

EURATOM RESEARCH ON GEOLOGICAL DISPOSAL – PRESENT STATUS AND PROSPECTS

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ABSTRACT

Support for R&D in nuclear science and technology has been part of the European Union's (EU) research agenda from the very beginning. This support is channelled principally through multi-annual research "framework programmes" covering all areas linked to the peaceful uses of nuclear energy. Research priorities in these programmes have changed over the years to respond to the key challenges within the nuclear sector. Currently, management of radioactive waste is a priority area of research in the 6th EURATOM Framework Programme (2002-2006), and geological disposal of spent fuel and high-level long-lived nuclear waste constitutes a key topic within this priority area. This current programme is a culmination of previous EU-supported projects and maintains continuity with previous research activities in this field. Nonetheless, in addition to the scientific and technical issues there are also important strategic and political considerations that will fashion the way future support is provided at the EU level. These considerations not only result from the restructuring of the EU policy framework for research in general, but are linked to the particular needs of the geological disposal research sector and the role that this research can play in fulfilling the EU's objectives. This is having an important influence on the planning of the 7th EURATOM Framework Programme. In particular, there is a need for more in-depth co-ordination between the respective efforts in EU Member States in this field together with, in a few key countries, political initiatives to initiate the necessary programmes.

INTRODUCTION

This paper presents the current status of European Union (EU) research in the field of geological disposal and analyses the prospects for and possible direction of future efforts, especially in the light of the current planning for the next (7th) Framework Programme (to be implemented from 2006/7). The paper also looks at the prospects for increased levels of co-operation between the EU Member States in this field, the need for appropriate political initiatives and what the aims of this research are and how it can make a difference.

Politics and the Framework Programmes

The EU is currently spending billions of euros each year on support for R&D in Europe. The political and strategic motivations behind this policy are clear – research is an essential ingredient in building a more dynamic and competitive Europe. In Lisbon in the year 2000, the then heads of governments all signed up to an agenda aimed at making the EU the "world's most dynamic knowledge-based economy geared to growth by the year 2010". Though progress in this direction has so far been insufficient, the new Commission of 25 Commissioners, sworn in in

November 2004 and responsible for driving Europe forward over the next five years, has reaffirmed the EU's commitment to the Lisbon goals. Improvements to the way research is undertaken – planning, coordination, structuring and financing – are key elements of this strategy.

Support for R&D is recognised within the Treaties establishing the EU as a competence shared between the EU institutions and the Member States. Clearly the Member States have their own national publicly funded research programmes, and in reality the money spent at the EU-level still only represents a small fraction, roughly 5%, of the total public spending on research in Europe. However, the advantage of the EU programme is that EU money can often “punch above its weight” and hopefully provide, if spent wisely, a disproportionate effect on the total research effort. The European Commission (EC) would like to see the EU contribution doubled in the future, though this will need approval of the Member States and will not be decided until the EU's budget for 2007-2013 is fixed sometime in mid-2005. There is reason to believe that the majority of EU Member States will be amenable to this proposal, especially since in 2001, as part of the renewed emphasis on research in the wake of the Lisbon Agenda, EU heads of government also signed up to the “Barcelona objective” to raise total research funding in Europe to 3% of GDP by 2010, compared with less than 2% currently. Ideally this would be split 1% public and 2% private, with the EU contributing approximately 1/10th of the public spending, i.e. double the present contribution.

As the executive institution of the EU, the EC is responsible for the planning and implementation of the EU research programme. For more than two decades, the principle method of providing this support has been the Framework Programme (FP). This is a shared-cost grant-based programme (projects being partly funded out of the EU budget, partly funded by the participating organisations), each FP having a duration of 4 – 5 years. These programmes are implemented via Calls for Proposals published at regular intervals in the EU's Official Journal. Evaluations of submitted proposals are usually carried out with the help of independent experts in the different domains. The precise content of these Calls for Proposals is often guided by the results of prior Calls for Expressions of Interest that permit the European research community to demonstrate its willingness and readiness to undertake specific research actions falling within the scope of the FP. The overall objectives, scope and priorities of each FP must be approved by the legislative organs of the EU – the European Parliament and the Council of Ministers – before the FP can be finally adopted in European Law and implemented by the EC. The EC is currently in the process of preparing its proposal for the 7th FP (FP7). This is a major undertaking involving broad policy considerations and extensive consultation and review.

The EURATOM Treaty

Ever since the start of the European “experiment” back in the 1950s there has been a separate Treaty covering nuclear matters. The EURATOM Treaty [1], short for Treaty establishing the European Atomic Energy Community, was one of the original Treaties of Rome at the inaugural signing in 1957. However, whereas the other EU Treaties have been modified, extended and improved over the years, the EURATOM Treaty has hardly been touched. Even in the new EU Constitution, signed by Heads of State / Government on 29th October 2004, it is annexed to the main text as a stand-alone protocol with the bare minimum of revision. One result of this lack of modernisation is that the legislature in the case of EURATOM legislation is still the Council of

Ministers (representing the views of EU Member States) acting alone, with the EU's democratic organ – the European Parliament – having only a consultative role. Furthermore, decisions in the Council often require unanimity, which can create problems in a Union of 15, not to mention the recently enlarged Union of 25 Member States.

