

ICEM07- 7108

EUROPEAN CONCEPTS FOR SHARED STORAGE AND DISPOSAL FACILITIES FOR RADIOACTIVE WASTES?

Ewoud Verhoef, COVRA the Netherlands

Hans Codée, COVRA the Netherlands

Vladan Štefula, DECOM Slovakia

Charles McCombie ARIUS Switzerland

ABSTRACT

Geological disposal is an essential component of the long-term management of spent fuel and high-level radioactive waste. Implementation of a suitable deep repository may, however, be difficult or impossible in some (especially small) countries because of challenging geological conditions or restricted siting options, or because of the high costs involved. For these countries, shared regional or international storage and disposal facilities are a necessity. The European Parliament and the EC have both expressed support for concepts that could lead to regional shared facilities being implemented in the EU. The EC therefore funded two projects that form the first two steps of a staged process towards the implementation of shared regional or international storage and disposal facilities.

In the period 2003 to 2005, the EC funded SAPIERR I, a project devoted to pilot studies on the feasibility of shared regional storage facilities and geological repositories, for use by European countries. The studies showed that shared regional repositories are feasible, but also that, if they are to be implemented, even some decades ahead, efforts must already be increased now. The first step would be to establish a structured framework for the work on regional repositories.

This is the goal of SAPIERR II (2006-2008): to develop possible practical implementation strategies and organisational structures. These will enable a formalised, structured European Development Organisation (EDO) to be established in 2008 or afterwards for working on shared EU radioactive waste storage and disposal activities. The EDO can work in parallel with national waste programmes. Participating EU Member States will be able to use the structures developed as, when and if needed for the furtherance of their individual national policies.

INTRODUCTION

It has been increasingly acknowledged over the past years that regional or multinational repositories can potentially increase safety, security and economics of radioactive waste disposal. Although there are sound environmental, safety and

security reasons for disposing the radioactive waste in national geological repositories as soon as possible, there are also good reasons why this will not take place in all countries.

For countries with small nuclear power programs, economies of scale will force them either to implement long-term storage and wait for decades, or to share a repository with others. Implementing a small repository and operating it for very long times is very costly. The need for supranational surveillance also points to shared solutions and there are past and current examples of countries being prepared to accept radioactive waste from others if a better environmental solution is thus achieved. Although the European Parliament and the Commission have both supported the concept of shared regional repositories in Europe, (national) political and societal constraints have hampered the realisation of such facilities up to now.

If storage and disposal facilities for radioactive wastes are to be shared, a long, phased or staged process has most chance of success, as demonstrated by the most successful national projects. Such a process should not conflict with any national programme goals or prematurely commit the participants to a shared repository. In this way, small nuclear programmes will have an alternative approach that can, if desired, be run in parallel with national activities. Larger nuclear programmes that have decided on a purely national disposal programme can make their expertise available to regional repository initiatives. They can also point out to their local populations that other Member States are seeking independent shared solutions, so that compulsory import of wastes is not a threat to any national programme. This paper describes the first two steps of such a staged process.

SAPIERR I

In the period 2003 to 2005, the EC funded project, SAPIERR-1 (Support Action on a Pilot Initiative for European Regional Repositories), was devoted to pilot studies on the feasibility of shared regional storage facilities and geological repositories, for use by European countries. SAPIERR-1 was

designed to help the European Commission clarify basic questions affecting the issue and to identify new research and technical developments that may be needed to implement regional solutions to European radioactive waste disposal. The official co-ordinator of SAPIERR I was DECOM Slovakia.

Twenty-one organisations from fourteen countries took part in the SAPIERR-1 project, which addressed legal aspects, inventory questions and possible options and scenarios for regional disposal. The main activities within the project were:

1. reviewing the international and national legal or regulatory issues that would affect implementation of regional storage facilities or repositories
2. constructing a reference inventory of the radioactive wastes arising in all of the 14 countries from which organisations joined the SAPIERR working group
3. evaluating potential designs, implementation timescales and likely costs for shared regional repositories, based on existing documented data on European national programmes
4. looking at potential scenarios for organising the implementation of European regional repositories
5. identifying those aspects that require further study or research before proceeding further.

