ACTINET network for actinide sciences

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A. INTRODUCTION

The European Union currently produces 35% of its electricity from nuclear fission. Furthermore, as stated by the Green Paper "Toward a European strategy for the security of energy supply" published in 2000 by the European Commission, it should maintain a diversity of its sources of energy supply. Nuclear fission is therefore likely to contribute substantially to the European energetic mix in the future, as an option to reduce the energy dependency of the European Union, while avoiding greenhouse gas emission.

In this context, research and technological development will play an important role. Although the nuclear industry has now come to maturity and operates nuclear plants with a high level of safety and efficiency, some issues in the field of the back-end cycle and resource management remain open. Research and Development are needed to explore new concepts for nuclear energy generation that make better use of fissile material and generate less waste. One other major issue also requiring intensive Research and Development programs remains a broadly agreed approach to waste management.

All these issues require expertise and improved knowledge of the processes involved in the behaviour of fuels in reactors or transmutation targets, in spent fuel treatment, as well as a comprehensive understanding of the processes governing the behaviour of high level waste in storage and disposal systems.

Advanced research in actinide sciences is therefore recognized as one essential endeavour for further development of a dynamic, competitive and sustainable knowledge-based nuclear industry.

As a general trend of nuclear science and technology, the assessment of the behaviour of nuclear systems relies more and more on basic scientific understanding of each component, down to the nanometre and atomic scales. This requires further development of basic knowledge, which in turn needs to be supported by state-of-art experimental capabilities. Maintaining high-performance research infrastructures and expertise are therefore necessary to allow science-based decision-making on issues of great relevance for the industry, and for the public.

However, during the past decades, safety requirements have gradually made researches on actinides very costly, many radiochemistry laboratories in Europe have restricted their activities on actinides, and the actinide sciences have become less attractive for young scientists. At present, only few European national research institutions are able to maintain the necessary infrastructure to perform research at the relevant scale, and to support education in actinide sciences.

Because of its strategic importance, the research in actinide sciences must therefore be revitalized. Reinforcing links between national nuclear research institutes, the Joint Research Centre of the European Commission, and radiochemistry laboratories of academic research organisations, is necessary to maintain in Europe the threshold level of excellence and research in actinide sciences. This networking will not only facilitate the coordination and utilization of the available facilities, but also consolidate and optimise research programming and training capacities in Europe.

The network ACTINET has been established with the support of the European Commission in order to take some steps to bring both research infrastructures and human expertise in Europe at an adequate performance level in the fields of physics and chemistry of actinides, of high relevance for nuclear fission energy.

More specifically, ACTINET has a three-fold objective, related to i) research infrastructures, ii) research programmes, and iii) education and training:

i) A global European infrastructure policy is necessary, in a context where the available tools are scarce resources scattered among several institutes. Some facilities are redundant, while others are either missing or difficult to gain access to by academic researchers. It has been chosen to proceed step-by-step, starting by improving the accessibility of the major facilities to the scientific community, then optimising their utilisation at the European scale, and finally coordinating the future deployment of new facilities and instruments;

ii) Offering the access to up-to-date major experimental tools must be accompanied by the definition of shared ambitious research programmes, and by improved mobility between the involved institutions, in particular between academic institutions and national laboratories, in order to reduce the fragmentation of the European community of actinide sciences. The objective of the network is to stimulate and support joint research projects proposed by member organisations. The support essentially consists in access to pooled facilities and funding for the mobility of researchers and radioactive samples;

iii) Enhanced mobility and enhanced availability of the infrastructures for joint research programmes will allow the next generation of actinide scientists and engineers to gain hands-on experience as part of their training. The objective is to increase the attractiveness of actinide sciences among European students. The network also supports a stronger participation of national laboratories in training at the universities, as well as a stronger use of facilities for teaching and training.