The EURATOM Treaty covers everything that was important in the nuclear field in the late 1950s – nuclear safeguards, radiation protection, research, supply of fissile material. The inclusion of research has meant that all EU support for R&D in the area of nuclear science and technology (including radioactive waste, reactor systems – fusion as well as fission, etc.) comes under a separate legal base from the rest of EU research, and as a result must be covered by its own legally distinct FP. These EURATOM FPs have traditionally been run in parallel with the “non-nuclear” FPs and are implemented in a similar fashion using the same type of funding instruments, at least as far as research in the “fission area” is concerned.

EURATOM Research

Back in the early 80s, during the initial days of the FP, the EURATOM Programme accounted for something like 25% of the total EU research spending. Today this percentage is much less – in FP6 the nuclear (EURATOM) component is some €1.2 billion compared with some 16 billion for the whole of “non nuclear” research – though the funding has nonetheless increased in real terms. The majority of the EURATOM research budget is spent on the fusion programme – approx. 70% in FP6 – the rest goes on the other priority areas in the fission programme. One of these is, and has been ever since the first FP, management of radioactive waste. The scope of this area now includes partitioning and transmutation (P&T) as well as research on disposal options. In the past there have also been many projects on low-level waste management and decommissioning activities. However, for the last two decades, the principal topic of research is geological disposal of high-level / long-lived waste. Though the level of research spending on such aspects as fission reactor technology has fallen over this period (as would be expected with the coming to industrial maturity of the 2nd generation of power reactors), the research effort on managing the back end has remained a priority, reflecting the status of this subject as the only remaining issue to be resolved before a full industrial implementation of the whole nuclear cycle.

EURATOM RESEARCH IN GEOLOGICAL DISPOSAL – CURRENT STATUS

There has of course been a marked shift in focus of the research in geological disposal over the period of the EURATOM FPs. Initially work concentrated on more fundamental aspects of the physical, chemical and geological processes effecting deep disposal. Projects tended to be smaller and there was less emphasis on technology and engineering. With the construction of dedicated underground research laboratories (URLs) in the various host rock environments, research projects have become more focussed on the specific conditions prevailing underground as well as on the required engineering systems and demonstration experiments. Since there are only relatively few URLs in Europe, they have naturally become magnets for all EU research in host rock conditions, which in turn has resulted in enhanced co-operation between research teams and waste agencies in different Member States. The research often involves large and costly experiments, again encouraging interested research teams to combine efforts in order to reduce costs. The key role played by URLs means that they are also important focal points for EURATOM FP funding.

Status at the end of the 1990s

By the time of FP5 (1998 – 2002) all key areas of research in geological disposal were under investigation in the EU programme, many of the projects following on from research supported in FP4. However, one topic in particular was added in FP5 and concerned the study of societal and public involvement issues associated with waste management, in particular new ways of dealing with and communicating risk, and local democracy and governance issues associated principally with site selection. The inclusion of this topic (since retained in FP6) is indicative of a recognised need to deal with waste management issues on a holistic rather than purely technical level, and is a reaffirmation of the importance of political and strategic considerations in the planning of future research programmes. The extent of the FP5 research effort is depicted schematically in Figure 1.

