TOWARDS A COMMON KNOWLEDGE BASE FOR NUCLEAR RESEARCH: A CHALLENGE FOR THE STAKEHOLDERS COMMUNITY AND FOR THE EC

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At the Lisbon 2000 Summit, a strategic goal was proposed for the European Union: "to become the most competitive knowledge-based economy with more and better employment and social cohesion by 2010". Overall, in particular in the nuclear fission community, this EC initiative was well accepted by the main stakeholders. In Europe, the main stakeholders (i.e. suppliers and/or demanders) of nuclear knowledge are actually: the research organisations (with mixed public /private funding), the manufacturing industry (or vendors), the utilities and waste management organisations, the regulatory bodies (or technical safety organisations /TSOs) and the academia.

In the nuclear fission research area, under Euratom FP-5 (1998-2002), criticism was raised by a number of "high level experts" that too many Community efforts were devoted to production (e.g. through execution of shared cost actions) and not enough to dissemination and transfer (e.g. through education and training) and exploitation (e.g. through innovation) of nuclear knowledge. They were also complaining about the wasted resources due to the "fragmentation" of EU research.

As far as production of nuclear fission knowledge is concerned, a variety of poles (or fragments) of scientific research and operational feedback does exist in many countries but there is no clear common strategy on how to integrate these fragments at European level with a long term prospect. As far as dissemination and transfer of nuclear knowledge is concerned, the situation in some EU-25 countries is dramatic: mostly due to a bad public perception of nuclear energy, the lack of teachers and students becomes a serious concern. As far as exploitation of nuclear knowledge is concerned, all stakeholders are concerned about the unfair balance between supply and demand of knowledge, and about the relatively poor impact of research on technological and societal changes.

In conclusion, from a EU research point of view, the solutions to the above "nuclear challenges" have a common denominator: a common durable knowledge base. Actually, the nuclear stakeholders are interested not only in knowledge (if so, they could simply buy it!), but also in know-how. A better knowledge management strategy, in the framework of a nuclear European Research Area (ERA), is needed, with emphasis on the coupling of "production / dissemination / exploitation" of knowledge (PDE).

INTRODUCTION – LISBON 2000 OBJECTIVE: "EU BECOMES THE MOST COMPETITIVE KNOWLEDGE-BASED ECONOMY BY 2010" (STRATEGY OF THE "EUROPEAN RESEARCH AREA")

Besides its indirect links with foreign policy in the context of globalisation, Community research plays an important direct role as support to the specific Community policies. In this respect, an important event was the Lisbon European Council of 23-24 March 2000. At the summit, a strategic goal was proposed for the European Union: "to become the most competitive knowledge-based economy with more and better employment and social cohesion by 2010". The knowledge-based economy, actually, moves the development of the traditional industrial sector – abundant in labour, raw material and capital – to areas whose products, processes and services are rich in technology and knowledge.

The conclusions of the Lisbon Council emphasised that if Europe is to meet the challenge of globalisation, Member States need to adapt their education and vocational systems to the demands of knowledge society. Regarding EU research, it was also claimed, for example, that by the year 2010 an additional 700 000 researchers will be needed. In connection with this summit, the concept of the European Research Area (ERA) was launched by Commissioner P. Busquin. The main aim is to contribute to the Lisbon objectives by creating the conditions for an internal knowledge market without barriers. At this very early stage, the ERA strategy consists of identifying common needs ("mapping of centres of excellence"), proposing a common European vision in key research areas and developing implementation instruments, in particular, through the current sixth framework programme (FP-6 / 2003-2006) and through financial incentives for private and public research.

Community research (FP-6) is just a part of the ERA strategy (moneywise, actually, the most important one). To complement the FP-6 instruments, a number of financial, juridical and technical supporting measures are proposed - see *COM(2000)6* "Towards a European research area", January 2000 (*http://europa.eu.int/comm/research/era/index_en.html*).

Here are the main headings of this Communication:

- Optimised use of the stock of material resources and facilities available
  (e.g. maximising the potential offered by electronic networks)
- More coherent use of public instruments and resources
  (e.g. opening up of national programmes)
- More dynamic private investment
  (e.g. encouragement of risk capital investment and protection of intellectual property)
- A common system of S&T reference for policy implementation
  (e.g. development of the research needed for political decision-making)
- More abundant and more mobile human resources
  (e.g. harmonisation of university systems and free circulation of researchers)
- A dynamic landscape, open and attractive to researchers and investment
  (e.g. Marie Curie fellowships and use of the EU structural funds)
- An area of shared values
  (e.g. development of a shared vision of ethical issues in science and technology).