Legal aspects

The implementation of a regional repository would almost certainly necessitate changes in a number of national legal systems [1]. The various national attitudes towards shared disposal concepts are often reflected in the policies and in the legal / regulatory framework of the countries. Many countries currently ban import of wastes for disposal (e.g. Austria, Croatia, Czech Republic, Finland, France, Hungary, Latvia, Lithuania). Very few legally ban export; Finland is an exception. A few explicitly acknowledge the possibility of import or export and some have no formal position. A few countries (e.g. Switzerland) have already formulated rather detailed conditions under which import or export of wastes might be permissible.

At an international level, organisations such as the EC and the IAEA, have officially given support to the concept of regional repositories. Reservations or opposition have been expressed by some major programmes seeking a national solution. It seems clear that more international support for shared disposal facilities could help build acceptance for the concept. The EC and IAEA could help by making more specific the necessary legal and contractual frameworks.

Issues of liability, control, inspection, finances, etc. can be regulated in bilateral or multinational contracts. It would be, however, very sensible if such contracts or treaties were to be concluded with support and guidance from an international body such as the EC or the EU.

Economical aspects

In the SAPIERR project, diverse international cost estimates that have been published for spent fuel have been compared. The costs of geological disposal are high (80,000 to 1,200,000 €/ton of spent fuel) and only partially dependent on the amount of waste disposed of. Because of this, geological disposal is disproportionately expensive, sometimes even impossible, for countries with small nuclear power programmes or with only nuclear activities other than power production. In

those countries the volume of waste is too small to justify or finance a national repository. Long-term storage to accumulate enough waste and financial resources, or sharing repositories with other countries are the only alternatives. Figure 1 shows the economic benefits of shared, multi-national repositories.

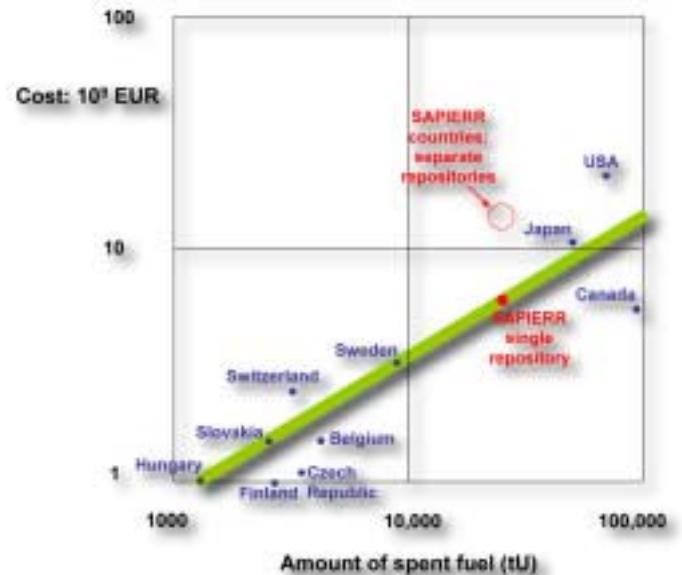


Figure 1: Deep repository costs as a function of quantity (spent fuel only)

Even for countries with larger nuclear programmes, co-operation and sharing could be attractive. A shared repository not only pools technical and financial resources, but also provides a wider choice of suitable geological formations and guarantees international supervision.

Inventory, concepts and timing

In order to evaluate potential designs, implementation timescales and likely costs for shared regional repositories certain simplifying (although rather unrealistic) assumptions have been made:

- No new nuclear power reactors will be built in the SAPIERR countries.
- The existing ones will operate to the end of their operational lifetimes and will be decommissioned immediately afterwards.
- There will be no plant life extension at the operating reactors.