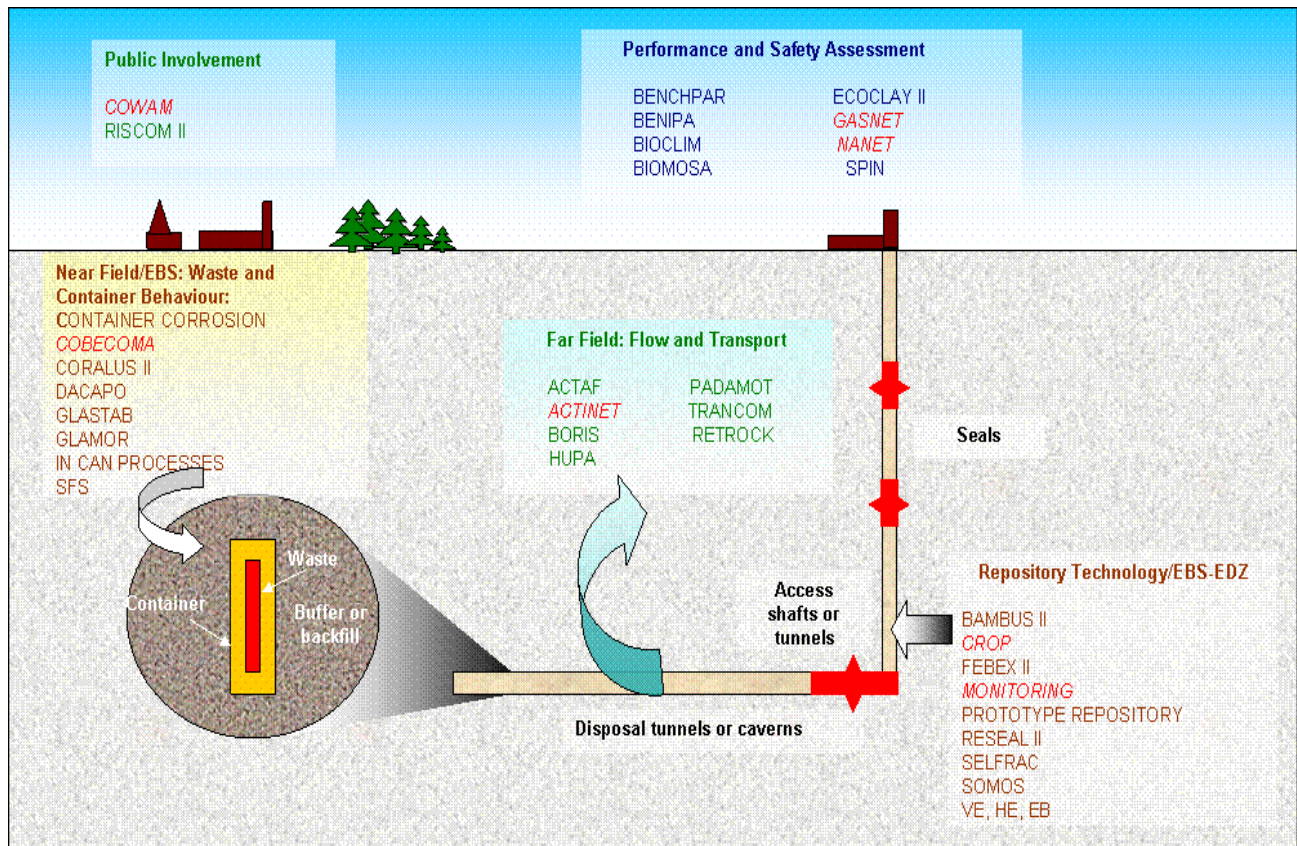


Fig. 1. FP5 coverage of geological disposal – names in red indicate projects aimed at coordination and networking (see [2] for project details; not all projects shown).

A New Vision for EU Research

Whereas EU research initially tended to concentrate on generation of knowledge, other more policy-related goals constitute key objectives of the support in recent years. These include increased collaboration in order to maximise the “EU added value”, ensuring there is an effective “critical mass” of research effort in key fields, the creation of “centres of excellence”, greater emphasis on competitiveness and public-private partnerships, increased support for research

infrastructures and generally the exploitation and management of knowledge rather than purely its acquisition. The watershed came at the end of the 1990s with the arrival of the previous Commission, in particular the ex-Commissioner for research Philippe Busquin, and was marked by the initiating of the European Research Area (ERA) and the integration of research policy into the EU's wider political objectives, most notably the 2000 Lisbon Agenda.

FP6 – the New Funding Instruments

Accordingly, in FP6 (2002 – 2006) the EC introduced new funding instruments to enable a more efficient and effective structuring of EU research, to reduce fragmentation and to promote European centres of excellence and mobility of researchers, all in line with the objectives of ERA [3] – the creation of a European “single market” in research. To attract EU support, research groups are now encouraged to join forces in collaborative partnerships called Networks of Excellence (NoE) and Integrated Projects (IP). An NoE is a means to create durable integration of key research organisations in a given area. The EU funding is specifically to cover the additional costs of integration rather than the actual research effort (i.e. salaries of staff) and the aim is to encourage these organisations to function as a single entity with a common programme of research, thus stimulating the strive for scientific excellence and eliminating needless duplication of effort. An IP on the other hand is a project that brings together as many of the key research players as possible in order to achieve ambitious aims that can go beyond the current state of the art. The expertise and advanced knowledge gained through an IP will generate greater visibility of research and facilitate wider dissemination of results within Europe.

Table I. Progress towards greater integration in research on geological disposal - comparison of the last three FPs

| Framework Programme | No. of projects | Total EC contribution | No. of projects aimed at coordination and networking | Programme emphasis |
|---------------------|-----------------|-----------------------|--|----------------------------|
| FP4 (1994-1998) | 42 | €33.5 M | 2 | RS ¹ |
| FP5 (1998-2002) | 43 | €29 M | 10 | RT ² + RS |
| FP6 (2002-2006) | 7 + | c. €45 M | all major projects must include these aspects | I&N ³ + RT + RS |

¹ RS = repository system behaviour (near-field / far-field basic phenomena)

² RT = repository technology / URLs

³ I&N = integration and networking

Consolidation of EURATOM Research in Geological Disposal

On a purely technical level, the aims of EURATOM research on geological disposal remain the establishing of a sound scientific basis for demonstrating the safety and feasibility of geological disposal. However, for many years, the EURATOM programme has also been actively encouraging more cooperation between research bodies in Europe. This is evident from the trends in recent FPs (see Table I) and the degree of cooperation achieved in research projects carried out in URLs. Consequently, the introduction of the new funding instruments in FP6 was an opportunity to improve still further the degree of collaboration between research actors. Since

the end of 2003, seven research projects, totalling some €32M of EU funding, have been launched in the field of geological disposal; four of these are large projects implemented using the new funding instruments and aimed at improving the fundamental understanding of key processes as well as the development and testing of new technologies. A final call for research proposals to be funded within FP6 is foreseen for April 2005, which will include projects covering complementary issues, in particular the development of integrated performance and safety assessment methodologies and tools. The current IPs and NoE have the aim of making all the acquired data, knowledge and expertise available and accessible to the broader scientific community, and will promote knowledge and technology transfer through specific training actions. Details and descriptions of these projects are listed in Tables II and III.

