OVERVIEW OF EU RESEARCH ACTIVITIES IN PARTITIONING AND TRANSMUTATION AND GEN IV REACTOR SYSTEMS IN THE EURATOM SIXTH AND SEVENTH FRAMEWORK PROGRAMS

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European Union (EU) (currently 27 Member States) shared-cost research has been organised in Framework Programs (FP) of durations of 4-5 years since 1984. The Euratom FP6 (2002-06) and the current FP7 (2007-11) have been assigned fission research budget respectively of 209 and 287 Million Euro executed by the European Commission (EC). In FP6, there are 11 projects (total budget 81 M€, EC contribution 43.5 M€) in all aspects of partitioning and transmutation ranging from road-mapping exercise to accelerator driven systems (ADS), lead-cooled Fast critical systems for waste transmutation, technology, fuel, nuclear data etc. In Gen IV Innovative reactor concepts, there are 10 projects (total budget 32 M€, EC contribution 16.5 M€) including High Temperature Reactors, Gas-cooled Fast reactors, Super-critical Water Reactors etc. The main nuclear research and training components in FP7 are: management of radioactive waste, reactor systems, radiation protection, infrastructures, human resources, mobility and training. International collaboration is an important element of the EU research policy. This paper presents an overview of the strategy of Euratom research and training in waste management including transmutation by ADS and Gen IV reactor concepts that are being pursued through Euratom Programs. The paper also presents highlights of the research underway in the projects funded by EC.

I. INTRODUCTION

Promotion of collaborative research and training in nuclear energy in Member States of the European Union has been at the heart of the Euratom Treaty since its establishment in 1957. The research work carried out within the provisions of this treaty has acted as a driving force for the development of nuclear power in the EU. However, the future of nuclear energy has been uncertain in Europe since 1986. The opinion of 'end users' across the "EU-27" has a very wide spectrum. There are those who pursue the policy of maintaining a high-density energy source such as nuclear to meet the base-load electricity requirements and there are those who oppose nuclear totally in a cultic fashion. However, more recently, the buzz of renaissance of nuclear power is increasingly in the air of Europe. This renewed interest is a manifestation of growing disquiet about carbon pollution, mounting demands for cleaner air, security, sustainability and diversification of energy supply. The objective of the EU energy policy (Ref. 1) is to transform the current fossil-fuel based energy system into a more sustainable one. The EU energy strategy is based on a diverse portfolio of energy sources and carriers combined with enhanced energy efficiency. It also addresses the pressing challenges of security of supply and climate change, whilst increasing the competitiveness of Europe's energy industry.

European Community research has been organised in Framework Programmes (FP) of durations of 4-5 years since 1984. The current Framework Program is FP7 (2007-2011). The priorities for the European Union's research and development activities for the period 2007-2011 are set out in the Seventh Euratom Framework Programme (FP7) (Ref. 1). The FP7 focuses on research areas such as nuclear waste management, safety of existing reactor systems and Advanced Gen IV reactor concepts, radiation protection, support for research infrastructures and retaining competences and know-how in all areas of nuclear science. The FP6 (Ref. 2) focused on a limited number of research areas combining technological, industrial, economic and social aspects. FP5 and its predecessors did contribute effectively to the policy of supporting science and technology by encouraging co-operation between research players of the Member States. Despite this achievement, no specific European research policy had earlier been seen to emerge. National research programmes were undertaken to a large extent independently of one another.

One of the objectives of EU is to achieve greater co-operation between Member States' research strategies and a mutual opening up of programmes. With the challenges and prospects opened up by the technologies of the future, there is a need that European research efforts and capacities should be more thoroughly integrated. With this view in mind, the European Commission launched the so-called 'European Research Area' (ERA) initiative in

January 2000 (Ref. 3). The Sixth Framework Programme (FP6) encompassing the period 2002-2006 was geared to make ERA a reality (Ref. 4) and FP7 is building up on this aspect and completing certain European Research Areas such as on partitioning and transmutation (P&T) research which is now fairly well integrated across EU.

