonds by means of an international certification scheme being used for all trade in diamonds.

Security of the supply chain

Approximately 95% of the world's trade is transported via maritime containers. Container security and the security of the supply chain have become key elements in international security. JRC-IPSC is addressing these issues from two different angles.

On one hand, JRC-IPSC has developed a number of 'proof of principle' concepts for sealing and tracking systems and has realised prototypes that are currently being field tested with industry.

Secondly, JRC-IPSC successfully tested the use of software-based Container Traffic Monitoring (ConTraffic – based on open source intelligence gathering and data mining) during the joint customs surveillance operation called 'FAKE', coordinated by European Anti-Fraud Office (OLAF) and the Taxation and Customs Union DG (TAXUD).

Europe media monitor

The Europe Media Monitor (EMM) is a service which automatically scans on-line news sites and incoming news agency wires, 24 hours per day, 7 days per week. A new EMM service called News Explorer released in 2005 can track information on persons, events and places over time. It automatically identifies the main stories each day in 13 languages and flags places, persons and organisations referred to in those stories.

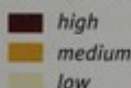
During 2005, JRC-IPSC developed a new 'Open Source Intelligence Suite' (OSint). By the use of in-house developed language tools, it can automatically identify persons, organisations, dates and phone numbers and register co-occurrences of these across thousands of documents.

MARS crop yield forecasting system

At the end of June, 2005, JRC-IPSC published a report on the effects of the severe drought affecting parts of Europe (Iberian Peninsula, western France). The system was able to provide an early evaluation of the impact of the extreme climate conditions, for example a reduction of at least 24 million tonnes in cereal production. Despite the strong impact in those areas, the analysis showed however that the effect, at the EU25 level, would be mitigated by normal or above normal productivity in other areas.



2005 drought impact on wheat yield



Standardised and harmonised European electronic logbook for fisheries

Regulations are being prepared by the European Commission to establish the requirement for on-board electronic logbooks to record fish catches. JRC-IPSC has supported this process by coordinating the SHEEL project. Real time trials of 16 vessels all over Europe and Iceland during 2005 have shown that different software packages with different satellite communications providers are able to provide mutually compatible transmissions. The SHEEL project has delivered important input to the preparation of legislation on electronic logbooks for fisheries, such as the size of the reports and messages, the cost of transmissions via satellite and the use of the acknowledgement of receipts and the Certification authority.

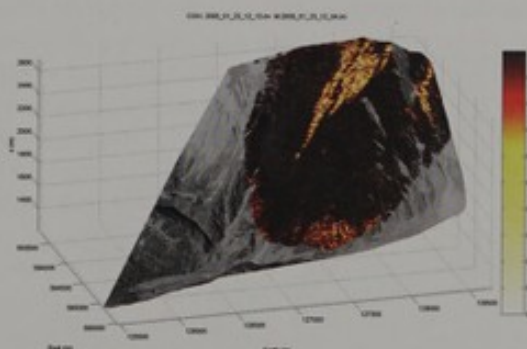


Electronic logbook

Conventional logbook

Towards an early-warning system for snow avalanches

In 2005, in the frame of a joint field campaign with the Swiss Federal Institute for Snow and Avalanche Research (SLF-Davos), the interpretation of the images collected with a JRC-IPSC's radar instrument has demonstrated its unique capability to detect every avalanche occurring during day and night time even under adverse weather conditions (fog, snow storms). The project's main achievement has been the identification of a set of reliable indicators in support of an early-warning system for snow avalanches. Other results include a technique to precisely map the risk of avalanches based on the analysis of the historical archive of radar images, and a processing algorithm to map the snow accumulation on the slope 24 hours a day.



Coherence of a natural avalanche, Sion Valley (CH), January, 2005

CRELL – Centre for Research on Lifelong Learning

Commencing operation in Autumn 2005, the Centre for Research on Lifelong Learning (CRELL), based on indicators and benchmarks, is a joint initiative of the Education and Culture DG and JRC-IPSC. The centre extends the Commission's research capacity in the development of statistical indicators to monitor and evaluate the performance of education and training systems in Europe.

European Co-ordination Centre for Aviation Incident Reporting Systems (ECCAIRS)

JRC-IPSC's ECCAIRS software has been adopted as the basic module of TOKAI, the EUROCONTROL's aviation incident occurrences reporting system.



DG JRC Institute for Environment and Sustainability

The mission of JRC-IES is to provide scientific and technical support to EU policies for the protection of the environment contributing to a sustainable development of Europe.

2005 has been a busy year for JRC-IES in supporting the European policy-maker. Major upcoming environmental legislation such as the Directive for an Infrastructure for Spatial Information in Europe (INSPIRE), the Marine Strategy and the Soil Framework Directive benefited from the sound scientific and technical support provided by DG JRC experts. In 2005, JRC-IES has further intensified its collaboration with a large number of strategic partners, particularly the Environment DG, the European Environment Agency and the PEER Network of European Environmental Research Centres. JRC-IES also re-launched the Institute web site (<http://ies.jrc.cec.eu.int/>) providing access to 26 freely accessible environmental data portals. Further success stories include:



DG JRC vehicle for air pollution measurements

Monitoring air pollution from a cruise ship in the Mediterranean Sea

As a new approach to improve our understanding of the effects of air pollution on climate change, JRC-IES has mounted an automatic monitoring station on board a cruise ship which follows a regular route in the western Mediterranean basin. The station will collect rarely taken measurements, on a permanent basis, of air pollution over the sea, in particular measuring ozone, particle size distributions and black carbon (light absorbing) particles. These measurements are interesting because it is postulated that the heating of the lower atmosphere, caused by the enhanced absorption of light due to air pollution, can reduce rain clouds and thus increase the frequency and impact of droughts. Research has shown that the impact

of aerosols on radiation in the Mediterranean is among the highest in the world, thus making the area an ideal study site for climate research.