B. ORGANISATION OF THE NETWORK

ACTINET is a consortium gathering more than twenty five European research institutions. It was established in March 2004 with the support of the European Commission under a four year contract within the sixth Framework Programme for Research and Technological Development. The network is designed as a long lasting structure, and intends to operate beyond this four year period.

The members of the network range from large national laboratories to smaller university departments, thus bringing at the same time major experimental facilities, training experience, academic and applied research capacities, within the broad area of actinide sciences.

Four major organisations form the “core group” of the network:

- the Commissariat à l’Energie Atomique (CEA), with 9 research centres in France, including Saclay, Marcoule and Cadarache. CEA has at his disposal a set of unique facilities and operates in the fields of nuclear energy (support for nuclear power stations, design of future reactors and fuels, safety, waste management…), defence, technologies, and fundamental research in physics and life sciences;
- the Institute for TransUranium elements (ITU) in Karlsruhe. It is one of the Institutes of the Joint Research Centres of the European Commission, and is dedicated to actinide research;
- the Forschungszentrum Karlsruhe (FZK) in Germany, a research institution working in the area of technology and environment. In particular the Institut für Nukleare Entsorgung (INE) is a part of the FZK operating in safety research for nuclear waste disposal;

- the Studie Centrum voor Kemenergie - Centre d'Etudes Nucléaires (SCK-CEN) in Mol. It operates in Belgium in the fields of radioactive waste management and site restoration, in nuclear reactor safety and radiation protection.

The other members of the network are research organisations and academic organisations. Today these members are:

Research organisations:

- CIEMAT in Spain,
- the Centre National de la Recherche Scientifique (CNRS) in France,
- the Forschungszentrum Jülich GmbH (FZJ) in Germany,
- the Forschungszentrum Rossendorf (FZR) in Germany,
- the Royal Institute of Technology (KTH) in Sweden,
- the Nuclear Research Institute Rez in the Czech Republic,
- the Institute of Low Temperature and Structure Research, in Poland,
- the Paul Scherrer Institute (Switzerland)
- the Nuclear Research and consultancy Group (Nederland)
- the Imperial College (United Kingdom)

Universities:

- most of French universities, through their joint laboratories with CNRS,
- the Chalmers University of Technology in Sweden,
- the Czech Technical University in Prague in the Czech Republic,
- the Johannes Gutenberg University in Germany,
- the University of Copenhagen, in Denmark,
- the University of Stockholm (Sweden)
- the University of Antwerpen (Belgium)
- the University of Cambridge (United Kingdom)
- the University of Cyprus (Cyprus)
- the University of Helsinki (Finland)
- the University of Liège (Belgium)
- the University of Manchester (United Kingdom)
- the University Politècnica de Catalunya (Spain)
- the Ecole Nationale Supérieure Chimie Paris (France)

The network is coordinated by the CEA.

A Governing Board formed of representatives of each member organisation, is responsible for the general policy and strategic orientations of the network. It provides budget guidelines and takes major decisions like the inclusion of new member organisation (and the exclusion or withdrawal of a member organisation). The inclusion of the universities of Potsdam and Münster has already been approved, and the inclusion of several additional new members is currently under consideration.

The Governing Board appoints an Executive Committee and a Scientific Advisory Committee. The Executive Committee is responsible for the day to day management of the network, while the Scientific Advisory Committee provides general scientific guidance and acts as referee for the selection of collaborative research projects.

A number of specific Task Groups have also been appointed by the network to tackle with specific issues, like facilities, education and training, etc.

C. POOLED FACILITIES

A first priority objective within ACTINET is to pool selected parts of the major facilities of some large European institutes (CEA, ITU, INE, SCK-CEN, FZR, PSI), and to operate this pool as a multi-site user facility, in order to make it accessible to all members through a competitive selection of joint research projects.

The pooled facilities are laboratories that allow handling radioactive material at various levels of activity (from dilute solutions to high concentrations of actinides and spent nuclear fuel) and under specific conditions (inert gas boxes), with access to analytical techniques and specific characterization methods (elementary and isotopic analysis, laser spectroscopy, synchrotron radiation etc.).