Table II. On-going FP6 research projects in the field of geological disposal

| Project title & description ¹ | Instrument ² | Co-ordinator | Number of consortium partners ³ | EU contribution / total cost | Start date & duration |
|--|-------------------------|------------------------------------|--|------------------------------|-----------------------|
| ACTINET-6 – Network for Actinide Sciences. See www.actinet-network.org | NoE | CEA (FR) | 27 (13) | €6.35M / €10.5M | 1/3/04 4 years |
| ESDRED – Engineering Studies and Demonstrations of Repository Designs. See www.esdred.info | IP | ANDRA (FR) | 13 (9) | €7.32M / €18.1M | 1/2/04 5 years |
| NF-PRO – Understanding and physical and numerical modelling of the key processes in the near-field and their coupling for different host rocks and repository strategies | IP | SCK.CEN (B) | 40 (10) | €8M / €16.8M | 1/1/04 4 years |
| FUNMIG – Fundamental processes of radionuclide migration | IP | FZK-INE (DE) | 51 (15) | €8M / €15M | 1/1/05 4 years |
| COWAM-2 – Community Waste Management 2: Improving the governance of nuclear waste management and disposal in Europe. See www.cowam.org | STREP | Mutadis (FR) | 19 (9) | €1.2M / €2.33M | 1/1/04 3 years |
| CETRAD – Coordination Action on Education in Radiation Protection and Radioactive Waste Management | CA | UWC (University of Wales, Cardiff) | 20 (17) | €250K / €303K | 1/1/04 15 months |
| SAPIERR – Support Action: Pilot Initiative for European Regional Repositories. See www.sapierr.net | SSA | Decom Slovakia, spol. S.r.o. | 2 (2) | €195K / €53K | 1/12/03 2 years |

¹ See Table III for fuller descriptions, or refer to <http://www.cordis.lu/fp6- euratom/projects.htm> for more complete information and latest updates.

² NoE = Network of Excellence; IP = Integrated Project; STREP = Specific Targeted Research Project; CA = Co-ordination Action; SSA = Specific Support Action (full details on <http://www.cordis.lu/fp6/instruments.htm>)

³ The figures in brackets indicate number of different European countries represented.

Table III. Brief descriptions of on-going projects

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|---|
| <p>ACTINET-6 is to achieve a sustainable integration of European research on the physics and chemistry of actinides. The goals are, more specifically, to co-ordinate the use of the major actinide research facilities within the European scientific community, improve human mobility between member institutions (in particular between academic institutions and national laboratories) and to promote excellence through a process of selecting R&D projects and support for training activities. ACTINET-6 has a broad participation of research organisations and academic institutions with expertise in actinides science, as well as effective links with the user community.</p> |
| <p>ESDRED has the overall objective of demonstrating the technical feasibility of deep disposal on an industrial scale, especially as regards the activities required during construction, operation and closure of a deep geological repository. The project will also show how these activities comply with requirements regarding long-term safety, operational safety, safeguards and monitoring. ESDRED is a joint research effort by the major European radioactive waste management agencies (or their subsidiaries).</p> |
| <p>NF-PRO is to investigate dominant processes and their couplings affecting the isolation of nuclear waste within the near-field and apply and develop conceptual and mathematical models for predicting the source-term release of radionuclides from the near-field to the far-field. Results and conclusions of experimental and modelling work will be integrated in performance assessments. To understand the performance of the overall near-field system, an adequate insight in both the performance of the individual near-field sub-systems and their interactions is essential and this constitutes the core of the integration component of the project. The consortium of 40 partners represents 7 European waste management agencies, 25 research institutions and 8 Universities.</p> |
| <p>FUNMIG is the last of the series of major IPs to be funded that follow on from key areas of activity in previous FPs. The main objectives are the fundamental understanding of radionuclide migration processes in the geosphere, their application to performance assessment and the communication of the results. An understanding of processes involved in the transport of key radionuclides and their retardation at the molecular level is fundamental, but this must be scaled up to the dimension of host rock strata being considered in Europe (clay, granite, salt). The migration processes can then be studied at scales of interest in performance assessment (PA), and this integration and abstraction to PA are key issues. The knowledge acquired during the project will be disseminated to the wider scientific community and other stakeholders by active training and other dedicated knowledge management activities. A large consortium of research organisations, waste management agencies and universities across Europe are implementing the project.</p> |
| <p>COWAM-2 aims to improve the governance of radioactive waste management by providing a critical analysis of past and current decision-making processes on geological disposal in Europe. The work programme is being developed through four thematic work packages on: implementing local democracy and participatory assessment methods; influence of local actors on the national decision-making process; quality of decision-making process; and long-term governance. The COWAM-2 international consortium involves partners from 9 European Countries (including 3 new EU Member States) encompassing different categories of actors involved in radioactive waste management: research institutes (4), universities (6), NGOs (3), implementer (1) and SMEs (5).</p> |

Table III. Brief descriptions of on-going projects (cont'd)

CETRAD is aimed at developing proposals for structuring and delivering both education and training in the management and disposal of high-level and long-lived radioactive wastes in geological formations, covering also the related radiation protection needs. This project is seen as a forerunner of a more comprehensive pan-European Network in this area, which should emerge from this work. The CETRAD consortium comprises mainly the implementing organisations, with 17 European countries represented, including 6 new EU Member States or candidate countries

SAPIERR is organising and integrating national information on waste in Central and Eastern European countries in sufficient depth to allow concepts for potential regional options to be identified and new R&D needs to be scoped. The prospects for countries to work together to explore multinational solutions for their waste management problems has long been discussed at the international level, and this has provided the impetus in this case for organisations in the countries involved to explore the feasibility of such an approach to disposal in particular. SAPIERR aims only to establish the boundaries of this issue. Possible future programme components and structures will be suggested, but proposals for regional facilities, including potential siting, are not part of this initial pilot study.