Major agreements on air quality signed

JRC-IES has signed Memoranda of Understanding (MoU) in the field of air quality with some global and regional partners, enhancing DG JRC's support to the relevant European policies. One agreement has been signed with the Korean National Institute for Environmental Research, reinforcing the collaboration between the Korean National Motor Vehicle Emission Research Laboratory and DG JRC's Vehicle Emissions Laboratory (VELA). Another MoU was agreed with the Lombardy Region of Italy on air pollution reduction, establishing a multi-annual programme of joint activities whereby DG JRC will provide scientific and technical assistance to the implementation of the Region's air quality policies. The results of this joint initiative will provide a reference model for other European regions suffering similar problems.



Performing measurements at the Vehicle Emissions Laboratory at JRC-IES

Launch of the European platform for life cycle assessment

In collaboration with the Environment DG, JRC-IES officially launched the European Platform on Life Cycle Assessment in 2005. The platform provides the Commission, Member States and European businesses with selected, high quality reference data, recommended methodological guidance, and a reference point for knowledge dissemination. Life cycle assessment studies support the analysis of the overall environmental implications of products (goods and services), covering their whole life cycle from the extraction of raw materials, through production and use to final waste management. This can help avoid the 'shifting of

burdens' among the products' life cycle phases. Through the Integrated Product Policy, the platform directly supports the Thematic Strategies on Natural Resources and on Waste Prevention and Recycling as well as related legislation.

A proposal for defining the geographical boundaries of Amazonia

Following a request of the Amazon Cooperation Treaty Organization (ACTO), JRC-IES coordinated a workshop of highly esteemed European Amazon experts to come up with an independent proposal on how to define the geographical boundaries of Amazonia. To delineate the extension of this important ecoregion from a scientific perspective is of highest relevance to be able to create Pan-Amazonian databases based on a harmonised geographical reference. The expert opinion facilitated by DG JRC will serve as a starting point for a consensus building among experts and relevant research institutions in the Amazon Countries. The aim of the process is to provide the Amazon Cooperation Treaty Organization with a management tool allowing the creation of a cross-border environmental information system for the entire Amazon Region, thus contributing to the sustainable management of the largest rain forest of the world.



Handing over a satellite map to the Amazon Cooperation Treaty Organization

Update of the 'Well to Wheels' report on alternative fuels

The recent pressure on oil prices, resulting from a growing world oil demand, is a signal and also a driver for the European Commission to assess the alternatives to conventional fossil fuels for transport. In this context, JRC-IES has published a major update to the so-called 'Well to Wheels' study on alternative fuels, developed by DG JRC in collaboration with two important partners from industry, the European Council for Automotive Research and Development (EUCAR) and the Oil Companies' European Association for Environment, Health and Safety in Refining and Distribution (CONCAWE).

This thoroughly reviewed document is a reference for comparing the direct costs, the potential availability and the energy and greenhouse gases balance of the alternative fuels. Many chapters have been revisited, offering new pictures on biofuels availability projections and of the soil emissions due to growing biofuel crops in the European Union. New developments regard also the vehicles, like a chapter on improved Natural Gas vehicles simulations, or a reviewed chapter on hybrids vehicles potential.

The report is available online at: <http://ies.jrc.cec.eu.int/WTW>.



DG JRC Institute for Health and Consumer Protection

The mission of the JRC-IHCP is to provide scientific support for the development and implementation of EU policies related to health and consumer protection.

2005 provided a number of critical challenges through which the Institute was able to demonstrate key aspects of its work. Most noteworthy was the rapid validation of a protocol for the detection of non-authorised, genetically-modified Bt10 in response to the emergency situation arising from its unauthorised release into the EU food chain.

Support to the legislation of Genetically Modified Organisms

The drafting of proposals on seed-sampling protocols and threshold interpretation with respect to the implementation of the traceability and labelling regulations was among the portfolio of activities in 2005 of the Institute's Community Reference Laboratory (CRL) for GM Food and Feed. The CRL, which is assisted by the European Network of GMO Laboratories (ENGL), validated about ten protocols in 2005 for the detection of GMOs.

JRC-IHCP research activities on biotechnology have also led to significant contributions in the areas of sampling protocols, method validation and in bioinformatics; and work is currently underway to develop the first validation worldwide of a bio-chip for the detection of GMOs.



An international conference on implementing the GMOs regulation organised by JRC-IHCP in Tunis, Tunisia, September 2005

Chemicals policy

JRC-IHCP continued to provide support for the current chemicals policy and achieved consensus agreement of Member States on the potential risks of HERO (High Expected Regulatory Outcome) substances to human health and the environment (including flame retardants, plasticizers, and detergents).

The work under the Biocidal Products Directive (98/8/EC) gathered momentum, with the first risk assessment submitted under the programme on the wood preservative sulfuryl fluoride.

JRC-IHCP organised and submitted the EU-harmonised hazard classification and labelling for 950 substances or groups of substances, and health and safety dossiers for 331 novel chemical substances developed for the EU market.

The Institute submitted proposals for new test methods to OECD including a refinement of the acute fish toxicity test using fewer animals, and contributed to the development of guidance for risk assessment as well as providing training courses in Italy, Spain, Netherlands, Slovakia and Romania.

Human exposure

The development of the European Exposure Assessment Toolbox, evaluating overall risk for European citizens when exposed to chemicals from various sources (ingestion, inhalation, skin contact), progressed in 2005 and gained substantial interest from the Chemical Users Roundtable comprising a number of leading multinational companies.

The Institute's Community Reference Laboratory on Food Contact Materials completed the spectral characterisation of the reference collections of monomers and additives for up to 383 substances from food contact materials.