II. THE EUARATOM SEVENTH FRAMEWORK PROGRAMME (FP7) (2007-2011)

The objective of the Seventh Euratom Framework Program in the area of nuclear fission and radiation protection is to establish a sound scientific and technical basis in order to accelerate practical developments for the safer management of long-lived radioactive waste, enhancing in particular the safety performance, resource efficiency and cost-effectiveness of nuclear energy and ensuring a robust and socially acceptable system of protection of man and the environment against the effects of ionising radiation. Efforts are still required to ensure a continuation of the European Community's outstanding safety record and the improvement of radiation protection continues to be a priority area. The key issues are operational reactor safety and management of long-lived waste. In all uses of radiation, throughout industry and medicine alike, the overriding principle is the protection of man and the environment. In addition, the individual technical areas are linked by key cross-cutting topics such as the nuclear fuel cycle, actinide chemistry, risk analysis and safety assessment and even societal and governance issues. Research will also be needed to explore new scientific and technological opportunities and to respond in a flexible way to new policy needs that arise during the course of the Seventh Framework Programme. The following activities are to be pursued. (a) Management of radioactive waste: Implementation-oriented research and development activities on all remaining key aspects of deep geological disposal of spent fuel and long-lived radioactive waste and, as appropriate, demonstration of the technologies and safety, and to underpin the development of a common European view on the main issues related to the management and disposal of waste. Research on partitioning and transmutation and/or other concepts aimed at reducing the amount and/or hazard of the waste for disposal. (b) Reactor systems: Research to underpin the continued safe operation of all relevant types of existing reactor systems (including fuel cycle facilities), taking into account new challenges such as life-time extension and development of new advanced safety assessment methodologies (both the technical and human element) including as regards severe accidents, and to assess the potential, the safety and waste-management aspects of future reactor systems, in the short and medium term, thereby maintaining the high safety standards already achieved within the EU and considerably improving the long-term management of radioactive waste. (c) Radiation protection: Research, in particular on the risks from low doses, on medical uses and on the management of accidents, to provide a scientific basis for a robust, equitable and socially acceptable system of protection that will not unduly limit the beneficial and widespread uses of radiation in medicine and industry. Research should also be carried out to minimise the impact of nuclear and radiological terrorism and diversion of nuclear material. (d) Infrastructures: Support should be given to the availability of, and cooperation between, research infrastructures such as material test facilities, underground research laboratories, radiobiology facilities and tissue banks, necessary to maintain high standards of technical achievement, innovation and safety in the European nuclear sector. (e) Human resources, mobility and training: Support should be provided for the retention and further development of scientific competence and human capacity (for instance through joint training activities) in order to guarantee the availability of suitably qualified researchers, engineers and employees in the nuclear sector over the longer term.

II.A Planned Research Activities on P&T and Gen IV Reactors in the Euratom FP7

Based on the above Framework Program, a detailed work programme of Euratom FP7 (version 2007) was adopted by the EC in December 2006 which is planned to be updated regularly and call for proposals are planned to be launched yearly. On the bases of this work programme, a call for proposals (FP7-Fission-2007) was launched on 22 December 2006 having a deadline of 2 May 2007 with an indicative budget of 49 M Euro (Ref. 5). In this call, proposals were requested on 22 topics related to radioactive waste management, reactor systems, radiation protection, infrastructures and certain cross-cutting subjects. The Call produced 54 eligible proposals out of which 39 Collaborative Projects, 4 Coordination Actions and 11 Support Actions. The total requested EC funding was around 4 times the indicative budget. Several proposals in P&T, Gen IV reactor systems and Cross-cutting activities were received on topics such as (i) Partitioning processes for viable recycling strategies, (ii) Innovative fuels and claddings for Generation IV systems, (iii) Materials for transmutation technologies and Gen IV reactors etc. Evaluation of these proposals was carried out by international independent experts in June 2007 and the process of selection and grant agreement for certain highly ranked proposals within the constraints of the available budget are now underway. The total EC budget for shared cost projects in Nuclear Fission and Radiation Protection including P&T and Gen IV Reactor Systems is 287 M€ for FP7 (2007-2011).