The strategy of the European Research Area is discussed in a number of EC Communications, such as: "Makng ERA a reality" and "More research for Europe: Towards 3% of GDP", in connection with the conclusions of the European Councils of Barcelona 2002 and Brussels 2003, which respectively,

- Agreed that overall spending on R&D in the Union should be increased with the aim of approaching 3% of the GDP by 2010 and that two thirds of this investment should come from the private sector;
- Urged Member States to take concrete action on the basis of the proposed Action Plan (*http://europa.eu.int/comm/research/science-society/action-plan/action-list_en.html*) and to speed up the implementation of the ERA by the application of the new FP-6 instruments.

By way of reminder, Community research has been organised in framework programmes of four years duration since 1984 (launched by Commissioner E. Davignon). The current FP-6 research programme extends over the period 2003-2006 and consists of the EC part (EUR 16 270 million) + the Euratom part (EUR 1 230 million, broken down into 750 for fusion and 480 for fission, i.e. 190 for indirect actions organised by DG Research + 290 for direct actions executed by DG JRC). On an annual basis, the total FP-6 research budget (EUR 17 500 million) represents approximately 5% fo the public civilian research budget of the EU Member States, which is also 4% of EC's budget.

BACKGROUND OF THE EUROPEAN RESEARCH AREA: A "CONSTITUTION FOR EUROPE" (JUNE 2004) AND A MODEL OF SOCIETY BASED ON SHARED VALUES (E.G. FREE ACCESS TO KNOWLEDGE)

The Europeans ara attached to a model of society based on a combination of a market economy and a high level of quality of life (e.g. "more and better employment and social cohesion"). Moreover a number of common principles are shared, as human rights, respect of minorities, social protection, right on basic education and free access to fundamental knowledge, etc.

Treaty establishing a Constitution for Europe (June 2004)

The general aims of the research and innovation policy of the European Union are given in the "Treaty establishing a Constitution for Europe", as approved at the intergovernmental conference on 18 June 2004 (document CIG 87/04, 6 August 2004) / Part III – The Policies and Functioning of the Union / Title III – Internal policies and Actions / Chapter III – Policies in other Areas / Section 9 – Research and Technological Development, and Space / Article III-248:

«1. The Union shall aim to strengthen its scientific and technological bases by achieving a European research area in which researchers, scientific knowledge and technology circulate freely, and encourage it to become more competitive, including in its industry, while promoting all the research activities deemed necessary by virtue of other Chapters of the Constitution.

2. For this purpose, the Union shall, throughout the Union, encourage undertakings, including small and medium-sized undertakings, research centres and universities in their research and technological development activities of high quality; it shall support their efforts to cooperate with one another, aiming, notably, researchers to cooperate freely across borders and at enabling undertakings to exploit the internal market potential, in particular through the opening-up of national public contracts, the definition of common standards and the removal of legal and fiscal obstacles to that cooperation.»

On the following web site, the above text is published and a public debate is proposed about the Constitution and the future of Europe: *http://europa.eu.int/futurum*.

In the specific case of nuclear energy research, under Title I "Tasks of the Community" and Title II "Provisions for the Encouragement of Progress in the Field of Nuclear Energy", the Euratom Treaty (Rome, 25 March 1957) states *that in order to perform its task, the Community shall, amongst other things,* promote research and ensure the dissemination *of technical information, and establish uniform safety standards to protect the health of workers and in general public and ensure that they are applied* (see EUROPA web site *http://europa.eu.int/abc/obj/treaties/en/entoc.html*). Worth nothing is the fact that the Euratom Treaty has been revisited as "protocol n° 36 amending the Treaty establishing the European Atomic Energy Community", added to the above document CIG 87/04 under the title "Addendum 1 / Protocols annexed to the Treaty establishing a Constitution for Europe".

A number of principles, such as free access to knowledge

Education is at the heart of many EU policies. Education in Europe cannot become a commercial product: free access to knowledge is a basic right, just like social protection and a number of other principles discussed in the above mentioned "Constitution for Europe". Free access to knowledge means, on the one hand, fair exchange of data amongst researchers, and, on the other, offering education and training services that disseminate state-of-the-art know-how. This version about education is shared, in particular, by the nuclear fission research community that is concerned about the decreasing number of experts throughout Europe.

The FP-5 project ENEN and FP-6 project NEPTUNO are illustrations of this European approach for nuclear education. Under FP-5, a group of 22 academic institutions and research laboratories have formed a legal association called ENEN ("European Nuclear Education Network", statutes filed in Paris in September 2003) – see *http://www3.sckcen.be/enen/* for registration as effective or associated members. Under FP-6, this effort is continued under the project "Nuclear European Platform of Training and University Organizations" (NEPTUNO) with special emphasis on the interaction with industry and regulatory bodies for training activities of common interest (e.g. common qualification scheme and mutual recognition of vocational traning courses – see *http://www.sckcen.be/NEPTUNO/*).