Based on these assumptions, the combined inventory of spent nuclear fuel, high-level radioactive waste, and long-lived intermediate-level radioactive waste from all the SAPIERR countries can be estimated [2]. Using three standard sized containers, the number of spent fuel containers could be estimated at approx. 13,000 (see fig. 2). This is a relatively large repository - c.f. Sweden: ~6000 containers; Finland ~1500 containers. Similar standardization of packages for HLW and partially also for ILW was assumed in order to analyze options for a single repository for all the waste and separate repositories for spent fuel and ILW in terms of optimum point in time, when they should be available and in terms of size and costs.

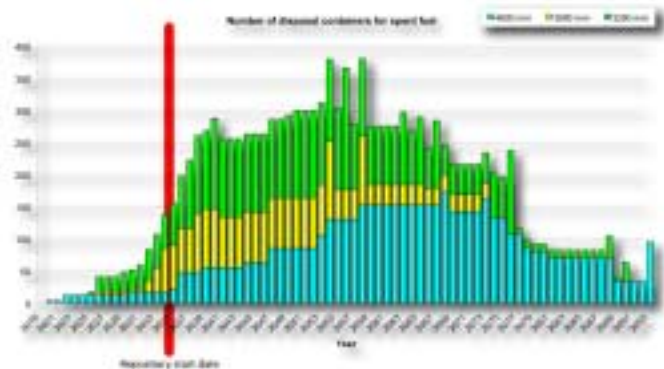


Figure 2: Production of spent fuel in SAPIERR countries, when spent fuel is packaged after 50 year storage

It was decided to use mature repository design concepts, one for hard rock and one for sediment, that represent the main trends in European repository development at present, and to focus on horizontal emplacement. The latter was chosen for ease of emplacement of SNF packages.

Figure 2 shows the optimum time for a regional repository would be around 2035; this would avoid the need for large SNF buffer storage facility. Calculating back from this time - allowing 5 years to gain operational experience and handle the small backlog of cooled spent fuel (~300 packages) then available - an encapsulation facility should be commissioned in 2030. Allowing 20 – 25 years for siting and site investigation, the development of a regional repository should start around 2010 – 2015.

Research and development

The study on options and scenarios was complemented by identification of requirements on trans-national research and development to be carried out in future; such an output is a requirement of the Support Action instrument. The following requirements have been defined:

TECHNICAL AND ENGINEERING REQUIREMENTS

- Improvement/coordination of national inventories
- Encapsulation of spent fuel or HLW
- Conditioning and packaging of other long-lived wastes
- Design of repository systems for multinational use
- Transportation studies

GEOLOGICAL AND ENVIRONMENTAL STUDIES

- Safety Studies
- Compilation of siting criteria for geological repositories
- Integrate geological screening studies from SAPIERR countries
- Contribution of investigations in underground laboratories

SOCIO-POLITICAL STUDIES

- Public attitudes to geological disposal and to shared repositories
- Harmonisation of legal and regulatory issues
- Compensation of hosts
- Review of current exchanges of toxic wastes in the EU

INSTITUTIONAL FRAMEWORK

- Security of storage and disposal facilities
- EU legal and legislative study

- Structures for a multinational disposal organisation
- Costs and financing
- Coordinated project planning

The top priority items are related to the institutional framework to be established since increased activities could then be set into an overall systematic approach. This would entail proposals to coordinate national plans of countries interested in regional solutions and to establish efficient, transparent structures for guiding and executing future projects.

Scenario

A potential scenario for realisation of a European regional repository has been postulated by the SAPIERR project (table 1). It is a “partner scenario” which is laid out below as a series of sequential steps. It is interesting that they do not differ greatly from steps taken within a federally organised state to seek a national disposal solution. A very preliminary timescale is suggested for each step.

