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PROGRESS WITH MULTINATIONAL STORAGE AND DISPOSAL CONCEPTS

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ABSTRACT

The growing importance of finding shared solutions for countries with small arisings of long-lived wastes from nuclear power generation has been increasingly recognised over the last few years. In this paper, we take a systematic look at recent developments focusing in turn on:

- international initiatives (IAEA)
- regional initiatives the European Union (EU)
- national positions for in 3 categories of countries:
  - those participating in the Arius association that was founded explicitly to promote the multinational concept
  - those with specific interests in shared solutions
  - those that might consider hosting a repository
  - those with laws or policies requiring national disposal.

Multinational concepts continue to face challenges that are more difficult than for national programmes. Nevertheless, progress to date indicates that the nuclear communities of the world may well be on the way to optimising radioactive waste management on a global scale.

INTRODUCTION

In this paper, we look at the current state of play in the increasingly visible field of regional, multinational or international waste facilities. The growing importance of finding shared solutions for countries with small arisings of long-lived wastes from nuclear power generation has been increasingly recognised over the last few years. In previous papers, we have expanded upon the fact that multinational repositories offer safety, environmental, security and economic advantages and that there can be no ethical objections to their implementation, if this is done in a volunteer country using state-of-the art technology. In fact, shared repositories will be essential if global environmental safety and security are to be assured.

A further challenge that could be addressed by a multinational approach concerns the security of disused radiation sources, which is of increasing concern. There are many research, industrial and medical users of sealed radioactive sources worldwide – some millions of sources are believed to have been manufactured over the years and many spent sources are in storage awaiting recycling or disposal. This raises fears that some countries may not have the capability to track and control them properly, raising the possibility of their easy diversion to use in 'dirty bombs'.

The inevitability of having to work together if realistic and secure closure is to be found for many long-lived waste producers is so obvious that activities to explore how best to do it increase almost monthly, after years in the backwoods. Shared answers to waste management have been acknowledged as essential for decades; they were discussed openly in the seventies during debates on the future on the nuclear fuel cycle. Subsequently, however, their discussion became almost taboo. No-one wanted to talk about international repositories – primarily because of the sensitive phase into which some national siting programmes were entering.

Now a window of opportunity has opened, due to three main factors. First, some national fuel-cycle waste programmes have, through careful considerations of both technical and societal issues, navigated their way through the shifting sands of finding acceptance and moved onto stable ground, where geological repository implementation now seems feasible. These successes demonstrate, at the national level, that technically, socially and politically acceptable answers to disposal challenges *can* be found. Second, pressure is increasing on some small nuclear programmes which can finish the course only by working together in multinational projects that also want to establish the best way of moving forward. Last – and very important - the problem of ensuring global nuclear security in a world characterised by incomplete controls and widespread terrorism is an increasing worry with respect to

some types of waste, and to some waste owners and producers around the world. If shared, centralised solutions can be found to ease these concerns, the world will become safer and more secure for all of us.

How are things developing around the world in mid-2003? Below, we take a systematic look focusing in turn on:

- international initiatives (IAEA)
- regional initiatives (EU)
- national positions for in 3 categories of countries
  - those participating in the Arius association
  - those with specific interests in shared solutions
  - those that might consider hosting a repository
  - those with laws or policies requiring national disposal.

A World-wide Overview

International developments at the IAEA:

Two significant developments have occurred over the last eighteen months: the completion of a report on regional and international disposal concepts and accelerated evaluation of the security of spent source disposal, which has potential implications for shared facilities.

The new report, entitled '*Developing and implementing multinational repositories'* will be discussed at a meeting in Vienna in September of this year. Although the emphasis is on spent nuclear fuel and high level waste, the report covers multinational disposal of all kinds of radioactive wastes, recognising that waste streams such as low-level wastes and spent sealed sources may also be disposed of in multinational facilities. A 'history' section demonstrates that such concepts are not new and that there has in the past been significant transfer of wastes for disposal in another country. Three 'sharing' scenarios are considered: a large nuclear country accepting waste from smaller programmes on an 'add-on' basis; small countries joining together because they do not have the capabilities themselves to implement a deep repository; countries joining up, not because they cannot implement national solutions but because they are aiming at economic and environmental optimisation. The report lays out the benefits challenges and requirements for all stakeholders – host country, partners and third parties. Emphasis has been placed on the key challenge of achieving adequate acceptance of the concept at political and public levels.