More generally, one of the objectives of the EU policy in education is to promote a quality offer in higher education with a distinct European added value, putting the emphasis on EU mobility as part of European study programmes. The universities and vocational training centres of the EU-25 should become attractive: this is the purpose of SOCRATES/ERASMUS (*http://europa.eu.int/comm/education/programmes/socrates/erasmus_en.html*) and of /MUNDUS (*http://europa.eu.int/comm/education/programmes/mundus/index_en.html*). The latter ERASMUS/MUNDUS programme is aimed, in particular, at enabling highly qualified graduates and scholars from all over the world to obtain qualifications and/or experience in the European Union.

PRODUCTION, DISSEMINATION/TRANSFER, AND EXPLOITATION OF NUCLEAR KNOWLEDGE: THE "NUCLEAR CHALLENGES" (CONCERNS ABOUT REACTOR SAFETY AND SECURITY OF ENERGY SUPPLY).

Nuclear energy in the enlarged EU-25 is a fact: in 2003, 32% of the total electricity generation came from nuclear energy, with a total of 153 nuclear power plants, most of them more than 20 years old. Nuclear is the Community's largest single energy source for electricity generation, ahead of coal at 29% and gas at 15%. It represents 15% of primary energy and is thus an important factor in the EU policy for security of energy supply. It represents a total capacity of 145 net GWe and a cumulated experience of more than 4700 reactor-years. As far as the EU-15 is concerned, the 136 nuclear power plants operating nowadays consist of 88 PWRs, 19 BWRs, 1 FBR, 2 VVERs-440 as well as 26 AGR and MAGNOX reactors. As far as the 10 new Member States are concerned, the Czech Republic, Slovakia, Hungary, Slovenia and Lithuania, are operating all together 17 NPPs: they consist of 12 VVERs-440(213), 2 VVERs-1000, 2 RBMKs and 1 PWR. Worth mentioning also is the recent decision of the Finnish company TVO to build a fifth NPP (Olkiluoto 3, EPR type, 1600 MWe, OK from Finnish authorities in May 2002, contract with Framatome ANP-Siemens consortium in December 2003).

Besides challenges that require technical and socio-economic skills, there are a number of "nuclear challenges", that require a new culture of nuclear knowledge management (i.e." production, dissemination/transfer and exploitation" of knowledge). Under Euratom FP-5 (1998-2002), in particular, criticism was raised by a number of "high level experts", that too many research efforts were devoted to production (e.g. through execution of shared cost actions) and not enough to dissemination and transfer (e.g. through education and training) and exploitation (e.g. through innovation) of nuclear fission knowledge. In addition, many stakeholders are complaining bout the "fragmentation" of European research over both time and space. They are also concerned about the decreasing number of nuclear experts and the subsequent loss of knowledge and competences in industry, regulatory bodies and research organisations.

As far as production of nuclear knowledge is concerned, fragments of scientific knowledge (of very high quality) are developed in many EU-25 countries, using public (e.g. national or EU) as well as private (e.g. industrial) funds, but there is no clear common strategy on how to integrate these fragments at European level with a long term prospect. The frequent lack of integration between successive research programmes (at both national and European levels) and amongst the various participating organisations leads to a mosaic of "sub-critical" research projects that are usually doomed to vanish at the end of each programme. In many cases, this lack of integration, over both time and space, leads at EU level to wasted resources (i.e. duplication of manpower, installations and funding), which is particularly detrimental in a period when research budgets are reduced.

As far as dissemination and transfer of nuclear knowledge is concerned, the situation in some countries is dramatic, especially in the education and training community. In many EU-25 countries, mostly due a bad public perception of nuclear energy, the lack of teachers and students becomes a serious concern, as has been reported in a number of recent Euratom, IAEA and OECD/NEA reports. There are still too many barriers between suppliers and demanders of knowledge. Too many difficulties are encountered in transferring knowledge from old to young generations, and in sharing scientific or technical (S/T) data of common interest amongst public research organisations: "ivory tower" behaviour and multiproperty of research results seem to be the two main reasons. A better interaction between the nuclear research community and the outside world is necessary. In particular, a better dissemination and transfer of research results could improve the mutual trust that is one of the bases of the reconciliation of the public opinion with nuclear.

As far as exploitation of nuclear knowledge is concerned, all potential end-users are concerned about the unfair balance between supply and demand of nuclear knowledge, and about the relatively poor impact of public research on technological and societal changes. Exploitation can take several forms: either for further research purposes (usually long term national research strategies) or for prompt commercial purposes (usually short term technological applications). For several end-users, it is important to "level the playing field" and so to set up EU-wide common conditions for a fair exploitation of Community research. Here are three examples of common exploitation needs, taken from areas covered in Euratom research:

— In the area of reactor safety, a common safety justification framework is needed: in the context of the deregulation of the European electricity market, an objective, consistent and predictable environment is necessary amongst the organisations belonging to the triangle "regulatory bodies – manufacturing industry – electrical utilities" across the EU-25.