III. THE EURATOM SIXTH FRAMEWORK PROGRAMME (FP6) (2002-2006)

The scientific and technical goal of the Euratom FP6 Specific Program "Research and Training Program on Nuclear Energy" has been to help exploit the full potential of nuclear energy, both in the long and short term. Its development and exploitation is to be done in a sustainable manner while combating the climate change and reducing the energy dependency of the EU. Nuclear fission research and development activities in this programme have been subdivided into (a) Management of radioactive waste, (b) Radiation protection and (c) Other activities in the field of nuclear technologies and safety.

In the area (a), the priority has been to find a permanent and safe solution for the management of long-lived, high-level waste that is acceptable to society. This includes establishing a sound technical basis for the demonstration of long lived high level waste disposal in geological formations. This is to be supported by studies on P&T and further supplemented by exploring the potential of system concepts that would by themselves produce less waste in nuclear energy generation. Combating the decline in both student numbers and teaching establishments by a better integration of European education and training in nuclear safety and radiation protection is another important aim. Description of area (b) is out of scope of this paper.

In the area (c), the activities are intended to respond to the scientific and technical needs of the policies of the European Community in the fields of health, energy and the environment. The aim is to ensure that the European capability is maintained at a high level in relevant fields not covered by the areas (a) and to contribute towards the creation of the European Research Area. These activities are carried out mainly in the following areas: (i) innovative concepts: evaluation of the potential of innovative concepts that offer advantages in terms of safety, environmental impact, resource utilisation, proliferation resistance, development of improved and safer processes in the field of nuclear energy, (ii) education and training concerning nuclear safety and radiation protection aimed at integration and consolidation of national efforts to achieve economy of scale, and covering in addition such areas as mobility and human resources, trans-national access to infrastructure, and coordination activities, and (iii) measures for the safety of existing nuclear installations.

In FP6, research in P&T includes areas such as fundamental assessment of the system and safety aspects of the overall concept of P&T and, in particular, of its impact on waste management and geological disposal. In the area of partitioning, continued R&D of hydrometallurgical and pyro-chemical processes has been carried out with a view to a demonstration of the most promising techniques. In the area of transmutation, the development of basic knowledge and technologies for transmutation and evaluation of their industrial practicability, in particular, of transmutation devices such as accelerator driven sub-critical systems (ADS) is proposed (Ref. 6).

Three Calls for proposals including topics in P&T have been made in December 2002 and November 2003 and June 2005. In the first two calls, the so-called new instruments (such as Integrated Projects) were used as a priority. The Integrated Projects (IPs) are designed to give increased impetus to the European Community's competitiveness and/or to address major societal needs by mobilising a critical mass of research and technological development resources and competencies. In the third call, in addition, the Integrated Infrastructure Initiatives (III) instrument was also used to establish a durable networking of research infrastructures across EU such as Heavy Liquid Metal (Lead and Lead-Bismuth) loops or accelerators for nuclear data applications. Specific Targeted Research Projects (STREP) are sharply focused on research and technological development designed to gain new knowledge either to improve or develop new products, processes or services or to meet other needs of society and Community policies. Coordination Actions (CA) are used for coordination or networking activities of consortia across EU without carrying out new research and development. Avoiding the micro management, increased autonomy has been given to consortia in the management (both scientific and financial) of projects that are judged on the global end-results.

Euratom budget for funding research and training projects in the area of partitioning and transmutation for a number of Framework Programs (FP3 to FP6) has been increasing from 4.8 M€ in FP3 to 43.5 M€ in FP6. Clearly the importance of P&T has been recognised over the years. Funding for Gen IV reactors started in FP5 where the EC budget was 12 M€. However in FP6, it rose to 16.5 M€. The total EC budget for shared cost actions in Nuclear Fission and Radiation Protection Program for FP6 including P&T and Advance Reactor Systems is 209 M€.