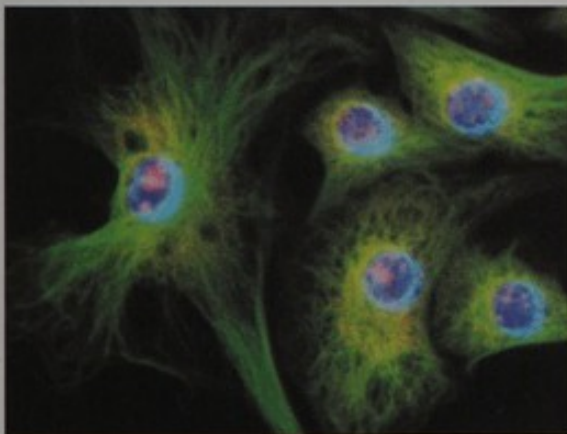
During the first phase (2003-2005) of the European Indoor Air Monitoring and Exposure Assessment Study (AIRMEX), air measurements were made in nine European cities to estimate personal-exposure and indoor/outdoor concentrations in public buildings and kindergartens for selected volatile organic compounds. Preliminary results indicate that personal-exposure concentrations of aromatics and carbonyls are notably higher than

indoor/outdoor concentrations. In particular, 45% of all cases of personal-exposure concentrations of benzene in air samples compared with 25% of outdoor concentrations and 30% of indoor concentrations exceeded the annual mean limit of $5 \mu\text{g}/\text{m}^3$ which is required to be met by 2010 (Directive 2000/69/EC).

Throughout 2005, JRC-IHCP coordinated the activities of the Network partnership on 'Consumer Exposure Modelling'. The network, comprising institutions from Europe, USA and Canada, has the task of harmonising and validating existing consumer-exposure models on the basis of common protocols and procedures.

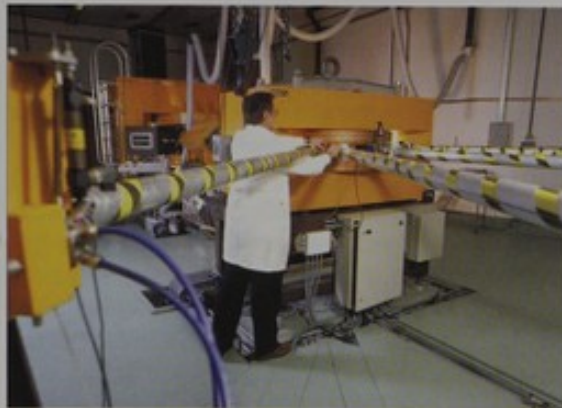
Nanobiotechnology

The Institute's involvement in the field of nanobiotechnology has provided a fruitful source of collaboration. JRC-IHCP is partner in several large European projects which address a number of pertinent issues with far-reaching implications, one example being the study of the toxicology of nanoparticles.



L929 mouse fibroblasts cultured onto ALL 20 W films

Practical results from collaborative projects have recently included the development of polystyrene microspheres which allow controlled immobilisation of antibodies against microcystins, and the development of novel bio-sensors for the measurement of cell toxicology in vitro.



The Cyclotron facility offers the possibility to produce a wide range of radioisotopes for both Nuclear Medicine and various research applications

Cyclotron applications in medicine

The cyclotron facility of JRC-IHCP is one of a limited number of variable-energy, multi-particle cyclotrons in Europe and has enabled collaborative research into the production of important isotopes relevant to the medical field. Examples include Astatine-211 for cancer therapy, and Copper-64 which can be used simultaneously for both therapeutic and imaging purposes and for which the Institute has recently developed a novel, cost-effective method of production.



DG JRC Institute for Prospective Technological Studies

The mission of JRC-IPTS is to provide customer-driven support to the EU policy-making process by researching science-based responses to policy challenges that may have both a socio-economic as well as a scientific/technological dimension.

Supporting Community policies for sustainable production and environmental protection

In 2005 the DG JRC European Integrated Pollution Prevention and Control Bureau (EIPPCB) delivered five new 'Best Available Techniques reference documents' to the Environment DG on (1) Food, Drink and Milk, (2) Organic Fine Chemicals, (3) Surface Treatment of Metals and Plastics, (4) Waste Incineration and (5) Waste Treatments.

Located at JRC-IPTS since 1997, the Bureau provides a major contribution to the implementation of the Integrated Pollution Prevention and Control Directive (IPPC Directive, 96/61/EC). This Directive aims – through a system of national permits based on Best Available Techniques (BAT) – at achieving integrated control of consumptions of energy, water and raw materials as well as prevention of pollution to water, air and soil, which could potentially arise from about 55 000 industrial installations across Europe.

EU Member States authorities must ensure that permits for the concerned industrial processes include emission limit values based on Best Available Techniques. In the determination of these techniques, the competent licensing authorities have to take into account the Best Available Techniques reference documents (BREF) adopted by the European Commission. These are based on an exchange of technical information between experts from industry, Member States authorities, research institutes and NGOs. This exchange is catalysed by the EIPPC Bureau, which sets up a technical working group for each BREF. Each of these documents is the outcome of a two to three year process. So far, 27 out of 32 planned BREFs have been finalised.

Prospects for agricultural income under the Common Agricultural Policy (CAP) in the new Member States and Accession Countries

In 2005, JRC-IPTS prospectively assessed the implementation of the 2003 CAP Reform in four New Member States and one Accession Country. This assessment brings new evidence of the reform's positive impact on the agricultural income of the

Czech, Hungarian, Latvian, Polish and Romanian farming systems.