— In the area of radiation protection, common safety standards are needed: in particular, in the area of low dose effects (i.e. <50 mSv), despite the still existing S/T uncertainties, the regulators are expected to issue common health and safety guidance that is acceptable by all parties concerned.

— In the area of waste management, common best practices are needed: despite national geological constraints, the waste management agencies are sharing a common body of S/T knowledge and of communication practices that may help improve solutions for waste disposal as well as public acceptance.

DEFINITION OF KNOWLEDGE AND STRONG COUPLING OF THE THREE COMPONENTS OF KNOWLEDGE MANAGEMENT IN THE ERA STRATEGY: PRODUCTION/DISSEMINATION/EXPLOITATION (PDE)

Most experts agree on the following definition of S/T professional knowledge. Two types of knowledge (explicit and implicit) are considered, requiring very different knowledge management techniques:

— Explicit knowledge that can be shared directly using standard communication channels, like education and training: basic knowledge (e.g. scientific disciplines, usually transferred through textbooks and higher education) and technical knowlegde (e.g. technical achievements or operational feedback, usually disseminated through technical training or scientific reports);

— Implicit or tacit knowledge that can be shared only after alteration to make it explicit: technical know-how (e.g. best practices, often plant dependent and transferred through team meetings) and individual experience (e.g. “lessons learnt” from a high-level expert who was particularly creative, often person dependent and transferred through mentor/novice partnership).

From a EU research point of view, the solutions to the “nuclear challenges” discussed in section 3 have a common denominator: a common durable knowledge base that could be made available to each stakeholder for his/her own exploitation. In the nuclear fission area, the main stakeholders concerned with knowledge management are: the research organisations (with mixed public / private funding), the manufacturing industry or vendors, the utilities and waste organisations, the regulatory bodies (and/or TSOs) and the academia (e.g. universities) – for more details see next section 5.

In view of meeting the above “nuclear challenges”, a better knowledge management strategy, both at national and EU level, is needed, focussing on the coupled system “production / dissemination and transfer / exploitation” of knowledge (PDE), illustrated in Figure 1. These 3 components are strongly coupled: all together they represent the backbone of knowledge management. Community research (FP-6) is located in the middle of Figure 1, but is actually just a catalyser in the integration process. This process will lead naturally to the desired durable common knowledge base while optimising value for money in EU research programmes (in line with the Lisbon 2000 strategy).

For obvious reasons, the nuclear stakeholders are interested not only in explicit knowledge (if so, they could simply buy it through textbooks and S/T reports!), but also in implicit knowledge and subsequent applications. The capacity to transform information into knowledge and knowledge into decision and action is one of the big challenges of the knowledge-based economy. Actually the stakeholders want to take an active part in the construction of the PDE system. They launched already a number of interesting “integrator” initiatives, upon which a nuclear European research area can be built.

“Production / Dissemination / Exploitation” (PDE) of knowledge is a cycle or a system (with control and feedback machanisms), encompassing both explicit and implicit knowledge, that is: covering the entire spectrum from basic textbooks to industrial innovation. In practice, however, it is clear that the treatment of implicit knowledge represents a much tougher challenge (some networks of excellence are working on it – see role of “knowledge manager” in Conclusion). Actually the common knowledge base that is aimed at, can be exploited for various purposes: e.g. research, industrial applications, regulatory decisions and/or technological or societal changes.