Feedback from the Research Community

The experience so far with the new FP6 funding instruments has prompted discussions and critical re-evaluations of the way EU funding for research is provided and the structuring effect it has on European research in general. At the Euradwaste'04 conference in March 2004 [4], at which the current status of EU research in the field of geological disposal was presented, a panel of experts discussed “how to develop integration through research networking”. In the opinion of these experts:

- EU co-operation on R&D remains essential, allowing more efficient use of resources and better knowledge dissemination within a broader international community;
- closer co-operation and more efficient implementation of projects is essential in order to achieve shared goals;
- large funding instruments in FP6 have nonetheless introduced difficulties in obtaining agreement between all partners (compromise is often problematic since individual partners are constrained by the objectives of their national programmes);
- partial integration is desirable and feasible, and allows waste agencies to maintain independence from safety authorities and reviewers.

This feedback, together with the report of a review body looking at the application of the new FP6 funding instruments in the EU research programmes as a whole [5], may lead to a revision of the way the funding instruments are used during the remaining duration of FP6, and later in FP7. In the EURATOM area for instance, more emphasis may be given to smaller projects using more traditional funding instruments in those cases where research aims can be achieved without resorting to the administratively heavier new instruments.

EURATOM FP6 is restructuring the way R&D in geological disposal is conducted in Europe – that, after all, is the intention. It is also reaffirming that common views on the main scientific issues in this field can develop within Europe (despite the differences between countries on issues such as nuclear power). However, FP6 is still in its early stages, and it is too soon to say exactly where this restructuring will lead and how much sustainable integration can be achieved. What is clear, however, is that these remain key objectives of EU research funding in this field.

EURATOM RESEARCH IN GEOLOGICAL DISPOSAL – FUTURE PROSPECTS

Planning of FP7

The EC is now actively involved with the planning of the next, the 7th, Framework Programme (FP7), due to begin in 2006/7. In a Communication in June 2004 [6], the Commission published its political thinking and indicated how it intends to address the key issues, especially those preventing the full implementation of ERA – measures promoting support for fundamental research, innovation, competitiveness, cooperation, co-ordination of national programmes, infrastructures and mobility of researcher are all included. This vision of the future represents more than simply a reassertion of the objectives of FP6, and is intrinsically linked with the aims of the Lisbon Agenda and a re-evaluation of the role that research must play in achieving these goals. During this planning exercise the EC is soliciting opinions from Member States and all key research stakeholders in the EU, including via Web-based public consultations.

The EC's technical services responsible for the EURATOM FP are also considering how future EU funding can best be used in the field of nuclear science and technology. In the area of geological disposal, the most important stakeholders are the national radioactive waste management agencies, responsible for the management of waste arisings and the implementing of national waste management programmes. As such, they are the “drivers” behind the lion's share of the research effort in the EU and are involved in the majority of the projects at EU level, certainly those involving research in URLs.

However, it should be appreciated that all agencies are under constraints imposed on them by their national circumstances. Important differences exist between countries as a result of the varying degrees of progress in the development of disposal systems, the choice of host rock and the differing regulatory requirements imposed by governments and national safety authorities. The most marked differences are between countries with identified sites and those with no clear policy regarding long-term management. This highlights the need for decisions to be taken at the political and strategic level as well as at the level of research priorities.

Key Considerations for Future EU Support

The key, therefore, to a successful programme of EU support – with its emphasis on co-operation – is flexibility. The waste agencies generally acknowledge that there are clear benefits from further integration and co-operation, though they need to be able to set the agenda and decide how far this should go, and be assured that the benefits of participation outweigh any disadvantages. Clearly their number one priority remains their respective national programmes, and EU support should help rather than hinder them in this respect. After all, the sooner there is

an operating repository somewhere in Europe the easier it should be, certainly from the point of view of public and political opinion, for other countries to follow suite.

In fact, there are already several important bi- or multilateral collaborative actions between national programmes in Europe. Such collaboration exists because of common strategies (e.g. host rock) or through sharing of facilities such as URLs, though often could be better formalised. The EC considers this to be a useful basis on which to build part of the support effort in FP7.

Though the new instruments introduced in FP6 are administratively very heavy, requiring significant financial and human resources, there is also widespread agreement on a range of benefits, such as enabling access to a wider infrastructure and knowledge base and the positive integrative effect the projects can have in working practices. In this respect, it is important that the co-operation established in the current IPs be built upon in future, thus ensuring continuity in the R&D effort and avoiding the need to set up new consortia from scratch. This need for continuity is stressed by all involved in the R&D effort in this field.