The main ACTINET pooled facilities are listed below and more details can be found in the website of the network at http://www.actinet-network.org.

The CEA provides the LN1 Laboratory in Marcoule, the LECA laboratory in Cadarache, and the DPC analytical platform in Saclay. The LN1 is a part of the ATALANTE facility. It has been commissioned in April 2005, and it is dedicated to molecular chemistry of all actinides in solution, solid state and at interfaces. It brings together selected techniques to obtain structural information, speciation and thermodynamic properties. The LECA has a set of shielded analytical equipment able to characterize highly irradiated fuels and materials, including electron probe micro-analysis, scanning electron microscope, and secondary ion mass spectroscopy. Finally the Analytical Platform of the Department of Physics and Chemistry provides a large set of analytical tools, and the instruments for characterisation of the chemical retention of inactive tracers or radionuclides on natural and industrial solid phases.

The ITU provide instruments for the study of solid-state properties of actinides compounds with particular emphasis on metals and alloys, instruments for the study of the thermodynamics, the thermophysics and radiation damage with particular emphasis on oxides, and instruments for solid-liquid interface chemistry.

The FZK-INE provides an analytical platform with radio-analytical methods, trace and isotope analysis, surface and solid-state analysis, and a wide spectrum of speciation methods. INE also provides an access to the FZK synchrotron radiation source ANKA dedicated for the study of actinides.

The SCK-CEN provides access to the LHMA hot cell facility (shielded cells for the post irradiation examination of fuel rods and core components), solid state research tools for nuclear samples, chemical and radiochemical analysis tools.

FZR provides access to the Rossendorf beam-line, at the European Synchrotron Research Facility in Grenoble (France), and to a pool of laser spectroscopic tools at the Rossendorf Laser Laboratory.

Finally PSI will provide the microXAS beam-line at the Swiss Light Source (SLS), which will be operational in 2006.

A first step has been to exchange and disseminate within the network, and within the European community of actinide sciences at large, detailed information on the capabilities and instruments available at each of the pooled facilities: presentations at conferences, web page, brochures… This has been done in particular by a specific Task Group on pooled facilities involving researchers from each facility

But an optimal use of the pooled facilities furthermore requires exchanging expertise to improve the experimental set-ups to meet common ACTINET user requirements, and improving compatibility and convergence of reference databases, software tools, and data processing methods, to be jointly used to allow a better comparison and interpretation of experimental results within the network. An example of project supported by the network in this direction is the joint ACTINET project called “ACTINET Sorption Board - Managing experiments, models and data ”, undertaken by FZR, CNRS, FZK, CHALMERS, and CEA, briefly described below (see section E).

A number of other issues have to be dealt with in order to reach operation as a multi-site user facility:

- implementing improved regulations and procedures to allow or ease access to and use of some facilities, including mutual acceptance of safety certificates already obtained by researchers at their home institutions or at other ACTINET institutions;
- preserving compatibility between users, in particular between academic ACTINET users and industrial users, including potential issues as confidentiality and planning,
- implementing or adapting the necessary trainings for ACTINET researchers, and last but not least.

First steps have been undertaken in this direction, by sharing information on the access procedures to each of the facilities in the pool, and the associated delays (security clearances, radiation protection measures, compulsory training courses); this will allow a better organisation of collaborative projects by the establishment of realistic schedules. This also showed, if necessary, that research projects in the field of actinide sciences often need to be prepared long in advance. A unified training concept for access to ACTINET pooled facilities is also under elaboration.

D. THEORETICAL USER LAB

In the same spirit as the pooling of experimental facilities, an objective is to bring together in a long lasting structure (the Theoretical User Laboratory) the tools and expertise available in Europe on actinide modelling and simulation, and to make these available to the whole European community of actinide scientists, in order to create an environment that will enable each research worker to come to grips with the problems of modelling systems of interest. The needed resources include both tools (access to local and national computing equipments and software) and human expertise. The concentration or networking of these resources should enable interested workers to make rapid progress in their research, thus contributing to spread expertise within the Network, increase the attractiveness of the field for students and young researchers.