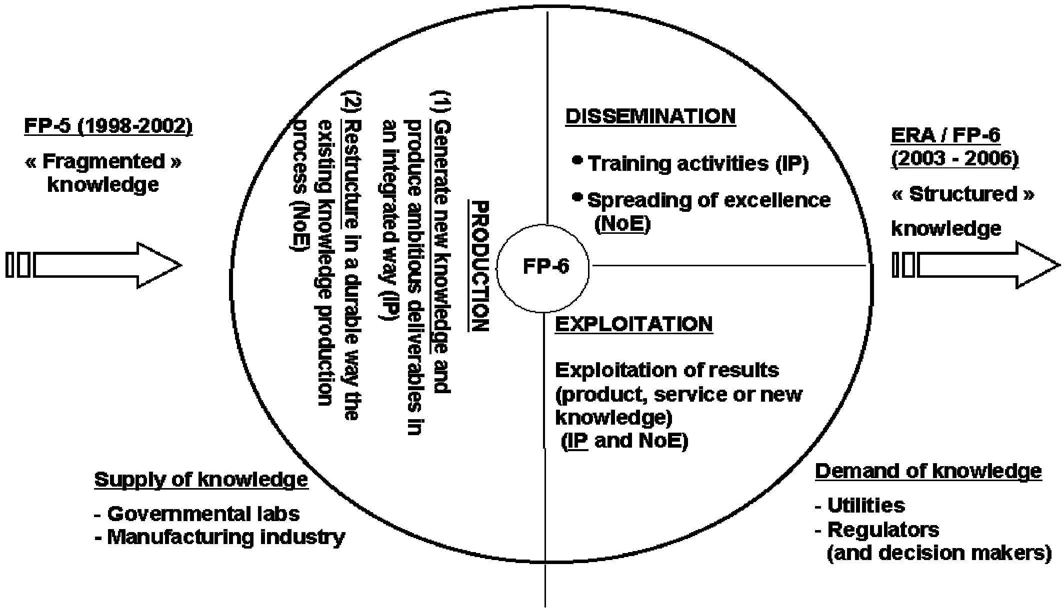

FIG. 1: Production / Dissemination / Exploitation of Knowledge ("PDE" system)

WHO ARE THE STAKEHOLDERS IN THE NUCLEAR ERA? (REGULATORY BODIES; UTILITIES AND WASTE AGENCIES; MANUFACTURING INDUSTRY AND VENDORS; RESEARCH CENTRES; ACADEMIA)

In the area of nuclear fission, one can distinguish 5 categories of stakeholders (already mentioned in the discussion about the PDE system in the previous section 4):

— The regulatory bodies and/or associated technical safety organisations (TSO)
— The electrical utilities and waste management organisations or agencies (+ service companies)
— The manufacturing industry and associated engineering companies
— The research organisations (public / private funding) and associated training services
— The academia (universities) and associated education services.

Traditionally, the first two categories are more interested in exploitation of research results (focussing on demand of knowledge), and the two next categories more in production (focussing on supply of knowledge) whereas the last one focusses on dissemination and transfer. As a consequence, all 5 categories of stakeholders are strongly interdependent: in principle, they should all aim at a fair balance between supply and demand of knowledge (see also Figure 1).

Each category has naturally its own strategy and has developed its own practices, for example: take care of public health and safety (regulatory bodies); generate electricity at the most competitive price (utilities) and take care of nuclear wastes in the most acceptable manner (waste management organisations); provide refurbishing services and design the next generation of nuclear installations (manufacturing industry); conduct research programmes on demand (research organisations); and teach the next generation of nuclear experts (academia). These corporate strategies have of course a direct impact on the decisions for research activities (e.g. what type of research can be outsourced?).

The regulatory bodies and associated technical safety organisations (TSO)

Their main priority is naturally the SAFETY of the nuclear installations. Since September 11, 2001, SECURITY of persons is another priority. The reactor safety and radiation protection authorities in each country are usually interested in (applied rather than fundamental) research of the confirmatory type, with results expected in the medium term (e.g. the duration of a framework programme, 4 years). In Community research projects, they are often driving forces to introduce the quality assurance culture, in particular, through the development and mutual recognition of common best practices. Through their participation in Euratom research, they exploit new knowledge and results, in particular, to have international confirmation of complex safety cases.

The electrical utilities and waste management organisations

Their main priorities are SAFETY and PERFORMANCE, two features that go hand in hand. They are usually interested in (applied rather than fundamental) research of the operational type, with results expected in the short-term (i.e. one year). Remember the slogan of some industries: "Industry is interested in good results in 1 year, not in excellent results in 10 years". In Community research projects, they are often driving forces to develop practical applications for safety and performance of NPPs or for nuclear waste management installations, respectively. Through their participation in Euratom research, they exploit the results obtained, in particular, to consolidate a common knowledge base that is acceptable by all stakeholders (including the regulators).

The manufacturing industry and associated engineering companies

Their main priorities are SAFETY, PERFORMANCE and INNOVATION. They are usually interested in (applied rather than fundamental) research of the exploratory (or promotional) type, with results expected in the long-term (i.e. beyond the duration of a framework programme). In Community research projects, they are driving forces to produce ambitious deliverables (products or services), for example, in connection with refurbishment of current plants and/or design of next generation of NPPs. Through their participation in Euratom research, they "offer", in particular, new materials and technologies (at the precompetitive stage) for which they expect international confirmation.

The research organisations and associated training services

Their main priority is to produce (both applied and fundamental) knowledge either to customers or to trainees (more and more on a competitive basis). In Community research projects, they are often driving forces to lead joint research and training actions, sharing large installations and promoting mobility of scientists amongst the European laboratories. Through their participation in Euratom research, they "offer", in particular, applied knowledge to the S/T community as well as to the political decision makers. In return, they expect to receive operational data from industry and/or regulatory organisations, in order to produce results that are directly exploitable for customers.

The academia (universities) and associated education services

Their main priority is to produce (fundamental rather than applied) knowledge and then to disseminate and transfer it to the young generations. This up-front knowledge does not necessarily focus on safety, performance or innovation of nuclear installations. They are interested, in particular, in S/T challenges that attract brilliant professors and students. In Community research, they are often driving forces to "push forward the frontiers of science", thereby maintaining the nuclear expertise at a high level. Through their participation in Euratom research, they expect, in particular, to get access to large infrastructures owned by public or private laboratories where they could send their students and test their findings.

