

PROGRESS WITH MULTINATIONAL REPOSITORY CONCEPTS

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ABSTRACT

Since the beginning of this decade, there has been a resurgence of interest in multinational disposal concepts, after early 1970s proposals for such facilities remained undeveloped for many years. Increased nuclear security and proliferation concerns have made obvious the need to keep radioactive and fissile material under close control at all times – including the period after these have been declared as wastes to be disposed of in geological repositories.

The past years were marked by strong support from multinational organisations for shared repositories. In particular, the IAEA published an overview on the topic, emphasised the potential advantages in several top-level speeches and also initiated a high-level international expert evaluation group on Multinational Approaches (MNA), that considered initiatives for both the front- and back-end of the fuel cycle. The European Commission (EC) also included the topic of shared regional European repositories in the Nuclear Package of legislation that it is trying (as yet unsuccessfully) to put through parliament. More specifically, the EC provided direct support for the multinational project SAPIERR which involves a working group of representatives from 14 nations in a pilot project on regional repositories in Europe. Further international cooperative efforts have been organised by the not-for-profit Association, Arius, which currently includes organisational members from 8 countries.

In addition to the above initiatives based on “partnering” concepts, one major nuclear nation, Russia, has expressed interest at governmental level in possibly hosting an international repository. In 2005, two international meetings took place to discuss this initiative further.

INTRODUCTION

Virtually all countries in the world with nuclear power programmes have concluded that geological disposal is a necessity, if we are to make the nuclear fuel cycle safe and environmentally acceptable without putting undue burdens on future generations [1]. There will be no SNF/HLW repository in operation until the next decade and many countries are looking towards the middle of the century.

For the larger, advanced nuclear programmes the problems are mainly societal issues associated with achieving sufficient public and political acceptance for specific sites for a national repository. For small countries, however, or countries with limited nuclear power programmes or countries with no nuclear power but long-lived wastes from other applications, a national deep geological repository may be ruled out on economic or practicality grounds. If SNF and HLW are not to remain dispersed for indefinite periods in dozens of surface stores around the world, these small countries need access to geological repositories.

This implies that multinational facilities for disposal of SNF/HLW are a prerequisite for the sustainable, safe and environmentally friendly use of nuclear power and other nuclear applications. Other activities in the nuclear fuel cycle – uranium supply, enrichment, fuel fabrication, reactor construction, reprocessing – are all provided as international services. The same status must be achieved for disposal.

THE INCREASING IMPORTANCE OF NON-PROLIFERATION AND SECURITY

In addition to the economic, safety and environmental benefits that multinational repositories can offer, the non-proliferation advantages have often been stressed [2,3,4,5]. In recent years, in particular following the series of terrorist attacks from 2001 onwards, increasing attention has focussed on both non-proliferation and security aspects [6,7,8]. Repeated statements by the Director General of the IAEA have pointed out the need to control the most sensitive parts of the fuel cycle (e.g.). In speeches to the 2003 General Conference of the IAEA [16] and at the major Waste Management Conference in December 2003 in Stockholm, Director General Mohammed El Baradei pointed out the potential advantages of small countries sharing disposal solutions. Still wider attention to the issue was drawn by an invited article by El Baradei, published in the *Economist* in October 2003 [9], in which he states:

“..... we should consider multinational approaches to the management and disposal of spent fuel and radioactive waste. More than 50 countries have spent fuel stored in temporary sites, awaiting reprocessing or disposal. Not all countries have the right geology to store waste underground and, for many countries with small nuclear programmes for electricity generation or for research, the costs of such a facility are

prohibitive. Considerable advantages—in cost, safety, security and non-proliferation—would be gained from international co-operation in these stages of the nuclear fuel cycle. These initiatives would not simply add more non-proliferation controls, to limit access to weapon-usable nuclear material; they would also provide access to the benefits of nuclear technology for more people in more countries.”

It is important to note that non-proliferation efforts include controlling not only enrichment of fissile uranium and reprocessing, to separate plutonium, but also long term storage and disposal of SNF/HLW. This point is made clear in the February 2005 report published by the Multinational Approaches (MNA) Expert Group that ElBaradei set up in mid-2004 [10]. The MNA report addresses the security and non-proliferation issues in a manner directly applicable to all aspects of the nuclear fuel cycle, and suggests five specific approaches for multinational initiatives. The implications of these proposals for storage and disposal concepts are discussed below.