As an example of a first effort undertaken in this direction, a school is organised in May 2006 in Lille (France) for both experimentalists and theoreticians interested in tools to treat actinide compounds. The objective is to show to both categories of scientists what they can actually bring to each other, what is reachable or not by measurement and calculation, in order to promote the interaction between theory and experiment.

Another example of action of the Theoretical User Lab is the definition of common needs for commercial software, the support to the development of specific modules in codes of general interest for the ACTINET community, and obtaining improved conditions of purchase for ACTINET member organisations.

E. JOINT RESEARCH

ACTINET supports joint research projects proposed by teams from the member organisations. These research projects potentially address all the major fields of basic actinide sciences, keeping in mind the potential applications for the production of nuclear fission energy:

The safety assessment of waste management strategies is a major issue, including geological disposal of radioactive wastes, and partitioning and transmutation of long-lived radionuclides on an industrial scale, which has to be established through demonstrations on weighable quantities of radionuclides. This requires an adequate understanding of the behaviour of materials containing actinides (fuels, waste matrices, transmutation targets), and of the chemistry of actinides in geochemical environments and in partitioning processes.

Furthermore, in-depth technical assessments are and will remain required to support operation of existing nuclear plants and improve their performance in terms of safety, economy and flexibility. This covers issues such as increased fuel burn-up, longer fuel cycles, extension of plant life, power up-rating, and therefore requires a better understanding of the fuel behaviour under reactor conditions and after irradiation.

Finally, the potential of innovative concepts for better use of fissile resources must be investigated and evaluated in terms of safety, economy, reliability, environmental impact, resistance against proliferation, and diversity of application. The assessment of these new concepts also requires considerable amount of experimental and modelling work on systems involving actinides.

Four calls for collaborative research projects have already been published within the network. A total of eighty proposals have been received and reviewed by the Scientific Advisory Committee. Among these proposals, forty-six research projects have been selected by the Executive Committee, ranging from instrumentation to quantum chemistry, from solution chemistry to the physics of irradiated actinide materials. For these projects, access is given to the requested pooled facilities, and support is given for mobility, accommodation, sample transports.

These projects have been undertaken by the end of 2004 or in 2005 and are now in progress, while the fifth call has its deadline in May 2006. For the sake of management, they are organised into three scientific scopes:

- Scope 1: actinides in solution and solid phases, including separation chemistry of actinides;
- Scope 2: actinides in the geological environment;
- Scope 3: actinide materials after or under irradiation.

A list of the joint research projects is given in a table at the end of this paper. We consider here in more detail three specific examples of ongoing projects.

One of the projects from scope 1 is entitled “Understanding the electronic structure of actinyl complexes” [1]. It is undertaken by the University of Manchester, CEA and FZR, with collaboration with the Department of Chemistry of the University College of London. The scientific objective is to probe actinyl bonding through the coordination of additional donor ligands, along the series of actinides.

This project starts by studies on uranium and neptunium undertaken at the Centre for Radiochemistry Research in Manchester and at the Rossendorf Beam Line in Grenoble.

In parallel, developments are undertaken at CEA Atalante in Marcoule to enable to continue the project forward to plutonium (this implies synthesis, structural and spectroscopic characterisation of novel plutonium complexes in an inert atmosphere environment).

The next stage of the project will then be the study of the plutonyl system in depth at both the CEA and ROBL facilities. A post doctoral student is exchanged between Manchester in Marcoule, thus allowing the strong coupling necessary for such collaboration.

All along the various phases of the project, a theoretical approach complements the experimental programme.