A Critical Issue – Knowledge Management

A recurrent topic in all aspects of the EURATOM fission programme concerns knowledge management in its various forms; indeed, the Lisbon Agenda stresses that this is of key importance to the whole EU research effort. It is of particular significance in the case of geological disposal because of the extremely long timescales over which the research effort needs to be maintained. In its broadest interpretation, this topic covers such aspects as

- inventory of past/ongoing research;
- detailed critical reviews, either of past/ongoing research or proposed future research;
- knowledge dissemination and transfer, involving not only distribution of reports but also access to scientific and industrial techniques, with due consideration of such aspects as commercial implications and intellectual property rights;
- education and training in general.

For example, in the context of the present status of waste management programmes, there have been calls to set up a review mechanism to assess the extent and “suitability for purpose” of past and current R&D. For some national waste agencies it is also a question of having access to the knowledge acquired and techniques developed in other national programmes or facilitating transfer of knowledge from more advanced programmes to developing programmes. This is especially important for the new EU Member States and those countries still at a more conceptual level. Waste agencies in particular feel strongly that the R&D effort should remain “objective driven”, and any review mechanism that is set up should have the ability to prevent a line of research from continuing unnecessarily. However, this must be balanced by the need to challenge the state-of-the-art in any topic, especially in a field in which the degree of public concern requires no stones to be left unturned.

Introducing Technology Platforms

The concept of knowledge management is of course closely linked with co-operation and how to optimise the relationship between the respective waste agencies and other key players. Among the new funding instruments, the NoE especially is aimed at encouraging the partners to enter into a profound and, hopeful, irreversible programme of integration. However, there are other ways to enhance the necessary co-operation amongst research partners; one that is currently being promoted as a solution to at least some of Europe's research problems is the technology platform. There are already several "platforms" in existence in other research fields, though it is too early to know whether they can be effective in all circumstances.

Essentially a platform should bring together all the key research stakeholders in a particular sector – industry, academia, regulatory authorities, research community, national research coordinators. This "forum" will then be responsible for the planning of the future research agenda in this field and then implementing this agenda. The stakeholders need to decide amongst themselves how best to conduct future research and must bring their own research programmes under the control of platform. Indeed, the original idea behind such platforms was that they should enable more private funding to be brought to key areas of research, in line with the Barcelona objective of raising research spending to 3% of GDP. However, the platform concept has turned out to be a much more flexible mechanism than first imagined, being adaptable to the peculiarities of different sectors. Clearly, though, well-defined ground rules need to be defined and high-level participation from the partner organisations is essential, especially when committing these organisations to follow the platform's agenda. Above all, the stakeholders need to have a shared vision regarding the direction in which the research should go and be willing to collaborate in order to further the platform's agenda.

A technology platform is not an EU funding instrument per se. Indeed, since it is not a legal entity it cannot receive direct funding, though if the conditions were right and the motivation sufficient one could imagine a platform evolving into a sort of joint venture company with its own legal status. The EC can be instrumental in providing the initial impetus and high-level political support needed to start up a platform, and once the research agenda has been agreed it would be a simple matter for the EC to orient the FP Calls for Proposals to fit in with this agenda. In this way, the EU can bring a significant degree of support to the platform's activities, though it must be stressed that a platform is not merely a lobby group to obtain EU funding, each of the stakeholders must contribute his own research effort if success is to be assured.

In the field of geological disposal there are several aspects of the research effort in Europe that lend themselves to management via a technology platform. First and foremost, the main end-users – the waste management agencies – are well defined and there is broad agreement amongst them on the common objectives. This vision is also shared amongst the other research stakeholders – for example the principal research institutes – and is reflected in national programmes (even though geological disposal is not yet officially identified as the favoured management option in a few countries). There is also a good degree of co-operation in ongoing projects, and the relatively small number of URLs also promotes a converging of national research programmes. A technology platform could also enable an exchange of experiences, sharing of technology and planning of research tasks of common interest (as well as identifying issues that are of purely national or bilateral interest).

The important work carried out in the FP5 project NET.EXCEL [7] has shown that a greater degree of integration is possible, and a follow-up study may be launched next year as part of the final Call in FP6 in order to elaborate further the ideas on knowledge management in general. Crucially, a mechanism, whether it is a technology platform or another concept, must be found that is capable of handling national programmes with different requirements (as a result of particular priorities, state of advancement, etc.). For example, a research programme could consist of a suite of components from which participants could choose the most appropriate for their needs. One aspect that requires careful consideration is the involvement of the safety authorities and how or indeed whether to include them in any future network or platform. As key stakeholders they need to be involved in some way, though the question of independence is also crucial and is closely linked with their credibility in the eyes of the public. One option used in platforms in other areas is to create a parallel “mirror group” with, say, interactions on a regular basis with the main platform of implementing organisations. Another important aspect that needs careful consideration is the question of intellectual property rights and the commercial basis, or otherwise, of the relationship between partners.

In the planning of future EU research, it is also clear that the new EU Member States have specific problems. R&D programmes are in general less well advanced in these countries and the waste agencies, if they exist at all in these countries, have fewer resources, all of which makes it difficult for them to participate on an equal footing in the latest IPs being launched in FP6. However, they still have a need for the results from this research, and this is closely linked with the issue of knowledge management and sharing of experiences. In addition, since national waste management programmes in these countries tend to be less well established than in Western Europe, there could be possibilities for enhanced integration between these countries, certainly at the level of R&D but also on more strategic matters – especially since the new Member States also tend to have smaller nuclear programmes. SAPIERR, in the current batch of on-going FP6 projects (Tables II and III), is looking at these very issues.