Post-accession agricultural net income perspectives were simulated for the year 2013 using three hypothetical policy scenarios. The full implementation of the 2003 CAP Reform would bring the highest increase of farming system agricultural income compared to the other two scenarios. Specialised cropping would benefit the most, mainly owing to the link between direct payments and farmed areas. The other simulations showed that a full removal of policy support at this stage of the reform would deteriorate the viability of the farming systems considered.



Agricultural harvesting in the EU

However, targeted redistribution of policy support towards the weaker component of the farming structure would improve agricultural income prospects.

Understanding the dynamics of the European researcher labour market

In 2005, JRC-IPTS performed an in depth analysis of EUROSTAT, OECD and national data in order to shed some light on the dynamics of the researchers' population in Europe. A broad EU25 picture

emerged and a comparative analysis of the evolving situation in many Member States was also possible.

This analysis showed that, over the period 1994-2003:

- there was a regular growth in the number of researchers in the EU;
- the supply of new graduates was sufficient to satisfy the demand for researchers in Europe;
- the growth in the number of researchers was mainly driven by the private sector;
- growth in industry was due, in large, to the performance of the service sectors;
- a new landscape for R&D in Europe is slowly emerging due, at the same time, to relative stability in the four big Member States and rapid growth in a set of dynamic countries;
- industrial R&D in the fast growing countries is more often carried out within firms that have less than 500 employees.

For the public sector, there was a clear difference between the increase of researchers in universities (+29%) and in government laboratories (+3%).



'Understanding the European researchers market future needs'. Copyright Duke University Photography

For industry, which had the most rapid growth (+38%), a more detailed analysis was carried out at the disaggregated level of the industrial NACE sectors. It revealed a major shift between sectors and also exemplified the specialisation of the Member States. In particular, the number of researchers in computer manufacturing was reduced by half while the number in the computer-based services more than doubled.

Biometrics deployment in Europe

Concerns over security have raised interest in technologies that would allow the identification of individuals based on their biometric traits (physical characteristics), in particular when crossing borders. Biometrics can enable a more secure identification process due to the strong link between a stored identity and its rightful owner. Like any technology, biometrics can offer great opportunities but also pose serious challenges.

JRC-IPTS carried out a study entitled 'Biometrics at the Frontiers: assessing the impact on society' which was presented to the European Parliament Committee on Citizens' Freedoms and Rights, Justice and Home Affairs (LIBE), in April 2005. The study made recommendations on issues requiring further research as well as policy options that need to be considered if Europe is to fully benefit from a large scale implementation of this technology.



The JRC **Enlargement** and **Integration Action**

Following the adhesion of 10 New Member States (NMS) to the European Union in May 2004, DG JRC continued to contribute to the integration process through its activities and projects. Moreover, special attention has been given to the research needs of four Candidate Countries (CC), namely Bulgaria and Romania – whose accession is planned in 2007 – and Croatia and Turkey which started accession negotiations in October, 2005. Finally, cooperation has started with the former Yugoslav Republic of Macedonia which, in December, 2005, acquired the status of Candidate Country, as well as with the other remaining Potential Candidate Countries (PCC) in the Western Balkan Region, namely Albania, Bosnia-Herzegovina and Serbia-Montenegro. The Enlargement and Integration Action (E&IA) of DG JRC consists of a number of integrated instruments aimed at stimulating S&T collaboration, hosting temporary staff at its Institutes, organising workshops and training courses and disseminating information within the NMS and CC.

In 2005, results include:

- Some 100 workshops and training courses on various scientific and technical aspects of EU policies have been organised by JRC institutes, with the participation of over 4000 experts from ministries, authorities, research institutes and controlling bodies coming mainly from the Enlargement countries, but also from the (old) MS and neighbouring countries. Collaboration with DG Enlargement's TAIEX unit continued particularly in the areas of Environment, Energy, Agriculture and Food Safety. All workshops were also open to experts from the Western Balkan countries and to select neighbouring countries in Northern Africa and Eastern Europe;

- The number of staff from NMS and CC working at DG JRC increased from 154 (end 2004) to 226 (end 2005), placing it among the highest of all Commission services. In 2005 the JRC issued an open call for 71 posts for scientists and experts from NMS and CC and received 303 applications;
- In 2005, DG JRC information days were held in Croatia, Romania, Bulgaria and Turkey involving some 1200 participants. In order to trigger new partnerships with leading S&T organisations in the NMS, DG JRC developed a new instrument directed at focusing collaboration on priority research needs of these countries, namely, the Round Table. In 2005, Round Tables were organised in Cyprus, Czech Republic, Poland, Slovak Republic and Slovenia.



Round table meeting in Ljubljana, 25 February, 2005



Enlargement workshop in Seville, 19-20 May, 2005

Technology Transfer and the European Research Area

The Sixth Framework Programme is one of main instruments for DG JRC to contribute to ERA. To date, DG JRC is involved in over 180 FP6 activities, from Networks of Excellence and Integrated Projects to infrastructure initiatives, individual and host fellowships, and actions designed to coordinate national research programmes.

In the framework of the research infrastructures programmes, JRC-IPSC and JRC-IRMM became involved in Integrated Infrastructure Initiatives in 2005. The JRC-IPSC initiative addresses experimental aspects of earthquakes, dynamic and geotechnical engineering and will make use of the European Laboratory for Structural Assessment (ELSA) reaction wall. The JRC-IRMM initiative will pull together Europe's leading infrastructures in astroparticle physics and benefit from the instrumentation in the HADES underground laboratory. JRC-IES will organise a series of training events related to methods in interdisciplinary environmental research with the Marie Curie programme.



European Laboratory for Structural Assessment (ELSA), JRC-IPSC, Ispra

In preparation of the next Framework Programme, DG JRC has started to become involved in a number of Technology Platforms in its competence areas (for example hydrogen and fuel cell technology, biotechnology, nano-medicine, sustainable chemistry, road transport and zero emissions).