Beyond its specific scientific interest, such a project shows how several research organisations can combine their expertise and facilities to implement a very complete and structured approach that would hardly have been possible for one single organisation.

One of the projects from scope 2 is entitled "ACTINET Sorption Board - Managing Experiments, Models and Data" [2]. It is undertaken by FZR, the CNRS (Ecole des Mines de Paris in Fontainebleau, France), FZK (INE in Karlsruhe), the CHALMERS University of Technology (Sweden), and CEA (Department of Physics and Chemistry in Saclay, France).

Sorption processes are of general importance for the nuclear cycle (restoration of uranium mining and milling sites, decommissioning of nuclear installations, performance and safety assessment of waste disposals), but also for remediation measures of sites contaminated through accidents and military actions. These processes govern to a large extend the reactive transport of contaminants in the geosphere.

In order to develop and promote the wide application of modern sorption concepts, the objective of the "Sorption Board" project is to define recognized quality criteria for sorption data, including experimental procedures, modelling and interpretation, taking into account results from spectroscopy and quantum chemistry.

This project also supports the development of databases by integrating current activities on a European level (like for example RES^{3}T in Germany and CTDP in France), in coordination with international ongoing projects (Phase II of the NEA Sorption project); this means, e.g., provide mutual access to data compilations, write tools to transfer information between the databases, merge data structures, tables and nomenclatures, unify user interface elements, offer links to geochemical speciation and reactive transport codes.

This will be accompanied by the definition and organization of blind prediction exercises for sorption case studies.

This project aims to the creation of a long lasting ACTINET Sorption Board, to strengthen a community for sorption modeling and pave the way for internationally agreed upon sorption data sets to be used in performance assessments and related fields, thereby increasing the confidence in their model predictions and the decisions based on them.

Another project has a similar objective within scope 3; it is entitled "Development of a thermodynamic database for advanced fuels" [3] by CEA (France), ITU (European Commission), KTH (Sweden), and CNRS with the University of Rennes (France), and aims to bring together competences in nuclear materials and in thermodynamic modelling to built a common predictive tool allowing the assessment of both thermodynamic properties and phase diagrams of advanced fuels (thermodynamic databases developed for oxide fuels cannot be extended to advanced fuels for future systems). This work is based on a careful critical analysis of experimental data of the literature and a complete modelling of solid and liquid solutions, on the assessment of the available thermodynamic data, on thermodynamic modelling of the binary systems and of selected ternary systems, and it will include compilation of a database, storage and dissemination of data.

However we will consider as a last example one of the projects from scope 3 entitled "A separate effects study of the behaviour of helium in uranium dioxide" [4], undertaken by CEA (Department of fuel studies in Cadarache, France), ITU (European Commission in Karlsruhe),

SCK-CEN (Belgium) and CNRS (CERI in Caen, CSNSM in Orsay and the Laboratoire Pierre Sue in Saclay, France).

There is today a lack of basic data and knowledge pertaining to the behaviour of helium in UO_2 and it is the aim of this project to fill the gap. Because of the complexity and variety of the phenomena involved, a range of experiments and model developments is required that will both be used to validate models and generate basic data which the models can use. Each contributor to the project excels in a given field, be it theoretical or experimental, but therefore only holds a limited number of scientific answers. This project therefore aims to aggregate tools, knowledge and skills around this shared scientific goal. This is being done firstly by defining a common sample preparation protocol. Samples will then be characterised using the different tools available through the network and will therefore circulate amongst the different members. Results from characterisation and modelling programmes performed in the different institutions will then be made accessible for discussion and analysis to all the members of the group. Application of the scientific results generated through the network will ultimately be integrated to long-term disposal or in-reactor applications.

F. EDUCATION AND TRAINING

Today some European academic centres still have a teaching activity and research programs in actinide sciences, although they usually lack support for renewing equipment, for increasing their staff and sometimes for keeping courses in nuclear sciences. In addition some scientific events, such as summer schools, workshops and symposia on actinides are regularly organised or have been proposed for the near future, and ACTINET members are organisers or actors in these meetings (e.g. ACTINIDES'05 organised in July 2005, the "Journées des Actinides" and the "Very Heavy Metal" conference in March 2006).