Note

A common knowledge base does not mean aiming at a unique understanding of physics or at a unique interpretation of data. It means essentially constructing and sharing a coherent set of data and of practices of common interest. Therefore a holistic view (in the framework of a nuclear ERA), maintaining diversity and quality assurance, is necessary, which enables the researchers to get more value for the same money. In nuclear, there are at least two reasons for maintaining diversity:

- Science can progress only if contradictory debates (based on qualified data) are possible
- Regulatory authorities should maintain their neutrality and independence (imposed by law).

Therefore interpretations (as well as numerical models) and conclusions might differ amongst nuclear stakeholders even when they use the same common knowledge base!

WHAT ARE THE SUCCESS CRITERIA NEEDED TO ACHIEVE A COMMON KNOWLEDGE BASE? (COMMON NEEDS, COMMON VISION OR STRATEGY, AND IMPLEMENTATION INSTRUMENTS).

Integration of European research is a prerequisite for the construction of the common knowledge base. In line with the ERA concept, any durable common strategy for S/T knowledge management should be based on EU integration and encompass the following activities: Production; Dissemination and transfer; and Exploitation (PDE system). Community experience has shown that EU integration policies are succesful only if common EU values are respected (section 2) together with the following 3 criteria:

- Identify a set of common needs;
- Develop a common vision strategy;
- Apply the right implementation instruments;

Actually the main stakeholders will be interested in EU integration – in particular, in the nuclear European Research Area – only if they are convinced of the long term benefits (e.g. S/T, societal of financial) of this process, that is: if they believe they will get more out of the process than what they have put into it. If one of the above 3 criteria is missing, this EU integration process will be incomplete.

What should the common knowledge base consist of? At the start, as a minimum, it should contain a list of research projects and main achievements as well as the list of relevant European experts. A first attempt in this sense has been done in the FP-5 project “Joint Safety Research Index” (JSRI – see http://w2ksrvx.ike.uni-stuttgart.de/jsri/). As said above, FP-5 was focussing on production of knowledge. In the particular area of Euratom, details about indirect research actions (DG RTD), related to nuclear fusion and fission, are given in the CORDIS website http://www.cordis.lu/fp5-euratom/src/projects.htm. The direct action programme of Euratom is given in the DG JRC website http://www.jrc.cec.eu.int/. As far as general dissemination and transfer are concerned, EU cosponsored publications about nuclear fission research, aimed at both the scientific community and the public at large, are available on http://europa.eu.int/comm/research/energy/fi/fi_pubs_en.html).

Under FP-6, the emphasis is on the strong links between production, dissemination and transfer, and exploitation of knowledge. Transfer of S/T information between the national scientific communities and the EC headquarters is strengthened through the network of National Contact Points (NCPs) – see http://www.cordis.lu/fp6/getsupport.htm. Information about FP-6 Euratom research projects (in particular, those that started in January 2004) is on http://www.cordis/lu/fp6-euratom/projects.htm.

Actually the common knowledge base should contain more than S/T information, as Community research is designed as a service to EU policies. Something like an internal market for knowledge in the EU should be established, that is: rules and incentives should be proposed to stimulate supply (i.e. production) and demand (i.e. exploitation) of knowledge, while ensuring its flow (i.e.dissemination and transfer). As shown in Figure 1, the role of FP-

6 is primarily to provide seed money to ensure the active participation of all stakeholders in the PDE system, that is: not only S/T experts but also, for example, economic experts from industry and juridical experts from regulatory bodies should be involved in FP-6 projects.

FP-6 IMPLEMENTATION INSTRUMENTS (IP AND NOE): CONTRACTUAL OBLIGATIONS REGARDING PRODUCTION / DISSEMINATION-TRANSFER / EXPLOITATION OF KNOWLEDGE (PDE SYSTEM)

As mentioned in section 1, the FP-6 is offering two new implementation instruments (IP and NoE). Actually they are aimed at "de-fragmentating", both in space and time, the fabric of European research and re-assembling (or re-structuring) it in an efficient cost-effective system. "Space" refers here to the stakeholders' groups whereas "time" refers to the transition between one programme (national or international) and the next one. More information is on the web site http://europa.eu.int/comm/research/fp6/instruments_en.html.

The main difference between an IP and other international research projects lies in the ambition of the "space" dimension of the desired structuring effect. In an IP, a "critical" mass of stakeholders ("vertical" integration) is brought together with the aim of integrating various S/T disciplines ("horizontal" integration) using various public and private funding sources ("sectorial" integration).