Table 1: Preliminary schedule for the implementation of a shared multi-national repository

Step	timescale
1	Pilot feasibility studies – 2010
2	Formalised consortium 2008 – 2012
3	Regional Repository Project Team 2010 – 2015
4	Siting studies for candidate siting areas 2015 – 2025
5	Establish business consortium or joint venture 2020
6	Establish construction & operation company 2025
7	Repository operation 2035 – 2095
9	Closure and post-closure 2095 –

Conclusions

SAPIERR succeeded in its objectives to bring together the interested representatives from multiple countries and to outline the issues associated with a potential European regional repository, including the proposal for further RTD under the European Commission Framework Programmes. The top level conclusions drawn from the SAPIERR-1 project were [3]:

- The potential benefits of multinational, regional repositories are recognized widely throughout the EU.
- The most obvious benefits are in the economic area, where shared repositories would lead to substantial reductions in expenditure throughout the Community.
- Many or most of the problems faced by regional repository initiatives are common to those being tackled by national disposal programmes, in particular concerning the task of siting the facility.
- If shared regional repositories are to be implemented, even some decades ahead, efforts must already be increased now.
- Before greatly enlarging the scale of the work on regional repositories, a structured framework should be established.

SAPIERR II

SAPIERR II (Strategic Action Plan for Implementation of European Regional Repositories) builds on the pilot studies of SAPIERR I to develop options for organisational frameworks and project plans that could lead to the establishment of an

EDO: a European Development Organisation for European regional repositories. To clarify issues related to the structure and future programme of the potential EDO, a series of specific studies are being carried out on organisational structures, legal liabilities, economics, safety and security and public and political acceptability. The options distilled from these studies will be presented and discussed at a workshop for interested countries and organisations, in order to identify potential end-users and to achieve consensus on a preferred way forward: the first steps of implementation or a further programme of preparatory work.

The formal partners in the SAPIERR-2 project are ARAO of Slovenia, Arius of Switzerland, COVRA of the Netherlands, Decom of Slovakia, ENEA of Italy, Enviros of Spain, RATA of Lithuania and SAM of the UK. Organisations from further European countries have been invited to participate in an associated working group. Through its partners and the invited organisations, the project has access to national data and also to experienced European expert organisations. The official co-ordinator of SAPIERR II is COVRA, with the technical management being shared by Arius.

Activities

The work plan is designed so as to fulfil the principal objectives. The first of these, proposing potential structures and project plans for a European Development Organisation (EDO), requires input from a number of specific studies that together form the second prime objective. The final objective, achieving sufficient consensus on a preferred way forward, should be achieved through interactions and a closing workshop together with bilateral discussions with potential participants in an EDO.

The tasks proposed in the projects are listed and described below. Each task translates into a work package (WP) within the work plan:

1. Preparation of a management study on the **legal and business options** for establishing a European Development Organisation (EDO) leading to one or more proposed frameworks (options) for such an organisation. Possibilities include a Joint Undertaking, a Joint Venture, a Consortium, a dedicated Company, an Association, etc.

2. A study on the **legal liability issues** of international waste transfer within Europe. Even in national disposal programmes, the issues associated with long-term transfer of liabilities are complex. For a regional repository, the challenges are still greater. Immediate transfer of all liabilities and shared responsibilities reaching out to far future times are two extremes that bracket the possibilities to be considered. This issue is important not only for the sharing scenario being pursued by the SAPIERR project, but also outside the immediate scope of the project, should the alternative "add-on" scenario, in which a large nuclear programme inside or outside the EU agrees to accept wastes from other countries also become relevant. In the latter case, elucidation of liability issues will also be of value to the EU.

3. A study of the potential **economic implications** of European regional storage facilities and repositories. The study will analyse the economic implications for potential users of such facilities and also for host countries. This will involve analysing existing costing studies, considering the possible schemes for financial and other compensation measures for a

host country and proposing possible financing mechanisms that equitably share the costs of all development work between the interested parties.



Figure 3: Schematic overview of SAPIERR work plan

4. Outline examination of the **safety and security impacts** of implementing one or two regional stores or repositories relative to a large number of national facilities. The radiological safety comparisons will be based on existing performance assessments. The considerations should cover operational safety, long-term safety and also transport. The examination of security considerations will involve initial identification and assessment of issues based on literature and views of experts.