Some of these education and training activities and resources are put in common within the network. In particular, a stronger participation of the ACTINET core members in training at the universities is planned, as well as a stronger use of the pooled facilities.

Calls for education and training projects are published jointly with calls for joint research, twice a year. Ten schools or workshops have been selected up to now out of eighteen proposals, and have been or are being organised with the support of the network; a list of these events can be found on the network website at http://www.actinet-network.org. They are also listed with the joint research projects at the end of this paper.

Furthermore, a yearly ACTINET Summer School has been established, and is organised alternately by ITU and CEA. The ACTINET Summer School consists in lectures, visits of laboratories, and laboratory demonstrations during which the participants can learn and experience the challenges of working with actinides.

The ITU ACTINET Summer Schools cover basic actinide chemistry, physics and material science, while the CEA ACTINET Summer Schools focus each time on a different field of actinide sciences: the first school was organised in June 2004 in Avignon (France), and dealt with "Thermodynamics and Kinetics of Liquid-Liquid Extraction", the third school will take place in Saclay (France) between the 3 and 7 July 2006 and will deal with "Geochemistry and Migration of Actinides".

G. TABLE OF JOINT PROJECTS

The table below provides the list of the joint projects approved at the four first calls of the network.

Title of the project	scope	contact
First Call (projects approved in September 2004)		
Actinide Interaction with colloids	2	Th Schäfer (FZK)
Development of components for spatially resolved speciation studies at the INE-Beamline	2	M Denecke (FZK)
Reaction of Np(V) with mineral surfaces- characterisation of reaction products by atomic force microscopy and X-ray photoelectron spectroscopy	2	F Livens (Manchester)
Investigation of the electronic behavior of the AnT(Ga1-xInx) systems (An=U, Transuranium and T a d transition metal)	1	R Troc (ILTSR)
Quantum chemical studies of actinides in solution	1	U Wahlgren (Stockholm)
Structural defects in binary and ternary actinide oxides	3	M Freyss (CEA) M Verwerft (SCK-CEN)
Investigation of U(VI)/U(V) carbonato complexes in aqueous solution by spectro-electrochemical and quantum chemical methods	1	Ch Hennig (FZR)
Development of chemical, electrochemical, spectroscopic and mass spectrometric methods for speciation of plutonium ions	2	JI Yun (FZK)
Aquatic chemistry and thermodynamics of actinides: Solubility, hydrolysis and complexation of tetravalent actinides	2	V Neck (FZK)
A separate effects study of the behaviour of helium in uranium dioxide	3	G Blondiaux (CNRS) Ph Garcia (CEA)
Second Call (projects approved in January 2005)		
Understanding the electronic structure of actinyl complexes	1	I May (Manchester)
Photodynamic Processes of An(III) and Ln(III) Organic Complexes	2	G Buckau (FZK)
Characterization of Solid-Water Interface Reactions of Metals and Actinides on Clays and Clay Minerals	E&T	A Bauer (FZK)
Interaction of actinide cations with metalloproteins	1	Ch Den Auwer (CEA)
Nuclear magnetic resonance studies on actinide ions: relaxivity and spectroscopy.	1	JF Desreux (Liège)