ASSURANCE OF NON-PROLIFERATION AND OF SUPPLY AND SERVICES

The MNA Group sets out as deciding factors influencing the assessment of multilateral approaches “assurance of non-proliferation and assurance of supply and services”. The former objective is clearly easier to achieve if multinational storage and disposal facilities can be made available. There are currently 35 countries with nuclear power plants (with more than 500 plants operating, being constructed or planned) and a total of 69 with research reactors. A total of 674 research reactors were operational, shutdown, under construction or planned in 1997, according to the most recent survey in the IAEA database (<http://www.iaea.or.at/worldatom/rrdb/>). Leaving spent fuel in all of these locations for many decades is obviously less proliferation resistant than collecting the material into a smaller number of facilities with very strong safeguards controls. In practice, the existing strict controls of the IAEA and EURATOM might even be enhanced by a further level of direct international control over a storage or disposal facility for SNF.

For the short and intermediate time frames, shared storage facilities alone would suffice to contain the proliferation risk. Shipping spent fuel removed from reactors to one of a few centralised facilities as soon as it has cooled enough for transport would be a sensible approach. Technically, with assured centralised interim storage, the question of implementing repositories could be postponed. There have been various proposals from potential hosts and user countries for shared storage facilities (see for example Bunn et al 2001; Ansolabehere 2003). However, in practice, as is strongly emphasised in the IAEA multinational storage report currently being drafted (IAEA 2005b), it will be difficult to transfer SNF/HLW to another country for storage without some clarity on the end-point of the agreement. Returning cooled spent fuel to many countries after several decades would simply reinstate the current proliferation risks of dispersed storage. Returning HLW from reprocessed spent fuel reduces proliferation risks by

retaining central storage of plutonium, but increases security concerns. Moreover, accepting returned HLW would compel small countries to seek national deep disposal solutions – in which case they may as well have retained the fuel for disposal.

In short the assurance of non-proliferation sought by the MNA Group is best attained by early implementation of shared storage facilities, with the essential ingredient of an agreed further step of disposal in multilateral repositories – either in the countries storing the waste or in a limited number of other volunteering host nations.

How could assurance of supply and services be guaranteed in a situation where many countries are relying on storage or disposal facilities being available in another country? One obvious answer is to have more than one multinational facility and thereby avoid the danger of creating a monopoly. An alternative or a complementary measure is to have direct international guarantees that avoid monopolistic behaviour. One way to achieve this is for the IAEA itself to guarantee continued provision of storage and disposal services. This could be done by establishment of specific internationally operated facilities, whereby agreements with the host country or countries would be required. An alternative is that the IAEA promotes binding arrangements between the service providers, ensuring that each will agree to taking over commitments of others, should these cease to provide promised services for storage or disposal.

The MNA Group recognizes in its report that there is currently no international market for storage or disposal. The assurance of non-proliferation sought by the MNA Group is best attained by early implementation of shared storage facilities, with the essential ingredient of an agreed further step of disposal in multilateral repositories – either in the countries storing the waste or in a limited number of other volunteering host nations. The MNA Group recommends that the IAEA supports the concept “by assuming political leadership to encourage such undertakings”. Specific ways forward are possible based on both of the multinational repository scenarios defined by the IAEA – “partnering” and “add-on” (by a large nuclear nation), as documented in TECDOC 1314 [2]. These possibilities are discussed below.

SCENARIOS FOR MULTINATIONAL APPROACHES TO DISPOSAL

The “add-on” scenario

The “add-on” scenario is one in which a large nuclear programme accepts wastes from smaller ones. There are several conditions that could enhance the probability of an add-on scenario being successfully implemented:

- The international community should recognise that any country offering storage or disposal services is potentially a contributor to global safety and security.
- A willing host country (or countries) must come forward, and should be able to demonstrate to the international

community that they have the necessary level of support for the project within the host country.

- Appropriate benefits for the host(s) must be agreed. These need not be purely financial; strategic and political issues may also be involved.
- The potential user countries of a multinational repository should develop mechanisms to assure that the safety standards in a multinational repository are not lower than those that each would accept for a national repository.
- International or supranational bodies (e.g. the IAEA or the EC) must be willing to play an active role in developing and controlling the multinational initiatives.
- Existing backlogs of stored spent fuel, HLW and LL-ILW must also be transferred, since complete avoidance of the need for an expensive deep repository will be the driver.