Intellectual Property (IP) and Technology Transfer

DG JRC is responsible for managing the intellectual property of the European Union, which includes the protection and exploitation of Commission-related intellectual property. Throughout 2005, more than twenty Commission services received assistance on a range of intellectual property issues from electronic copyright to protection of new trademarks.

DG JRC has been working with OLAF, the Commission Anti-Fraud Office, on support to fraud detection. After promising internal results using data-mining software developed at DG JRC, a licence agreement was prepared for OLAF to enable Member State authorities to use the software to detect anomalies in statistical returns. Since its launch in September, 2005, 10 MS customs offices have already licenced the software.

Within DG JRC, dedicated courses on IP were given, an entrepreneurship course was held, and 25 licence and exploitation agreements were concluded with industry and Member State authorities.

To encourage DG JRC researchers to invent, create and exploit innovative products and processes, an 'Innovation Project Competition' was launched in June, 2005. Projects with both a high exploitation potential and an institutional or public potential were eligible for funding and 6 projects from a total of 21 proposals were funded. Project results will be showcased in autumn 2006, but already one collaboration agreement and one patent proposal are in preparation.

Upon request and to exchange best practices, DG JRC organised a pilot workshop on Intellectual Property and Innovation in Ispra, Italy on 28-29 September, 2005. Two representatives from each New Member State and Candidate Country were invited and external speakers came from Oulu Tech (Finland) and ISIS Innovation, Oxford University (UK).

Management of Nuclear Facilities

Decommissioning of JRC nuclear installations

In 2005, DG JRC continued implementing its Decommissioning and Waste Management (D&WM) Programme to dispose of the obsolete nuclear materials and installations.

At JRC-IE, 210 High Flux Reactor spent fuel elements were shipped from Petten to Savannah River Site in the USA. This was the first batch of a removal of up to 420 spent fuel elements.

At the Ispra site, the management of nuclear activities and in particular the D&WM Programme was completely re-organised, merging the former Nuclear Decommissioning and Waste Management Unit and some key services of the Operational Health and Safety Unit within the new Nuclear Decommissioning and Facility Management Unit. This has improved staff synergy, work efficiency and increased cost savings. A critical revision of the Ispra D&WM Programme, supported by four external experts, was performed and leads to reconsider some strategic choices in view of experience gained so far and a value-for-money approach. In the meantime, an important contract was finalised for the sale and transfer of a large amount of un-irradiated nuclear material. Progress towards the start up of the Waste Management Facilities continued with the delivery of the Abrasive Blasting Unit.



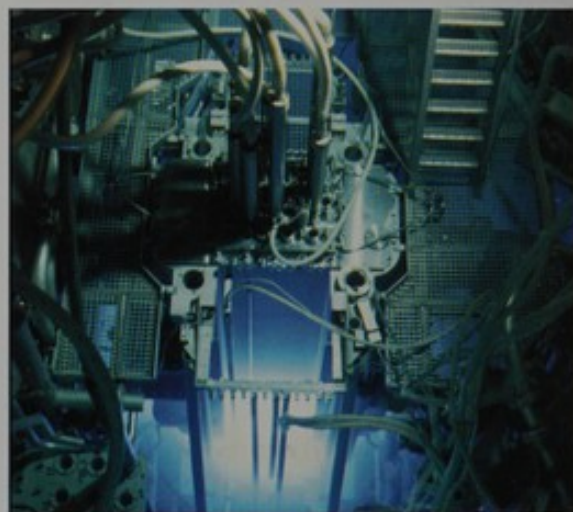
Abrasive blasting unit

At JRC-ITU, dismantling of obsolete glove boxes continued together with the clean up of hot cells. Finally, at JRC-IRMM, the provisional decommissioning plan was updated and transmitted to the authorities. Additionally, eight obsolete glove boxes and other equipment were dismantled and the waste removed from the site.

The High Flux Reactor

A new nuclear licence for the operation of the HFR was granted by the Dutch authorities in February, 2005. This accomplishment is the result of more than three years' preparatory work including the full safety re-evaluation of the facility and a new set of deterministic and probabilistic safety analyses. The licence has been granted to the HFR operator NRG, while DG JRC continues to use the HFR for its scientific programmes, maintains the ownership and the responsibility for the final decommissioning.

IAEA has performed a full-scope INSARR mission to comprehensively assess the safety of the research reactor. The inspection acknowledged that the issues identified in the 2002 INSARR were resolved and special mention is given to the implementation of a Safety Culture Enhancement Plan. The HFR safety management system has been adopted by the IAEA as a model for research reactors.



Top view of core and pool side facility at the High Flux Reactor (HFR)

In 2005, two irradiation testing experiments were finished successfully, one is ongoing and four others are under preparation. These irradiation campaigns aim to test the operational limits of innovative fuel for the U-Pu or Th-U fuel cycles, the incineration of minor actinides, or the fission gas retention capability of high burn-up fuel for high temperature reactors. DG JRC is currently the only laboratory worldwide that can offer the complete chain for gas-cooled reactor fuel qualification, i.e. irradiation, post-irradiation examinations and safety testing.

Exploratory Research



As was evident once again from this year's JRC-wide Exploratory Research Symposium, the JRC puts high emphasis on exploratory research providing space for the development of new ideas by its scientists. Exploratory research is important for fulfilling DG JRC's mission because it helps to anticipate future science and technology needs and to get prepared for potential future policy requirements.

The 5-10% of the institutional budget which is annually invested in exploratory research is considered as 'seed money' which may yield practical results at a later stage. At the symposium which was held on 15 December, 2005, six projects – each from a different institute – were reviewed.

The projects

A JRC-IHCP project (Ref. 1) was presented in which a simple and fast on-line method was developed to study the basal cytotoxicity induced by selected chemicals in an *in vitro* system as a model of concurrent cytotoxicity and carcinogenic potential. The method is based on the measurement of electrical impedance as cellular adhesion endpoint.