The security of disused radiation sources is of greatly increased concern. There are fears that many users worldwide, and some countries, do not have proper tracking and control of spent sources, raising the possibility of their easy diversion to use in 'dirty bombs'. In March 2003, the IAEA held a conference to address this security issue. Co-disposal of sources in a deep geological repository for fuel cycle wastes is clearly a sensible solution for countries developing such facilities, but many other countries do not foresee a requirement for a deep repository. The alternative being evaluated at present is the use of properly designed and managed borehole disposal facilities. This technology may be suited for providing a safe and affordable disposal route in developing countries, such as the numerous African States that use sealed sources, and South Africa has played a leading role in developing the concept. Critically, proper disposal facilities need to be available to countries that do not have the technology or the resources to implement national disposal projects. This implies the development of regional or multinational facilities. A number of countries each with only a small inventory of spent sources could agree to share a repository or a borehole disposal facility situated in one volunteer state. A larger country with significant volumes of waste requiring deep disposal might agree to help developing countries. The potential for regional initiatives to ease the security hazard of spent sources was referred to directly by US Energy Secretary Abraham, who chaired the IAEA Conference. He stated that the USA is *"prepared to work with other countries to locate, consolidate, secure, and dispose of high-risk, orphan radiological sources by developing a system of national and regional repositories to consolidate and securely store these sources"*. In addition, the IAEA is finalising a report on '*Disposal Options for Disused Radiation Sources'* .

Regional proposals for the European Union:

The April 2002 'Eurobarometer' survey of public opinion across the member states of the EU addressed views on radioactive waste. Among numerous other issues, the survey asked for opinions on whether each country should have its own HLW disposal facility, or whether regional, shared sites should be developed. Since the previous (1998) survey, the number of respondents believing that each country should have its own facility fell from 75% to 63%, with a corresponding increase (from 12% to 18%) in the number of people who believe that repositories should be sited in only a few EU countries, with shared access amongst co-operating countries. In some countries (see diagram on next page), support for regional solutions has almost doubled since 1998 (France, Greece, Ireland, Portugal and Spain). The Netherlands is the country with most people in support of a regional facility, with those who prefer a national solution no longer in a clear majority. Germany and Finland are the countries with reduced support for regional solutions, perhaps as a result of the emphasis of their current governments on implementing purely national solutions.

In the European context, the main new developments in the area of regional repositories result from the implications of the 'Nuclear Package' of directives. The proposals were adopted by the EC early this year and are expected to be discussed very soon by the European Council, as the Commission would like the legislation to be approved and implemented by the end of 2003. The package has caused controversy within EU Members States for various reasons, including general issues of national sovereignty and specific objections to the proposed over-ambitious deadlines. The particular aspect of the Directive that is of interest here is related to its mention of the possibility of regional, shared waste management solutions. Based for a large part on the IAEA 'Joint International Convention', the *Directive on the Management of Spent Nuclear Fuel and Radioactive Waste* provides that Member States should establish, according to a pre-set timetable, a strategy to deal with all categories of

radioactive waste – focusing on geological disposal as the safest method, given our present state of knowledge. The memo accompanying the Directive notes that a "*regional approach, involving two or more countries, could also offer advantages especially to countries that have no or limited nuclear programmes, insofar as it would provide a safe and less costly solution for all parties involved".* Clause 4 of Article 5 of the Directive itself reads as follows: "*The programme may include the exports of radioactive waste or spent fuel to another Member State or third country if such exports are fully in compliance with existing EU legislation, principally Directive 92/3/Euratom regarding waste shipments, and International commitments, are covered by firm contracts and only take place to States with appropriate facilities that meet accepted norms and standards and, in the case of fertile and fissile material, are under adequate safeguards.*