5. A review of **public and political attitudes** in Europe towards the concept of shared regional repositories. This will be based on input from literature studies by representatives of organisations participating in SAPIERR-2, complemented by a review by project team members of the situation in other European countries. An overview will also be prepared on how national programmes now and in the past have tried (or not tried) to encourage public participation in nuclear decisions. The work is linked to Work Package 3 since public attitudes can be strongly affected by local and national benefits.

6. Development of a **Strategy and a Project Plan** for the work of the EDO. The first tasks of an EDO would be agreeing a progressive, slow, staged strategy that would lead to the definition of potential host countries and eventually, to potential repository sites and definition of a parallel science and technology programme that could be addressed by the EDO after its initiation. Obviously the initial stages of the strategy and plan will be specified in more detail during the project; but the entire Plan will be a living document to be updated using input from the studies performed and from the supporting organisations. It is expected that the Plan will be based upon

the scenario that the EDO may, after some period, if the participants so decide, convert from a development organisation to a multinational, shared waste management implementation organisation.

7. **Management and dissemination** of information. Contact and consultation with appropriate national bodies and with EC staff is essential to gather the necessary policy and technical input for the project and before judging the feasibility of any proposals for future collaboration. An important component is a final broadly based workshop under the auspices of the EC to present the options to interested countries and organisations, in order to identify potential parties in further collaborative efforts, to achieve consensus on a preferred way forward, and to agree the first steps in its implementation.

Expected Results and outlook

The first project meeting took place in Baden on 29th November 2006. The aims of the project and work plan were reviewed. The next meeting of the SAPIERR project participants will be in the Netherlands on 6th – 7th June 2007 and will primarily be considering progress on the study of the legal liability issues of international waste transfer within Europe (which will be close to completion) and the economics, safety and security and political and public issues of shared solutions. The working group participants will meet a second time, towards the end of the project, to present and discuss progress and coordinate efforts between the work packages.

The project is to be concluded with an international seminar in Brussels in 2008, open to anybody interested in the topic. Currently virtually all EU countries, even those with very small nuclear programmes, are under pressure to try to follow purely national programmes, even though the EC and the European Parliament have supported the concept of regional facilities. In fact, the potential contribution of regional facilities to increasing safety, security and economics of disposal has been increasingly acknowledged over the past few years, by various international organisations and also by some national disposal programmes that themselves do not wish to participate in such shared facilities. The objective of the seminar will be to review and disseminate results of the project to a wide audience and to achieve sufficient consensus on a preferred way towards a European Regional Repository.

At the end of the project, the SAPIERR shared storage and disposal concept will have been developed to a level where either:

- future work could be handed over to the suggested new multinational EDO, thus establishing a firm basis for progress, or

- content and timing are defined for further actions required before an EDO can be established or
- the participants conclude that further efforts are not productive in this area at this time.

Any of the three of the potential outcomes mentioned in section 3 would have a large impact on subsequent European work on disposal and hence on public attitudes to nuclear power. If an EDO were to be established soon, then intensive co-operation leading to significant cost reductions could result. If further study is needed this will also be done through co-operation between countries. If it is decided that regional repositories are not realistic, pressure will increase on various small EU countries to initiate or build up national disposal programmes.

The project can also promote the harmonization of standards governing the implementation of geological repositories and other facilities. A regional facility will have to satisfy the safety standards not only of its host country, but most likely also of all of the user countries. Precedents already exist for national policies which lay down that any facility to which waste is exported must satisfy the standards of the exporting country.

REFERENCES

- [1] Christina Boutellier, Charles McCombie: Legal Aspects, SAPIERR report – deliverable No.2, August 2004, <http://www.sapierr.net>
- [2] Vladan Stefula: Inventory, SAPIERR report – deliverable No.1, September 2004, <http://www.sapierr.net>
- [3] Neil Chapman, Charles McCombie, Vladan Stefula: Possible Options and Scenarios of Regional Disposal and Future RTD Recommendations, SAPIERR report – deliverable No.3, September 2005, <http://www.sapierr.net>