In recent times most discussion on the add-on option has revolved around concepts in which Russia acts as host country. Over the past few years, Russia has been seriously examining the issue of spent fuel import and is currently the only country supporting this at government level. However, at present, Russia is not legally able to provide disposal facilities as the essential adjunct to storage facilities – nor has the issue of US-flagged spent fuel import and storage by Russia been resolved. This is an area where there are expected to be significant developments in the next few years.

The “partnering” scenario

For the “partnering” scenario, in which a group of usually smaller countries cooperate to move towards shared disposal facilities, exploratory studies have been performed most recently by the Arius Association, which also co-manages the European Commission SAPIERR project on regional repositories [11,12].

The following stages can be envisioned for a partnering scenario. It is interesting to observe that they do not differ greatly from steps taken within a federally organised state to seek a national disposal solution.

Pilot feasibility studies: A sufficient number of interested national organisations cooperate to organise and fund pilot studies.

Establishment of a formalised study consortium and dedicated Regional Repository Project Team To progress to the detailed level of study needed, a structured project team must be created, staffed and funded at the appropriate level.

Siting studies leading to candidate siting areas in different partner countries: The siting study is clearly the most sensitive work area. Optimally, it should involve working in parallel on a volunteering strategy and on a technical/societal study aimed at ranking options and keeping multiple options open.

Establishment of a Business Consortium or a Joint Venture: The purpose of this organisation is to organise and fund the characterisation of sites, to finalise agreements on the key issue of compensation for host communities and countries, to select a short list of preferred sites and to interact with political and regulatory bodies in the candidate countries.

Establish a construction and operation company: This is specific to the hosting country or countries with respect to legal structures, shared liabilities, funding mechanisms, etc

Repository operation: During the decades for which the repository will operate, the relationships between the partners can be of various types. Given the nature of the facility, international oversight by the IAEA will be a necessity (and the EC for a European repository).

Closure and post-closure: At some time in the far-future, the multinational repository will be closed and possibly monitored for some long time. As with the shared benefits, agreements for sharing liabilities must be agreed long before this final stage is reached.

The scenario sketched above is one of many possible variants. At the heart of a successful project lies the siting issue. However, this is a difficult problem even in national programmes – but this has not prevented local communities in some countries agreeing to host repositories. The MNA group of the IAEA also recommends an initial cooperation phase, with participating countries working on a “Siteless Pilot Project” – which is, of course, the precise course taken by the European SAPIERR project described below.

SAPIERR PROJECT: PILOT INITIATIVE FOR EUROPEAN REGIONAL REPOSITORIES

SAPIERR is a project under the 6th Framework Programme of the European Commission. It is carried out by a consortium of DECOM Slovakia and ARIUS. SAPIERR was launched on 1st December 2003 and its overall duration is 2 years. This project aims to bring together countries in Europe with an interest in investigating the possibilities for shared repositories for spent nuclear fuel / high-level radioactive waste, and in particular those countries with small nuclear power programmes that do not have the resources or the full range of expertise to build their own repositories.

A significant achievement of this project is that 21 organisations from 14 countries (Austria, Belgium, Bulgaria, Croatia, Czech Republic, Hungary, Italy, Latvia, Lithuania, The Netherlands, Romania, Slovakia, Slovenia and Switzerland) have agreed to take part in the SAPIERR working group. Using the inputs of these working group members, the consortium has produced a series of technical reports. Two data reports, one on inventories of radioactive wastes in the SAPIERR countries and one on legal aspects of the regional repository have been used as the basis for producing a report on options and scenarios for European regional disposal and on recommendations for future research & development in the EU. The findings and other information are available on the project website.

The first two technical reports describe in detail the inventories of spent nuclear fuel, high-level waste and long-lived intermediate-level waste, radioactive waste management policies, storage facilities, national programmes for repository development and their cost aspects, as well as the legislative framework in the individual countries represented in the SAPIERR working group. The inventory report also includes cumulative inventories for all the SAPIERR countries and their accumulation in time. The third report examines the way to move forward with the concept of regional repositories in Europe. The steps proposed are in line with those outlined in the previous section. One of the key observations is the huge economic savings than the European Union countries could attain if the SAPIERR project members alone were to share a disposal solution – around 8 billion EUR.

A follow-on project to SAPIERR is being suggested, with the objective of following up some of the legal and technical issues raised in more depth but, more importantly, of establishing, by 2008, a legal entity that could formally take on the role of pursuing the European regional solution.