IV. RESEARCH ACTIVITIES ON P&T AND GEN IV REACTORS IN THE EURATOM FP6

In response to the three calls made in FP6 (2002-2006), the process of selection of projects has been duly completed. The selected projects have started and in fact those started after the first Call have already finished their work. Other projects of second and third calls are continuing and are allowed to go beyond the official period of the framework program.

IV.A. Partitioning and Transmutation

The following is a brief outline of the projects in the area of P&T that have been selected for funding in Euratom FP6:

(i) PATEROS project: The implementation of partitioning and transmutation of a large part of the high-level nuclear waste in Europe needs the demonstration and feasibility of several installations at an "engineering" level to achieve the required objective of P&T. The goal of this 2-year Coordination Action (see Table 1) is to establish a global P&T roadmap leading up to the industrial scale deployment of necessary facilities. It will also establish critical milestones, preferred options and back ups, according to timescales and shared objectives at the European level.

(ii) RED-IMPACT project: Partitioning, transmutation and conditioning (P&T/C) and waste reduction technologies are expected to reduce the burden associated with radioactive waste management and disposal. P&T is likely to ease the final repository requirements and it will also contribute to the sustainability of nuclear energy in those countries that pursue this source of energy. The objectives of the RED-IMPACT project (see Table 1) are: (i) Assess the impact of P&T on geological disposal and waste management, (ii) Assess economic, environmental and societal costs/benefits of P&T (iii) Disseminate results of the study to stakeholders (scientific, general public and decision makers) and get feedback during the course of the study and (iv) Iterate and refine the work based on stake-holders' feedback to achieve full impact of this study on the implementation of the waste management policy of the European Community.

(iii) EUROPART project: The main objectives of Europart (see Table 1) are (i) the development of methods for the separation of individual minor actinides that are contained in aqueous nuclear wastes issuing from the reprocessing of uranium oxide (UOX) or mixed oxide (MOX) nuclear spent fuel and (ii) separation of grouped actinides (An) for recycling e.g. in an Accelerator Driven System following double-strata advanced fuel cycle concept. Partitioning techniques used are: (i) hydrometallurgy and (ii) pyrometallurgy. In hydrometallurgy, the partitioning methods are mainly based on the use of solvent extraction methods or extraction by chromatographic methods which will be applied for (a) individual separation of the trivalent Am/Cm/Bk/Cf ions (b) grouped partitioning of An and (c) reprocessing of innovative nuclear spent fuels. In pyrometallurgy, the nuclear wastes issuing from the reprocessing of present or future nuclear spent fuels can be dissolved into molten halide salts at temperatures of several hundreds of degrees followed by the separation of individual MAs (from U to Cf) or all actinides.

(iv) EUROTRANS project: The objective of EUROTRANS Integrated Project (see Table 1) is to carry out a preliminary detailed design of a ≈100 MW experimental facility (realisation in a short-term) demonstrating the technical feasibility of transmutation in an accelerator driven System (XT-ADS) as well as to accomplish a reference conceptual design (several 100 MW) of a modular generic European Transmutation Demonstrator (ETD) in the long-term. A lead fast critical facility connected to a continuous beam accelerator is being envisaged. As a first step, it is planned to use a modified VENUS critical facility located at SCK/CEN, Mol (BE) and couple it to a modified GENEPI D-T neutron generator in continuous mode. This sub-project is termed as GUINEVERE-project. U-free oxide fuels such as (Pu, MA, Zr)O2 or CERCER (Pu, MA)O2+MgO or CERMET (Pu, MA)O2 + Mo will be developed with a view to their use both in XT-ADS and ETD and are being qualified in HFR and Phénix reactors. A further assessment of structural materials and heavy-liquid metal (HLM) (Pb-Bi) technologies for transmutation systems both as a spallation target material and coolant will be made. Further development of nuclear data evaluated files and models involving sensitivity analysis and validation of simulation tools will be made. The outcome of this project is expected to provide a fairly reliable basis for an assessment of the technical feasibility of transmutation by ADS and a first estimate of the cost of an ADS based transmutation system.