The four cost categories mentioned in the IP contract are self explanatory, namely; RTD or innovation related; demonstration; training; and consortium management. The main focus of an IP is thus on the production of knowledge with emphasis on innovation – see also Figure 1. Dissemination and transfer of knowledge, under the form of training activities, is another requirement. Finally, exploitation of knowledge, under the form of demonstration, is also mandatory. In an IP, actually the EC funds («grant to the budget») represent approximately half of the total project value, as in the shared-cost actions of FP-5. In an IP, the EC is co-financing the delivery of a "a product" (or a service): the consortium should express a holistic view (that is: for example, a complete life cycle approach) in their work programme. The dominating partners are often industrial organisations that decide to share the scientific and financial risks of pre-competitive research, and to develop European platforms to discuss common best practices.

The main difference between a NoE and other international research projects lies in the ambition of the "time" dimension of the desired structuring effect. The ambition of a NoE is to achieve "sustainability", that is: the European organisations that decided to join their efforts in a NoE should not fall apart after the contractual deadline. Ideally, they should continue to work together as a "critical" mass of expertise and could become (at least in part) an autonomous organisation.

The three cost categories mentioned in the NoE contract are self explanatory, namely: joint programme including integration activities, joint research and spreading of excellence; and consortium management. Hence, production of knowledge as such is not the priority in a NoE: actually the emphasis is more on the collection and re-organisation of existing knowledge. Dissemination and transfer are a priority – see also Figure 1: each NoE is given the mission to spread excellence beyond the consortium, for example, through training. Exploitation is not a priority *per se*, unless it helps in the structuring process. In a NoE, the EC funds («grant for integration») actually serve for a long (term) "process" to take place: to some extent, after the contractual deadline, quasi-irreversible links are expected amongst the participating organisations! The dominating partners are often research organisations that agree to develop common research strategies, in particular, in view of constructing parts of a common knowledge base for the future.

Another interesting new FP-6 instrument besides IP and NoE is the "integrating infrastructure initiative" or I3. The fundamental objective is to provide an integrated service of Europe-wide relevance in its field with a view on long-term structuring effects. The proposed activities should ensure a coherent set of high quality services to the scientific community and are composed of: networking activities (demonstrating a European added value, e.g. a common knowledge base); transnational access activities; and joint research activities (representing a clear progress beyond the current state-of-the-art).

CONCLUSION – ROLE OF THE STAKEHOLDERS IN THE CONSTRUCTION OF THE NUCLEAR KNOWLEDGE BASE (COST/BENEFIT ANALYSIS OF EU RESEARCH PROJECTS, "KNOWLEDGE MANAGER" IN FP-6)

This paper has demonstrated that in the EU the nuclear stakeholders' community and the EC are moving "towards a common knowledge base for nuclear fission". The strategy for a common knowledge base is discussed throughout this paper in the light of the Lisbon 2000 strategy aiming at making the EU "the most competitive knowledge-based economy by 2010" (section 1). It is clear that all stakeholders share very similar concerns related to knowledge management, while adhering to a numbr of common basic EU values (section 2). A number of "nuclear challenges" have been identified, related to reactor safety now and security of energy supply in the future (section 3). In line with the concept of European Research Area (ERA), knowledge management is one of the pillars of research. Actually it consists of three components, strongly coupled together, namely: production (P), dissemination / transfer (D) and exploitation (E) of knowledge (section 4).

From a EU research point of view, the solutions to the "nuclear challenges" have a common denominator: a common durable nuclear knowledge and know-how base that is shared amongst all stakeholders for their own further exploitation, while optimising value or money. There are 5 groups of stakeholders in the nuclear community (section 5): the regulatory bodies (and/or TSOs), the utilities and waste management organisations, the manufacturing industry, the research organisations (with mixed public : private funding) and the academia. Each group has naturally its own strategy and has developed its own practices. European competitiveness is one of the main drivers in the integration process of production, dissemination/transfer and exploitation (PDE) of nuclear knowledge. Another driver is more of the political type: keep and develop the nuclear competences in Europe at a maximum level, at least until the end of the lifecycle of all nuclear installations.

To turn the nuclear ERA concept into reality, a number of success criteria should be satisfied (section 6). There seems to be a wide consensus about the need for common research. Similarily there seems to be a wide consensus about the instruments to conduct joint research. To ensure full success of a nuclear ERA, however, one component is still weak, namely: there is no real common vision or strategy on nuclear fission amongst the EU Member States, despite some national/regional attempts to do so. It is felt that the diversity of political and S/T opinions in this domain is still the major obstacle preventing full integration of research programmes. As a consequence, the common nuclear knowledge base cannot progress rapidly.