Regional repositories are also of interest outside Europe but have been little studied. SAPIERR will hopefully put the European Union in a leading position to provide advice and, possibly, services to other countries.

RECENT FURTHER PROGRESS WITH MULTINATIONAL INITIATIVES

In the past few years, there have been significant developments towards multinational repositories in several respects. The key points are listed briefly below.

IAEA support

- A series of public statements by the Director General emphasizing the need for multinational approaches;
- Publication of a technical document on multinational disposal and one on regional storage;
- Establishment of the Multinational Approaches Expert Group mentioned above;
- Sponsorship of the meetings mentioned below on international storage and disposal in Russia.

European Commission support

- Inclusion of regional repository concepts in the draft EC Waste Directive;
- Support of the SAPIERR project mentioned above.

Further international developments

- Support by US workers at MIT working on a project on "The Future of Nuclear Power" [13];
- Financing by the independent Russell Foundation of a US Academy of Sciences-Russian Academy of Science meeting on international repositories in Vienna;

- The topic of multinational disposal is integrated into numerous international Conferences on waste management at the technical and also the legal level.

The Arius Association

- Arius (Association for Regional and International Underground Storage) is a small group of organisations, currently from eight countries, cooperating in an association to support the concept of sharing facilities for storage and disposal of all types of long-lived radioactive wastes. Arius, is an organisation without commercial goals. The mission of the association is to promote concepts for socially acceptable, international and regional solutions for environmentally safe, secure and economic storage and disposal of long-lived radioactive wastes. A key objective is to explore ways of making provision for shared storage and disposal facilities for smaller users, who may not wish to - or may not have the resources to - develop facilities of their own.

Russian developments

- Government efforts to establish the legal basis for import;
- Joint Russian Academy of Science – US National Academies Workshop held in Vienna in June 2005 as a follow-on from the Moscow 2003 meeting;
- Dedicated conference sponsored by the Russian Ministry of Atomic Energy and the IAEA in Moscow in July 2005.

POLITICAL/PUBLIC ATTITUDES

There are no legal obstacles to countries deciding that they will implement a common repository in a willing host country. If this course is chosen, then lawyers from the partner countries involved can develop a legal framework for the cooperation. The feasibility of realising a regional repository is thus not strongly influenced by legal constraints.

The feasibility is, however, strongly dependent upon the political and public attitudes in both host and user countries and the issue remains a sensitive political topic in various countries – in particular in those that fear the prospect of a regional solution could disrupt national programmes. This could, some believe, happen in either of two ways.

Concern that a national repository might be compelled to accept foreign wastes might make acceptance of a site by a local community more problematic. The prospect of being able to export wastes to a regional repository might lead national politicians or waste owners to reduce the priority on (and the funding for) a national disposal programme. The former concern should be allayed by the firm assertions from the IAEA, the EC and from some national governments that waste import cannot be forced upon any country. The latter concern has not prevented various countries from pursuing a “dual track” option, keeping both national and regional alternatives open. This strategy is not a difficult path to follow since implementation of either option lies relatively far into the future

and similar national expertise must be built up and maintained for evaluating either option.

Distinct from, but related to, the political attitudes in EU countries are the views of the public in each country on the desirability of a multinational, regional disposal option. This question has been put to the public in the scope of the EUROBAROMETER polling done for the EC [14]. The polling work done in 1998 and 2001 showed that, whilst the majority still favour national disposal solutions, increasing numbers recognize the advantages of shared solutions. In some individual EU countries there have also been dedicated polls on the issue. Interesting results have, for instance, been published from Germany, a country whose political leadership is strongly opposed to multinational repositories.

Opinion surveys on waste disposal in Germany carried out by the Institute for Technology Assessment and Systems Analysis in Karlsruhe [15], included questions on the topic of international disposal. Only 31.5% of those questioned favoured a national solution, with 55.6% preferring an international option. The supporters of an international solution were to 70% in favour of an EU solution as opposed to a repository outside the EU. Questioned about whether this multinational EU repository could be in Germany 40% agreed, 40% disagreed and the rest were undecided. Significantly, however, 80% were against the repository being sited in their own region of Germany – whether the facility be national or international.