The “Nuclear Package”

Even though the EU’s research activities in geological disposal are being tailored to the new strategic requirements for EU research as whole, they must at the same time confront the specific challenges related to the very nature of the topic itself: the technical complexity and multidisciplinary nature of the research, the different degree of advancement in the various Member States, the extremely politically sensitive nature of the subject and the absence of agreed policy in certain countries. The EC has for some time recognised the need for clear political leadership in helping to resolve waste issues in Member States and is employing its power of initiative enshrined in the EURATOM Treaty to promote new legislation obliging Member States to take the necessary commitments.

Over the last two years, the energy policy wing of the EC has been actively promoting this new legislation. The famous “nuclear package” of proposed legislative measures was originally adopted by the EC in January 2003 [8], and a revised version, taking into account many of the comments of the European Parliament and Member States, was adopted by the EC in September 2004 [9]. To become European Law, these measures must have the backing in the EU Council of Ministers of a qualified majority of EU Member States; something that has yet to be achieved, largely because of the opposition of Germany and the UK^b. Nonetheless, the EC is still hopeful

that the changes introduced in the revised version of the package will convince Member States to accept the measures. One particular requirement appearing in the revised version concerns a reference to the need for more – and better – research on radioactive waste management. The EC's concern was two-fold. First, the funding by Member States of research on radioactive waste management was – and still is – inadequate. Second, the research being undertaken could be more effectively co-ordinated. This also responds to a criticism from the European Parliament, following their debate on the initial package towards the end of 2003, that the need for research should be given more prominence in the proposed legislation.

Research Funding in the EU Member States

It is difficult to estimate reliably exactly how much money is spent on research in this field by the EU Member States. During the initial drafting of the “nuclear package” the EC's technical services attempted to obtain this information, though in only a few countries is it readily available. In addition, the definition of what constitutes “research” is crucial – in the EU context, research is taken to mean “research, development and demonstration” (RD&D), which would just about cover all activities currently ongoing in the area of geological disposal in Europe. With this in mind, the EC looked at those countries with the most advanced (or extensive) national programmes, and derived an estimate of the amount of money being spent in relation to the nuclear electricity generated. It was found that Finland, Sweden and France all spend around €500,000/year for every terawatt-hour of nuclear electricity they generate. This is probably very similar to the level of expenditure in the USA, and is considered a reasonable application of the “polluter pays” principle. Note, though, that the USA has only one programme investigating one potential site, as opposed to three programmes and three or more potential sites for the three EU countries listed. In addition, the level of research spending in the other EU Member States is often woefully inadequate in comparison. One reason is the current indecision regarding preferred long-term management options in one or two countries, or a policy of “wait and see” in others. This underlines the need for political initiatives in all countries confronted with waste management problems, and the establishing of clear programmes for the management of all radioactive waste. This not only is a question of adequate research spending, but also involves defining responsibilities and establishing robust financing mechanisms and definite timetables.

For those countries currently with less advanced – or absent – national programmes, the EURATOM FPs are a lifeline enabling them to remain in touch with the current research effort^c. When these countries are in a position to develop further their national programmes, the involvement in EU research will hopefully enable them to gain a kick-start and benefit from the progress in the more advanced Member States. However, this presupposes that a mechanism is in place to permit this sort of exchange. Unfortunately, even in the EU, there is a tendency for national programmes (in any area, not just research) to reinvent the wheel rather than learn from the experience in neighbouring countries. Hopefully, the co-operation that is currently well ingrained in much of the radioactive waste research community will prevent valuable resources being devoted to repeating previous work. This is where a mechanism ensuring appropriate knowledge management, such as a technology platform, could be extremely effective, and is one of the reasons why such a mechanism is being championed by the EC's services.

The Wider Political Considerations

What are the broader political and strategic motives behind the EU's funding of research on radioactive waste? Indeed, what justification is there for spending any EU money in this field? Here we enter into a much more political and, in some respects, contradictory field. After all, the "polluter pays" principle is held up as an ethical rule in the management of radioactive (indeed all) waste, so what is the argument for devoting large sums of public money to the cause?

In the EC's Green Paper on security of future energy supply of November 2000 [10], the issues were clearly laid out and the choices starkly presented. The arguments were presented thus: nuclear power must be retained as an option in the EU's energy mix for environmental (absence of CO₂ emissions) and security / independence of supply reasons; the controversy surrounding the management of high-level waste needs to be resolved in order to enable nuclear power to retain its place in the energy mix; ergo more research – and better co-ordination between research efforts – is needed to (help) solve the outstanding technical issues, with political initiatives at both Member State and EU level required to set strategic priorities and put programmes in place.

These arguments are at the origin of the measures later proposed in the "nuclear package", together with the overriding concern to ensure and maintain high levels of nuclear safety, especially in the context of EU enlargement and the adhesion of the new Member States. These policy initiatives are a clear indication of the EC's political thinking on future energy supply and nuclear safety, and provide important political endorsement of the research priorities within the EURATOM FP. Further support for this research effort comes from the European Parliament and the Member States through the Council of Ministers, though for politicians and Member States alike there remains an extreme political sensitivity surrounding all things nuclear.