Synthesis of actinide endmember solids and solid solutions of relevance for geologic storage	2	M Amme (ITU)
Molecular and structural studies of radiolysis-induced actinide oxides dissolution in medium and high pH environments systems.	2	M Amme (ITU)
“UO2 thin films as model fuel systems: preparation, characterisation and investigation of surface reactivity	1	Th Gouder (ITU)
Actinides and lanthanides solution chemistry in water stable Room Temperature Ionic Liquids	1	I Billard (CNRS)
Interaction of Eu(III)/Cm(III) with Polyacrylic Acid: Investigation of properties and comparison with actinide humic susbtances interaction.	2	G Montavon (CNRS)
Neptunium interaction with green rust (Fe(II),Fe(III)-sulfate,hydroxide)	2	S Stipp (Copenhagen)
Short course with tutorial on aqueous – solid solution systems involving actinides (thermodynamic and experimental aspects)	E&T	D Kulik (PSI)
Spectroscopic approach of aqueous chemistry of Protactinium(V)	1	C Le Naour (CNRS)
Workshop for Young Researchers in Actinide Science	E&T	F Livens (Manchester)
ACTINET Sorption Board – Knowledge Infrastructure and Education	E&T	V Brendler (FZR)
ACTINET Sorption Board - Managing Experiments, Models and Data	2	V Brendler (FZR)
Coprecipitation of radionuclides with UO2 under anoxic and/or reducing conditions	2	B Grambow (CNRS)
Spectroscopy and Quantum Chemistry applied to Surface Reactions of Actinides on Aluminum Oxy-Hydroxides	2	T Rabung (FZK)
Development of a thermodynamic database for advanced nuclear fuels	3	Ch Guéneau (CEA)
Synthesis and characterization of phosphate ceramics doped with actinides	1	N Dacheux (CNRS)
Conference: Solid-state NMR of nuclear related materials: towards radioactive MASNMR	1	I Farnan (Cambridge)
Impact of radiogenic helium production on the behaviour of containment matrices	3	D Roudil (CEA)
Third Call (projects approved in June 2005)		
Workshop on Actinide Speciation using XAFS	E&T	M Denecke (FZK)
Hydrothermal stability of 238Pu and 239Pu-doped phosphate and titanate ceramics	3	Th Geisler-Wierwille (Münster)
JdA School	E&T	I May Manchester)

Thermo-chemical modelling of targets for minor actinide transmutation.	3	J Wallenuis (KTH)
Development of advanced EXAFS analysis methods for speciation of radionuclides in natural systems	2	A Rossberg (FZR)
Development of new experimental method using SIMS for the characterisation of actinide based materials	3	L Desgranges (CEA)
Performance and coordination structure of N-donor extracting agents for partitioning of trivalent actinides from lanthanides	1	M Mazzanti (CEA)
Fourth Call (projects approved in January 2006)		
Coupling variable energy X-ray Absorption Spectroscopy and quantum chemistry : a new tool to investigate actinide molecules	1	Ch Den Auwer (CEA)
Optimization of quantitative analysis for advanced nuclear fuels by electron probe micro analyse (EPMA)	3	O Dugne (CEA)
International Information Exchange Meeting on Thermodynamics of Nuclear Fuels	E&T	Ch Guéneau (CEA)
4th Workshop on Speciation, Techniques, and Facilities for Radioactive Materials at Synchrotron Light Sources, Actinide-XAS-2006	E&T	M Denecke (FZK)
Speciation of Np(V) on the calcite surface	2	F Livens (Manchester)
Studies of the Chemical Forms of Actinides and Fission Products Adsorbed on Nanocrystalline Magnetite	1	S Nikitenko (CNRS)
Microfocusing capability at the INE beamline	1	M Denecke (FZK)
MIGRATION 2005	E&T	H Geckeis (FZK)
Magnetism, crystallography and electronic structure of UM2-xM'xT2-xT'x compounds (M=Ni, M'=Cu, T=Si, T'=Ge)	1	S Van den Berghe (SCK-CEN)
Very Heavy Metals 2006 Conference	E&T	JP Daudey (CNRS)
Sorption of An(III) on mineral-oxide surfaces. A quantum chemical study	1	B Schimmelpfennig (FZK)
Properties of nuclear fuel/water interfaces under ion and electron beam irradiation relevant to the radiolysis effects on long term spent nuclear fuel storage	2	C Corbel (CEA)

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