(v) ELSY project: European Lead Cooled System, the ELSY project (see Table 1), aims to demonstrate that it is possible to design a competitive and safe lead-cooled fast critical reactor using simple engineered technical features. Safe burning of recycled minor actinides in the ELSY core will also be studied which is in line with the Gen IV objectives. Lead is chemically inert and has good neutronic characteristics that are unique among the coolants for a fast reactor. The use of compact in-vessel steam generators and of a simple primary circuit with possibly all 'internals' being removable are among the reactor features for competitive electrical energy generation and long-term investment protection. The project intends to address in detail the sustainability, economics, safety and reliability, proliferation resistance and physical protection aspects of the ELSY critical system.

(vi) PUMA project: Important issues concerning the use of Pu and MA in gas-cooled reactors are treated in ongoing projects. Nevertheless, the objective of the Plutonium and Minor Actinide Management, the **PUMA** project (see Table 1), is to provide additional key elements for the utilisation and transmutation of Pu and MA in

current and future (high temperature) gas-cooled reactor designs. The core physics of Pu/MA fuel cycles for HTRs will be investigated to optimise the CP fuel and reactor characteristics and to assure nuclear stability of a Pu/MA HTR core. It is also envisaged to optimise the present Pu CP design and to explore feasibility for MA fuel. PUMA also aims to contribute to the technological goals of the Generation IV International Forum. See also RAPHAEL (HTR) project below.

(vii) VELLA project: The Integrated Infrastructure Initiative project **VELLA** (see Table 1) aims to create a virtual European laboratory for 'Lead Technologies'. Its final goal is the creation of a network of the EU laboratories that operate devices using heavy liquid metals technologies, especially lead alloys. The initiative is required to achieve researcher's networking and integration rationalizing the exploitation of existing facilities across EU, trans-national mobility of researchers and carrying out of joint research activities with strong technological bias. It is expected that the "outcome" of the VELLA project in integrating facilities and research groups, will go well beyond the scheduled duration of the Initiative.

(viii) LWR-Deputy project: LWR-DEPUTY (see Table 1) will investigate novel fuels for deep burning of plutonium in existing nuclear power plants (NPPs) and to what extent the existing NPPs in Europe can create markedly less nuclear waste by moving to inert matrix fuels. The project will address (i) 'screening' (or test) irradiation of four CERMET fuel pins in a Materials Test Reactor (ii) in-depth post- irradiation examination of the thorium based fuels including code benchmarking, performance and safety assessment and (iii) an assessment of the efforts needed to introduce novel fuel concepts in existing NPPs.

(ix) EFNUDAT project: The Integrated Infrastructure Initiative project **EFNUDAT** (see Table 1) aims at networking experimental facilities in the EU for nuclear data measurements providing a platform for better co-operation and to integrate all scientific efforts needed for high-quality nuclear data measurements in support of (i) waste transmutation studies and (ii) design studies for Gen-IV systems producing less waste. The objective is also to provide adequate trans-national access to the available EU infrastructures and to co-ordinate joint research activities in support of other projects in the area of P&T. The EFNUDAT plans (i) Three Networking Activities to optimise the use of the facilities for nuclear data measurements and the analysis and dissemination of results, (ii) Nine different Trans-national Access Activities procuring approximately 4000 additional beam hours for external users that will carry out nuclear data measurements, and (iii) Three Joint Research Activities to raise the performance of the facilities and the efficiency of their use.