The EURATOM FP is instrumental in imposing a common European view on all aspects related to geological disposal; this has important benefits for efficiency of the research effort and cross-border harmonisation of proposed solutions. It is possible, even likely, that before the first disposal facilities are commissioned in Europe there will be common safety standards for their operation established in EU law (based, presumably, on IAEA recommendations). With this in mind, it is essential to develop common approaches for dealing with fundamental issues of nuclear safety in relation to geological disposal. This highlights that not only must the research community be concerned by this drive for enhanced co-operation and integration, but also the national regulatory authorities need to be involved, especially when it comes to research projects dealing with performance and safety assessment. EU legislation dating from 1985 and 1997 has already harmonised approaches to environmental impact assessment (EIA) across the EU; together with more recent EU legislation on strategic environmental assessment and amendments to ensure conformity with the Aarhus Convention, there is now a solid body of legislation in place at the EU level that can ensure equivalent approaches to implementation of controversial projects with potential for environmental impacts. However, only through a similar harmonised approach to nuclear safety and radioactive waste management issues can the concerns of the public at large be addressed.

CONCLUSIONS

- The EURATOM FP is providing an essential service to Member States in the field of geological disposal and is encouraging greater collaboration between waste agencies and other research organisations.
- The current FP6 projects are ambitious and far reaching undertakings that, through significant investments of public money, are contributing to major advances in the research effort as well as bringing about a restructuring of the research community in this field.
- These projects represent a continuation of the previous research effort in this domain and build on the success of work in earlier FPs; the current programme is also consistent with the wider political and strategic objectives of the EU as whole, both as regards nuclear safety and energy and research policy.
- However, this programme cannot itself ensure success in this field and there is need for Member States to take the necessary political initiatives, thereby guaranteeing, among other things, an adequate level of research spending across the EU. At the same time, future EU research policy in this field must stimulate and encourage even greater co-operation between key stakeholders in the research field – especially waste management agencies, but also regulators and national research programme managers.
- To achieve this degree of close collaboration, a suitable mechanism must be found that caters for national programmes of different speeds, but also allows the slower Member States to benefit from advances in other countries. These general issues of knowledge management are crucial to this future research effort, and one possible mechanism could be the technology platform, which is already being widely implemented in other domains of EU research. In this regard, the support and enthusiasm of the waste management agencies is essential.

REFERENCES

1. The EURATOM Treaty: <http://europa.eu.int/abc/obj/treaties/en/entoc38.htm>
2. “Geological Disposal of Radioactive Waste Produced by Nuclear Power ... from concept to implementation”, EUR21224, Office for Official Publications of the European Communities (2004) (ftp://ftp.cordis.lu/pub/fp6-euratom/docs/waste_disposal_eur-21224_en.pdf)
3. Communication from the Commission, COM(2002)565, 16/10/02, “The European Research Area: providing new momentum - strengthening - reorienting - opening up new perspectives” (http://europa.eu.int/eur-lex/lex/LexUriServ/site/en/com/2002/com2002_0565en01.pdf)
4. “EURADWASTE'04 -Radioactive waste management. Community policy and research initiatives”, Proceedings of the sixth EC Conference, Luxembourg 29 March - 1 April 2004, EUR21027, Office for Official Publications of the European Communities (2004) (http://www.cordis.lu/fp6-euratom/ev_euradwaste04.htm)
5. “Evaluation of the effectiveness of the New Instruments of Framework Programme VI”, Report of a High-level Expert Panel chaired by Professor Ramon Marimon, 21 June 2004 (http://www.cordis.lu/fp6/instruments_review/)
6. “Science and technology, the key to Europe's future - Guidelines for future European Union policy to support research”, Communication from the Commission, COM(2004)353, 16/6/04 (http://europa.eu.int/eur-lex/lex/LexUriServ/site/en/com/2004/com2004_0353en01.pdf)
7. Christer Svemar et al, “NET.EXCEL Thematic Network: Networking for Research on Radioactive Waste Geological Disposal”, paper presented at EURADWASTE'04, Luxembourg, 29 March - 1 April 2004 (http://www.cordis.lu/fp6-euratom/ev_euradwaste04_proceedings.htm - see Session VIII)

8. Proposal for Council Directives (EURATOM), Communication from the Commission, COM(2003)32, 30/1/03
(http://europa.eu.int/comm/energy/nuclear/safety/new_package_en.htm)
9. Amended Proposal for Council Directives (EURATOM), Communication from the Commission, COM(2004)526, 8/9/04
(http://europa.eu.int/comm/energy/nuclear/safety/new_package_en.htm)
10. Green Paper: “Towards a European Strategy for the Security of Energy Supply”, European Commission, Office for Official Publications of the European Communities (2001)
(http://europa.eu.int/comm/energy_transport/en/lpi_lv_en1.html)

FOOTNOTES

- ^a The views expressed in this paper are those of the authors and do not necessarily reflect those of the EC.
- ^b For a fuller presentation on the nuclear package, refer to paper “Radioactive Waste Management in the European Union – Progress Towards New Legislation” by Derek Taylor, also presented at WM'05.
- ^c Over the last few years, the EURATOM programme has probably accounted for some 5 – 8% of the total research funding (public and private) in this area in Europe.