Taking account of the necessity to monitor and construct a precise global budget for the greenhouse gas nitrous oxide (N_2O), a complete measurement procedure for the N_2O isotopomers has been developed in a JRC-IRMM project (Ref. 2) on absolute isotope amount fractions of oxygen and nitrogen in N_2O which can be used for atmospheric samples.

A JRC-ITU project (Ref. 3) was reviewed which compares the cytotoxic effects of alpha-immunoconjugates as compared to gamma irradiation on human leukemic lymphocytes on the molecular level. This information is important for the successful application of alpha-immunotherapy in the treatment of B-chronic lymphocytic leukaemia.

A JRC-IES project (Ref. 4) makes use of the Ensemble Prediction System (EPS) of the European Centre for Medium-range Weather Forecasts (ECMWF) consisting of a set of possible future meteorological scenarios as input to hydrological models for probabilistic flood forecasting. First results show that the inclusion of EPS in the European Flood Alert System (EFAS) improves flood forecasting.

A JRC-IE project (Ref. 5) studying the behaviour of gas and steam bubbles in liquid metal coolants flows is of importance for liquid metal cooled reactors with a simple flow path, where heat-exchangers are placed in risers. It aims at the parametric investigation of primary and secondary coolant combinations for the next generation of fast reactors by means of validated computational fluid dynamics (CFD) codes.

A JRC-IPSC project (Ref. 6) combines Automatic Identification System (AIS) data from merchant vessel transponders with satellite images of vessel positions for fisheries control. By subtracting lawful merchant shipping from the suspect target list, it enables a more focused search for illegal fishing. The picture below shows (right) a 30x30 km part of a RADARSAT satellite image over the Netherlands North Sea coast near Rotterdam. Green dots indicate ships detected on the radar image. Yellow crosses are fishing ship positions from the VMS system that tracks fishing vessels. Red crosses are AIS positions and tracks recorded by TNO (Netherlands Organisation for Applied Scientific Research). The left shows an enlargement with three large ships. (Radar image (c) CSA/RSI 2005.)



Using AIS to help identify illegal fishing

DG JRC References:

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3. S. MARTIN, C. Apostolidis, A. Morgenstern, F. Bruchertseifer, M. Weis, A. Romanov, ITU, et al.: Molecular effects of targeted alpha radiation and gamma rays in human leukemic lymphocytes
4. M. H. RAMOS, J. Thielen, J. Bartholmes and A. de Roo, IES: Exploration and interpretation of probabilistic forecasting of floods using weather ensembles
5. J. CARLSSON, IE: Gas and steam bubbles behaviour in liquid metal coolants flows
6. H. GREIDANUS, G. Lemoine and F.-X. Thoores, IPSC: AIS4FISH: Incorporation of AIS ship transponder data in fisheries monitoring



Press and Media Coverage in 2005

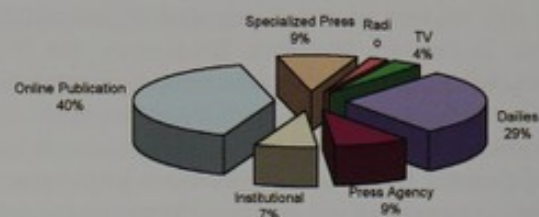
In 2005, significant DG JRC coverage was generated in the media, raising the visibility of the core work areas of DG JRC with print and audiovisual media outlets. Although difficult to categorise and assess the A-Z of all daily interactions with journalists, from facilitating an article to hosting a large thematic event, approximately one media event took place per week during the year, an average of 4 stories was generated every day, and total known coverage was almost double the 2004 figures.

The types of events ranged from

- Thematic press briefings and conferences;
- Organisation of media visits;
- Information Days and Round Tables in new Member States and Candidate Countries;
- Stands at exhibitions and conferences;
- Open Days at Institutes;
- Regular and informal 'meet & brief' media breakfasts/lunches with senior management & scientists.

For major events, a quick snapshot of results in 2005 reveals that 9 press briefings and 6 press conferences took place in 10 countries, i.e. Belgium, Bulgaria, Croatia, Cyprus, The Czech Republic, The Netherlands, Romania, Slovenia, Turkey and the United Kingdom. For media and coverage, 761 media participated on-site at events, 53 countries world-wide generated coverage and 1391 'known' coverage pieces were generated (1310 print and 81 audiovisual).

Key Dailies	400
On-line	561
Pan-European	102
Press Agencies	120
Specialised Press	127
Radio	31
TV	50
TOTAL	1391 coverage pieces

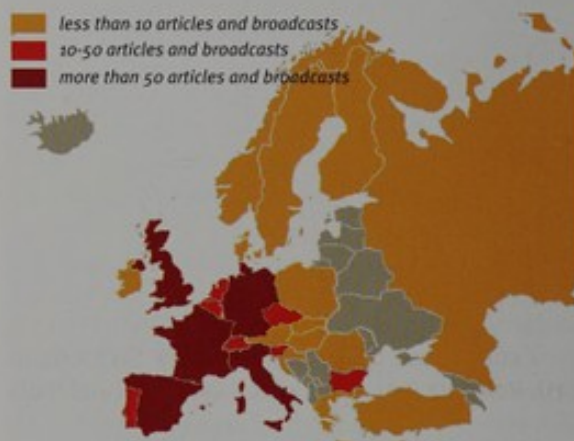


Total coverage per type of media - percentages

Countries reached

In 2005, DG JRC generated media coverage in 53 countries worldwide, from Canada to India and China; and from Venezuela to Angola, Korea and Australia. This included 22 out of 25 EU Member States (the exceptions being Latvia, Lithuania and Estonia where a targeted action is planned for June, 2006).