(x) CANDIDE project: The project is focussed on nuclear data issues that are critical to the assessment of the safety and effectiveness of the various proposed waste management strategies, by considering primarily the fuels and structural parts of the core. The project aims to establish links of the data producing community to the existing structure of coordinated nuclear data activities including evaluation and validation and finally provide links to industry. The purpose of CANDIDE is not to produce new experimental data or evaluations, but to review the current modes of nuclear data production, assess the present status of our knowledge, estimate what accuracy can be reached with state-of-the-art numerical simulation techniques, identify the needs for improved nuclear data, and suggest appropriate actions to be taken to meet those needs.

(xi) NUDAME project: The EC Joint Research Centre (JRC) at Geel (BE) operates a 150 MeV linear electron accelerator with a white-spectrum neutron TOF facility (GELINA) and a 7 MV light-ion Van de Graaf (VdG) facility which is capable of producing highly accurate neutron data over a wide energy range from a few MeV to about 24 MeV. The goal of **NUDAME** (see Table 1) project is to promote trans-national access to these facilities and to stimulate a coherent use of the infrastructures in order to endorse the neutron data requirements.

IV.B. Gen IV Reactor Concepts

The following is a brief outline of the projects in the area of Gen IV reactors that have been selected for funding in FP6:

(i) RAPHAEL project: The Project addresses the viability & performance of the Very High Temperature Reactor (VHTR) systems (see Table 2). This innovative system is designed not only for competitive and safe power generation but also for industrial process heat supply and in particular for hydrogen production. The selection and qualification of materials for very high temperature components, graphite internals and vessel is a key area of the project. The critical components (in particular the intermediate heat exchanger) are developed. The fabrication of advanced fuel with higher performances is tested. The irradiated fuel behaviour in disposal conditions is studied. Computer tools for reactor physics, safety analysis and fuel behaviour are qualified. Moreover the modelling of the fuel irradiation behaviour is improved. Finally an evaluation of the viability & performance of the whole system will be studied. This

Table 1: Euratom FP6 projects underway in the area of P&T indicating their salient features							
SN	**Acronym**	**Title**	**Budget (M€)**		**Co-ordinator**	**No. of partners**	**Start date & duration**
			Total	**EC**			
1	PATEROS	P&T European Road-map	0.8	0.6	SCK/CEN (BE)	17	01/09/2006 24 months
2	RED-IMPACT	Impact study of P&T on Waste management	3.9	2.0	KTH (SE)	23	01/03/2004 36 months
3	EUROPART	Partitioning techniques and processes	11.2	6.0	CEA (FR)	26	01/01/2004 42 months
4	EUROTRANS	All Aspects of Transmutation by sub-critical ADS	45.0	23.0	FZK (DE)	32	01/04/2005 48 months
5	ELSY	Waste transmutation in Lead Cooled critical system	6.9	2.95	ANSALDO (IT)	20	01/09/2006 36 months
6	PUMA	Pu and MA Management by thermal Gas-cooled system	3.7	1.85	NRG (NL)	17	01/09/2006 36 months
7	VELLA	Networking of lead loop infrastructures in Europe	3.3	2.3	ENEA (IT)	12	01/10/2006 36 months
8	LWR-DEPUTY	LWR fuels for deep burning of Pu in thermal systems	2.4	1.25	SCK/CEN (BE)	10	01/08/2006 48 months
9	EFNUDAT	Networking of EU facilities for nuclear data measurements	3.0	2.4	CNRS (FR)	10	01/11/2006 48 months
10	CANDIDE	Networking of Nuc. data for EU Industrial Development	0.8	0.8	UU (SE)	15	01/01/2007 24 months
11	NUDAME	Trans-national access for nuclear data measurements	0.2	0.2	EC-JRC (IRMM)	1	01/04/2005 36 months
		Totals	**81.0**	**43.5**		**183**	

programme has been set-up to compliment and support European national VHTR programmes and to contribute to the international effort on GEN IV VHTR projects.