The results of all polling exercises indicate clearly that achieving local acceptance for a repository remains a very challenging task, even for a national facility. This is borne out by actual experience. Only in Finland and Sweden have local communities democratically agreed to host a geological repository, provided that it could be shown to be safe. In both cases, the local communities already host nuclear power plants and have a long history of interacting with the repository implementing body. In France, a local region at Bure, with no prior nuclear experience, has agreed to host an underground laboratory that may later be developed into a repository. In various countries (e.g. France, Sweden, Switzerland, UK), local publics have also rejected specific proposed facilities.

For a multinational, shared repository it can only be expected that the challenge of interacting constructively with the public is still greater than in the national setting. The fear that opposition would increase massively has certainly led to advanced programmes explicitly excluding import of foreign waste as an option. The polling results quoted, however, indicate that there is a growing minority of the public who already recognise the potential advantages of shared regional repositories.

CONCLUSIONS

There is clear recognition internationally that multinational approaches in the overall nuclear fuel cycle can enhance security and can help hinder proliferation. Despite earlier controversies, the potential advantages are also recognised for multinational storage and disposal facilities. Concrete steps can

be taken now to move beyond empty expressions of support towards specific practical initiatives.

Specific repository projects involving technical and societal efforts towards siting and constructing a shared repository will need closer coordination, direct involvement of the interested countries and the international agencies, and significantly increased resources. Most of the small countries that could benefit most directly from shared repositories have not yet accumulated sufficient funds to implement a national repository. However, there are certainly sufficient resources available in these countries, if pooled, to support a serious joint waste disposal programme. Initially, this would be aimed at clarifying the options for a shared regional facility. However, more support for backend studies on storage and disposal is needed. The relatively large funding which is proposed for tackling security issues at the front end should be complemented by increased – although still comparatively modest – financial support for progressing shared repository projects for commercial reactor fuels. The “partnering” scenario outlined earlier in this paper exemplifies one possible practical approach. A wider and more intensive follow up to the current SAPIERR project could greatly help further progress.

However, the biggest, potentially fully international, storage/disposal initiative that could be grasped and developed immediately is that proposed by Russia. A combination of fuel leasing, allowing take-back of Russian origin fuels, and acceptance of foreign fuels requiring USA consent under existing fuel-flagging rules would be a first step. In our view, however, the Russian storage initiative will only be acceptable if the endpoint of disposal is also available for those client countries that wish to use it – this means actually available, or specifically planned and financed, rather than held out as a vague future prospect. Of course, real interest in sending spent fuel to Russia (or to any other country with an international repository) will be shown by small countries only if existing backlogs of stored spent fuel can also be transferred, since complete avoidance of the need for an expensive deep repository will be the driver. A key driver behind providing storage is the prospect that spent LWR fuel can be regenerated for use in a new generation of fast reactors. Both the waste-type and the waste take-back implications of this are much different from those of reprocessing. Whatever new technology eventually has to offer in this direction, it is nevertheless likely that Russia would need to offer a menu of storage and disposal services if it is to develop widely used multinational facilities. Currently, some movement towards openly exploring these issues is taking place, as evidenced by the Conferences this year in Vienna and Moscow.

If the international community wants to make a really useful contribution to global security and safety then this is where it could direct its resources. Specifically, we propose that the IAEA offers to assist Russia to move forward by assembling both the funding and the enormous expertise that exists internationally to develop, in a timely fashion, a state-of-the-art international geological repository for long-lived wastes. In return for this offer, Russia should agree to a new level of transparency and international oversight in the development work. Only in this way can the trust of the international

community be enhanced to a level needed for small democratic countries to enter into long-term commitments to transfer fuel to the Russian Federation. This would be a truly worthy project with truly global benefits – it is surely to promote solutions such as this that the IAEA was founded and exists today.

Of course, a single supplier of disposal services could present strategic and economic risks for potential customer countries. Global waste inventories, however, easily justify multiple international repositories and commercial competition could conceivably encourage this. If the international community acknowledges the global value of having international repositories available and is prepared to support their development, then it is not unlikely that other candidates could also appear. These might be other large countries or they might be smaller countries willing to consider hosting a facility implemented with partners.

We need supranational solutions if we are to achieve any of the goals discussed in this article. These solutions need not only the strongest of support from the United Nations and its Member States but they also need to be championed by the major countries, working together.

In the ways suggested above, real progress could be made over the next few years, with projects based both on the partnering and the add-on scenarios. We need bold initiatives for global solutions if we are to achieve the global improvements in safety, security and economics that multinational repositories can bring.

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