Significant coverage was also generated in Accession and Candidate Countries such as Bulgaria, Croatia, Romania and Turkey; plus Associated Countries to FP7 such as Norway and Switzerland.



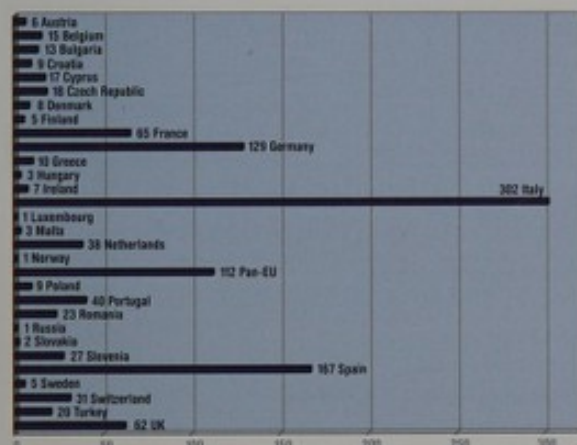
Geographical reach of coverage generated by the DG JRC events series in 2005. Colour depth from orange to dark red shows the amount of coverage generated



Strong remote coverage

A noticeable trend in 2005 has been how thematic press releases or features are being picked up by media outlets in other regions of the world. This 'remote coverage' is particularly evident with 'new' online media. The PR Unit's more strategic approach of building thematic media databases will also continue to impact positively in 2006.

Looking at the number of articles per country, results were consistent with tactical targets, reflecting also where major events were hosted. Italy (302), followed by Spain (167), Germany (129), France (85) and the United Kingdom (62) had the most coverage hits inside the EU 25, with Portugal (40) the Netherlands (38), and Slovenia (27) also well featured.



Total coverage in Europe for 2005

In terms of non EU countries, the United States (70) comes out on top followed by Switzerland (31), Romania (23), Turkey (20), China (11) and India (10). Pan-European media (112) performed well for DG JRC in 2005 with notably European Voice, Cordis, Euronews and Euractiv. Also important were other international media (109) such as the International Herald Tribune and Nature.

Quality as well as quantity

To demonstrate how actively targeting 'key' generalist and specialised press paid off in 2005, we can count coverage, for example in:

Die Welt (11), Financial Times Deutschland (6), FAZ (5), Le Monde (7), Financial Times (6), Il Sole 24 Ore (5), Hospodarske Noviny (5), Delo (5), Helsingin Sanomat (4), Nature (4), El País (3), Irish Times (3), BBC News (3), New Scientist (3) etc.

Highlights TV Broadcasts

Examples of TV Broadcasts in 2005

- Interview on EFAS (BBC NEWS)
- Japanese report on EFAS (NHK)
- German broadcast on Avogadro Project (3sat)
- Interview on soil atlas (YLE)
- Italian Report on GAO (RAI)
- Turkish news on Information Event (TRT)
- Begin report on press trip to IFMM (rtbf)
- Report on GAO (Euronews)
- Polish news on Launch of Krakow project (TVP3)
- Bulgarian announcement on information event (BNT)
- Romanian report on information event (TVR)
- Czech report JRC round table (KROK)
- French report on crop yield forecast (LA CHAÎNE)

Examples of TV Broadcasts in 2005

Highlights Radio Broadcasts

Examples of Radio Broadcasts in 2005

- Interview on PRIME on German Radio 01/10/2005 (Deutschlandfunk)
- Interview on Climate change on Italian Radio 20/02/2005 (Radio 1)
- Report on Information Days on Romanian Radio 25/05/2005 (Radio 1)
- Broadcast on EFFIS on Portuguese Radio 11/09/2005 (Radio 1)
- News on Round Table on Czech Radio 16/06/2005 (Radio 1)
- Broadcast on Opening of Hydrogen Test Facility on Swedish Radio 07/2005 (RTV N-H)
- Broadcast on Opening of Hydrogen Test Facility on Dutch Radio 07/07/2005 (Radio 1)
- Broadcast on ECVAM on Swiss Radio 11/02/2005 (Radio 1)

Examples of Radio Broadcasts in 2005



The JRC 2005 Figures on Staff, Budget and Publications

Core staff

The core staff of DG JRC (M-male, F-female) is composed of the following categories:

Core staff (end-of-year situation)								
2003			2004			2005		
M	F	Total	M	F	Total	M	F	Total
Officials								
794	262	1056	1116	360	1476	1117	379	1496
Temporary agents on five-year renewable contracts								
344	123	467	62	41	103	112	67	179
Temporary agents on non-renewable contracts								
39	10	49	44	8	52	26	7	33
TOTAL								
1177	395	1572	1222	409	1631	1255	453	1708

Of the 1 708 total, 1094 staff members are working on scientific projects and 614 are in administrative positions.

Commission policy for the 'integration of research staff into the mainstream of the Commission's personnel policy' is reflected in an overall decrease in the number of temporary agents from 2003 (516 staff) to 2005 (212 staff).

Nevertheless, a margin of flexibility of between 10 and 35% of permanent research posts will be maintained for the recruitment of specialised staff to cope with needs that have a strict time limit.