(ii) GCFR project: This project is directed at the long-term goals of R&D for the Generation IV Gas-cooled Fast Reactor (GFR). Studies include self-generating cores, robust refractory fuel, high operating temperature, direct conversion with a gas turbine and full actinide recycling possibly associated with integrated on-site fuel reprocessing. The project is closely linked to RAPHAEL project. The R&D includes system integration and design and safety, Fast neutron fuel, other core materials and specific fuel-cycle processes. The GCFR project (see Table 2) will contribute to Gen IV GFR programme, namely: the safety approach for GFR, the pre-selection of GFR reference design options and promising alternatives, the Preliminary Viability Report for GFR, selection of the Experimental Technology Demonstration Reactor (ETDR) design options, including safety design features, a contribution to the Safety Options Report, establishing the mission and contributing to the ETDR Mission Report.

(iii) HPLWR Phase-2 project: The project assesses the critical scientific issues and the technical feasibility of the High Performance Light Water Reactor system with a view to determining its future potential. This project deals with: (a) conceptual layout of the plant including core, reactor pressure vessel (RPV) components (b) economic assessment (c) analysis of the thermal core for neutronic, thermal-hydraulic and mechanical aspects including decision on the feasibility of the fast core option (d) concept of safety system by simulations of several accidents and transients with improved safety codes (d) selection of tested materials and data for fuel rod cladding, core and RPV materials (e) numerical heat transfer modelling and derived correlations (f) proliferation resistance. The project fits perfectly into the Generation IV roadmap, and is complementary to the international research on Supercritical Water Cooled Reactors (SCWR)

(iv) ALISIA project: This project has the objective to assess liquid salts for innovative applications. Liquid salts are efficient in heat transport and heat transfer due to their large heat capacity, high boiling point and excellent

thermal conductivity. The main objective is to strengthen the existing network of molten salt technologies and to prepare for future activities in this area. It will also contribute to the Gen IV on the MSR system.

(v) EISOFAR project: This project is designed to build a roadmap for a European Innovative Sodium-Cooled Fast Reactor system. It will address strategies and requirement on safety, safeguards for proliferation resistance and physical protection improvement and implementation, reduction of investment and operating costs. It will also study core designs with minor actinides and other design option and promising alternatives.

(vi) STUGRANTS project: is a support action for providing assistance and grants to students for attending Euorcourses organised within the framework of RAPHAEL project on HTRs.

(vii) JHR-CA project: Jules Horowitz Reactor Coordination Action aims to fill the gap of second generation of Material Testing Reactors (MTR). An initiative for a new MTR facility in Europe is launched to meet the continuous need of irradiation capabilities and to replace the present ageing facilities. This new device will be an international service-oriented user-facility to answer demands from international industry and to address issues such as safety, sustainable development etc. The JHR definition studies provide detailed design, performance versus needs, schedule and cost. The work addresses fuel & material studies, plus medical application. An International Advisory Group, is set-up within the OECD/NEA to assess the project and to promote international collaboration.

(viii) HOTLAB project: The general objective is to assess the European hot-cell laboratories capacity and its aptitude for supporting the nuclear industrial and research community both at present and in the future. The ultimate goal is to preserve appropriate nuclear research infrastructure in Europe by combining the best available competences at the highest quality. It will take stock of the present research capabilities, in the form of an internet-based highly-dynamic permanent database, including the inter-laboratory transport facilities.

(ix) SNF-TP project: The overall objective of the Sustainable Nuclear Fission Technology Platform (SNF-TP) is to develop a coherent European strategy and to provide mechanisms for consolidating and deciding future joint undertakings within the Euratom Treaty. The SNF-TP would also consolidate the European and Euratom contributions to the GIF-initiative. The Platform would provide the forum for establishing future proposed projects for the Euratom Framework Programs.