As a matter of fact, research in nuclear fission in Europe has not yet reached the "critical mass" necessary to levy the public and private resources needed to face the many challenges ahead of the Union. These challenges cover actually a wide range: political (e.g. public opinion about nuclear), economic (e.g. deregulation and privatisation of electricity market), technical (e.g. plant ageing management), scientific (e.g. low dose irradiation effects) and education / training (maintenance of competences). Time is also a big constraint: critical decisions at the EU level need to be taken before the year 2015 when the current generation of nuclear installations reach their end of life.

The new instruments of FP-6 (in particular, integrated projects IP and networks of excellence NoE) were presented with emphasis on their explicit roles in the construction of the PDE

system (section 7). Production, dissemination/transfer and exploitation (PDE) of knowledge are mandatory activities (to be specified in the Community contract) in each FP-6 project.
The success or failure of the nuclear knowledge integration process depends naturally on the commitment of the stakeholders. Actually, they are interested not only in knowledge but also in know-how: they are collectively concerned about the exploitation potential of the common knowledge base. Therefore they usually want to play an active role in the construction of the PDE system – Figure 2 below.
In conclusion, it is clear that durable foundations will be ensured for the common nuclear knowledge base only if the stakeholders and the EC build it upon solid blocks (e.g. stakeholders' or national "integrator" initiatives) and if all participants share substantial resources, driven by the conviction that they will get more out of the EU integration process than what they have put into it.
Recently, some major European organisations have made a cost/benefit analysis of their participation in Euratom research, while emphasizing the central role of nuclear knowledge management now and in the future. Here is an interesting "official" statements from a large European utility at FISA-2003 (http://www.cordis.lu/fp5-euratom/src/ev-fisa2003.htm):
"To give an idea of the quantitative benefits which can be obtained from sharing costs in the framework of European programs, we can mention a few illustrative figures: in the nuclear field, in 2002, we brought about EUR 3.5 million and got access to R&D results worth EUR 36 million. This factor of 10 is obviously a strong incentive for a utility to get actively involved in the ERA!"
To turn the PDE system concept into practice, some FP-6 projects are pioneering a "knowledge centre" and have nominated a "knowledge manager". There is some similiarity with the role of "quality assurance" manager that exists already in many Community projects. The knowledge manager is responsible for optimising the interaction between "production ↔ dissemination / transfer ↔ exploitation" of knowledge and he/she reports to the project's consortium. Here are two examples of such FP-6 projects: the integrated project NF-PRO ("Understanding and modeling of the key processes in the near-field….and repository strategies" / http://nf-pro.sckcen.be) and the network of excellence ACTINET-6 ("Physics and chemistry of actinides" / http://www.actinet-network.org/).

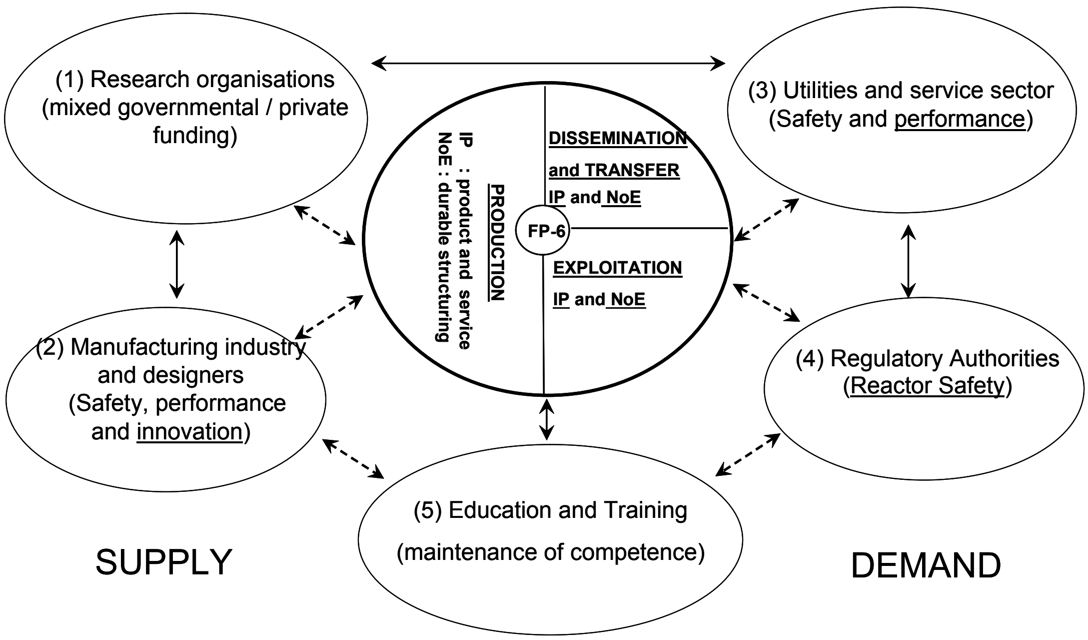

Fig. 2 : Role of the stakeholders in the construction of the common knowledge base.