Core staff distribution (end-of-year situation)								
2003			2004			2005		
M	F	Total	M	F	Total	M	F	Total
Institute for Reference Materials and Measurements								
128	46	174	131	53	184	142	65	207
Institute for Transuranium Elements								
168	40	208	180	40	220	180	42	222
Institute for Energy								
127	20	147	131	28	159	124	28	152
Institute for the Protection and Security of the Citizen								
171	45	216	174	41	215	192	53	245
Institute for Environment and Sustainability								
192	55	247	200	55	255	198	60	258
Institute for Health and Consumer Protection								
87	54	141	98	62	160	105	71	176
Institute for Prospective Technological Studies								
33	18	51	45	19	64	51	23	74
DG, ISR, DPRM and ISD								
271	117	388	263	111	374	263	111	374
TOTAL								
1177	395	1572	1222	409	1631	1255	453	1708

Visiting staff

In addition to its core staff, DG JRC has an active policy of hosting grant holders, visiting scientists, seconded national experts, auxiliaries and trainees, primarily from the Member States and Candidate Countries. Visiting scientists bring skills, knowledge and expertise to help resolve current scientific challenges, while benefiting from the cultural diversity, multidisciplinary research domains and extensive research networks at DG JRC. In order to respond to the ever increasing demands for scientific and technical support, the number of visiting staff has increased by 253 persons from 2003 to 2005.

Visiting Staff (end-of-year situation)								
2003			2004			2005		
M	F	Total	M	F	Total	M	F	Total
Trainees								
19	20	39	25	17	42	38	23	61
Postgraduate grant holders								
42	36	78	41	31	72	26	19	45
Post-doctoral grant holders								
48	22	70	57	34	91	70	43	113
Visiting scientists								
21	10	31	16	6	22	0	0	0
Seconded national experts								
29	9	38	37	22	59	48	23	71
Auxiliaries								
211	227	438	200	241	441	93	127	220
Contractual agents								
0	0	0	6	11	17	216	221	437
TOTAL								
370	324	694	382	362	744	491	456	947

Equal opportunities

The JRC-wide network on 'Women and Science', set up in 2000, continued to monitor gender equality. In December, 2005, the group was expanded by establishing the DG JRC Working Group on Equal Opportunities.

In 2005, an official was appointed for implementing the Commission policy on equal opportunities. DG JRC prepared and submitted the 'DG JRC Action Plan 2006-2008 for Equal Opportunities' to the Commission in December, 2005. The Women and Science network held 4 meetings with representatives from all 7 Institutes, published the annual report, a new leaflet, held seminars for new DG JRC staff and a Workshop on 'Gender Balance at JRC: Why is it Important?'.



The percentage of women as category A* grade officials and temporary agents showed a positive increase of up to almost 20%. Concerning visiting scientists, gender parity remained stable with women making up 48.2% at the end of 2005.

Budget (budget and expenses – institutional activities)

The available credits to DG JRC are subdivided into staff expenses, means of execution (maintenance of buildings and equipment, electricity, insurance, consumables, etc.) and specific credits (direct scientific procurements). The credits come from the institutional budget, made available directly from the European budget to DG JRC for the 6th Framework Programme. The following sums were committed from the institutional budget:

In million Euro	2003	2004	2005
Staff expenses	168	197	199
Means of execution	53	56	64
Operational appropriations (FWP)	35	36	36
TOTAL (rounded)	256	289	299

In addition, a total of €66.9 million was made available to finance an action programme to shut down and decommission nuclear installations and manage the waste activities related to the EURATOM Treaty.

Additional credits of €20.9 million came from contributions from countries associated to the Framework Programme and from competitive activities undertaken by DG JRC.

DG JRC competitive activities

The table below shows the value of contracts signed and inscribed in the accounts from 2003 to 2005.

Contracts signed (in million Euro)	2003	2004	2005
Indirect actions	4.1	16.7	18.2
Competitive activities outside the Framework Programme (FP)	17.3	21.8	11.1
Third party work	4.5	6.4	5.3
TOTAL (rounded)	25.9	44.9	34.6

A portion of DG JRC's income comes from participation in FP6 indirect actions, performing additional work for Commission services, and contract work for third parties such as regional authorities or industry. These competitive activities complement the tasks outlined in DG JRC's own work programme and are seen as an essential tool for acquiring and transferring expertise and know-how.

Three quarters of the way into FP6, DG JRC is enjoying a 53% success rate and has been awarded a total of 185 projects, 55 of which were granted in 2005. Institutes participate in 16 Networks of Excellence (NoEs), 50 Integrated Projects, 48 Specifically Targeted Research projects, 25 Specific Support Actions and 21 Coordination Actions. DG JRC is also involved in 5 Infrastructure initiatives, 2 Research Training Networks and 2 Training Courses, and it employs 4 Marie Curie fellows. Examples of projects that started in 2005 are:


- Human Integration into the Lifecycle of Aviation Systems
- Towards European Sectorial Testing Networks for Environmental Technologies
- Sustainability Impact Assessment of Strategies Integrating Transport, Technology and Energy Scenarios
- Highly parallel cell culture in nanodrops
- Towards hydrogen production with CO₂ management
- Analysis by Neutron resonant Capture Imaging and other Emerging Neutron Techniques: new Cultural Heritage and Archeological Research Methods
- Sustainable Aquafeeds to maximise the Health Benefits of Farmed Fish to Consumers
- Network of reference laboratories and related organisations for monitoring and bio-monitoring of emerging environmental pollutants

Competitive activities outside the FP include additional work to Commission services that is not covered by DG JRC's own work programme. In 2005, new contracts signed amounted to over €11 million.

Publications registered in 2005

	1	2	3	4	5	Total
IRMM	63	29	172	0	3	267
ITU	61	1	115	3	23	203
IE	45	26	77	1	3	152
IPSC	47	27	129	2	111	316
IES	158	54	92	4	21	329
IHCP	48	29	158	1	7	243
IPTS	15	13	43	0	0	71
	437	179	786	11	168	1581

1. Monographs and articles
2. Technical EUR reports
3. Contribution published in conference proceedings
4. Special publications
5. Other documents and publications



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Abstract

*Report on the activities, accomplishments and resources related to the JRC work carried out in 2005. An overview is
given of the mission and its implementation, the scientific activities and the relations with the outside world.*



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