(x) ENFTP project: This Support Action aims at establishing a "Think Tank", with the mission to analyze the situation expected to exist after the FP6 European nuclear fission RTD Programs and to recommend the best instrument (within the envisaged European Research Area) and corresponding Road Map for contributing to an integrated strategy aimed at ensuring that fission nuclear energy will remain an essential component of the energy mix needed for sustainable development in Europe

Table 2: FP6 projects underway in the area of Gen IV Reactor Systems concepts indicating their salient features

SN	Acronym	Project Title	Budget (M€)		Co-ordinator	Start date End Date
			Tot	EC		
1	RAPHAEL	ReActor for Process heat, Hydrogen And Electricity generation	19.8	9.0	AREVA NP	15/04/2005 14/03/2009
2	GCFR	The Gas Cooled Fast Reactor project	3.6	2.0	NNC(UK)	01/03/2005 28/02/2009
3	HPLWR Phase 2	High Performance Light Water Reactor - Phase 2	4.6	2.5	FZK(DE)	01/09/2006 31/08/2010
4	ALISIA	Assessment of LIquid Salts for Innovative Applications	0.6	0.25	CEA (FR)	01/01/2007 31/12/2007
5	EISOFAR	Roadmap for a European Innovative SOdium cooled FAst Reactor	0.6	0.25	CEA(FR)	01/01/2007 31/12/2007
6	STUGRANTS	Students grants for RAPHAEL EUROCOURSES	0.04	0.04	USU(DE)	01/07/2006 31/06/2008

Table 2 continued: Cross-Cutting Activities

7	JHR-CA	Jules Horowitz reactor co-ordination action	1.50	1.50	CEA(FR)	01/01/2004 31/12/2005
8	HOTLAB	European network on hot laboratories	0.23	0.20	SCK/CEN (BE)	01/01/2004 30/06/2005
9	SNF-TP	Sustainable Nuclear Fission Technology Platform	0.80	0.60	CEA(FR)	01/10/2006 30/09/2008
10	ENFTP	Towards a EU nuclear fission technology Platform	0.27	0.20	CEA(FR)	01/01/2005 30/06/2005
		Totals	**32**	**16.5**		

V. INTERNATIONAL COOPERATION

International cooperation is an important element in the EU research policy. Cooperation with the International Science and Technology Centre (ISTC), Moscow and the Science and Technology Centre in Ukraine (STCU) is ongoing in the areas of partitioning and transmutation through mutual participation in the funded projects of Euratom FPs and those of ISTC and STCU projects. Cooperation between Euratom FP6 projects and US-DOE AFCI programme is also being fostered similar to the one with JAEA, Japan as well as with KAERI, Korea in the areas of mutual interests in P&T and Gen IV reactor systems. Euratom is committed to cooperation and participation in GIF and is actively contributing in all concepts of Gen IV that are being studied.

VI. CONCLUSIONS

The funding decision of projects for research and training activities in the field of partitioning, transmutation and Gen IV reactor systems under the Euratom Sixth Framework Programme is now complete (see Table 1 and 2). Some projects are just starting while others are finished and the latter have produced very encouraging results particularly in the area of partitioning and those relating to studies of the impact of P&T on waste management.

Significant progress has been made in FP6 in establishing the European Research Area in partitioning and transmutation in the EU. A well-balanced portfolio of 11 P&T projects in Euratom FP6 (2002-06) are underway with a total budget of ~81 M€ and EC contribution of ~43.5 M€. All major actors of P&T in EU are a part of these projects. Most of the Gen IV reactors concepts are under study in the EU and contributing to the GIF and this contribution will be further reinforced in FP7. A good portfolio of 10 projects with a total budget of ~32 M€ and EC contribution of ~16.5 M€ is allocated to these studies.

FP7 (2007-11) has been launched on time in December 2006 and is well on its way. Projects selected (June 2007) under the first call of FP7 are likely to start their work in the last quarter of 2007. International cooperation is an important element in the EU research policy. The collaboration between EU funded FP6 projects and the ISTC/STCU projects on P&T is progressing satisfactorily. Euratom is actively participating in GIF.

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