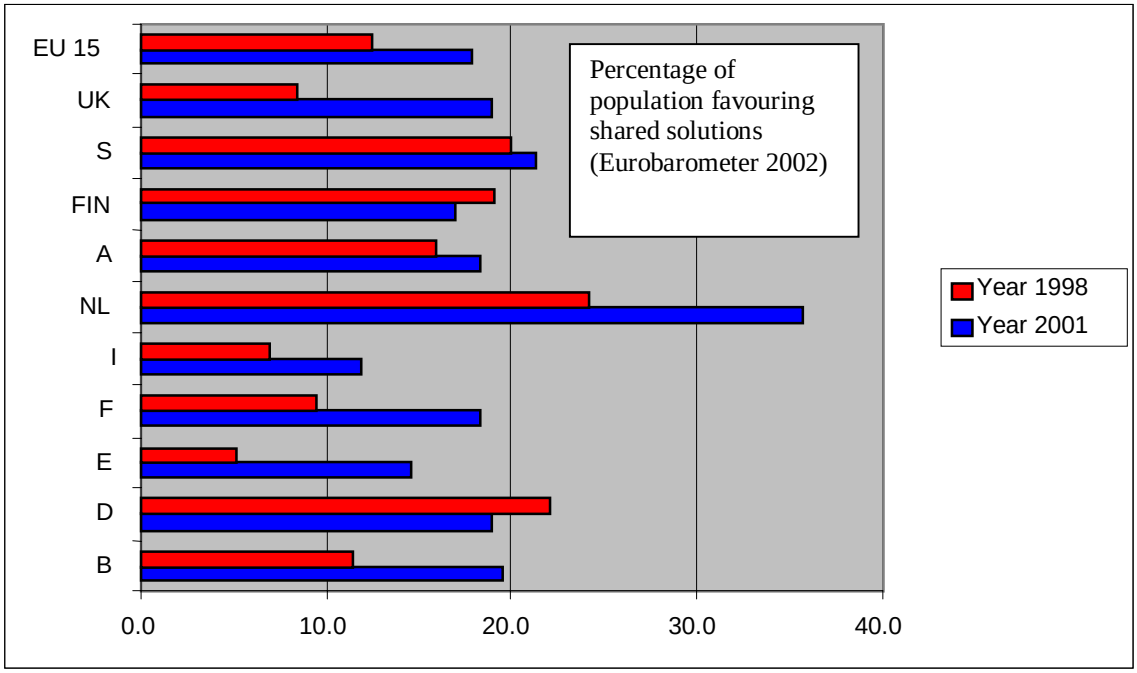
The obvious need for European regional solutions led Arius and Decom to develop a proposal, SAPIERR (Support Action: Pilot Initiative for European Regional Repositories), which is intended to take the first steps to identify the major factors that would control their feasibility. The project was submitted to the European Commission for consideration as part of the next round of Euratom projects in the EU 6th Framework Programme. SAPIERR would look into both shared interim storage and shared disposal facilities. Such solutions raise new trans-national issues of safety and governance, not so far addressed by national programmes in the European research area: issues of nuclear security, the safety performance of multi-user repositories with the potential for an unusual diversity of waste types, national and European public acceptability, trans-boundary waste transport, and national and European economics and law.

SAPIERR is a pilot initiative that will, if funded, bring together interested Member States and Associated Countries to help to establish the boundaries of the issue, collating and integrating information in sufficient depth to allow potential regional options to be identified and any consequent novel R&D needs to be identified. Specific proposals for regional facilities, including potential siting, would not be part of this initial pilot study. Instead, the work is aimed at establishing the boundary conditions for regional collaboration and the implications for an enlarged European Community.

Countries with Arius members

The countries from which Arius members originate are Belgium, Bulgaria, Hungary, Italy, Japan, Switzerland; some member organizations represent the national waste management organization and some are private companies. In addition to support of Arius for the SAPIERR project, there have been other developments in some of the countries during the last year. ENEA, the Italian waste management organization became a member in early 2002 and in 2003 the Italian representative, Piero Risoluti, was elected President of the Association.

The country with significant national developments has been Switzerland. At the end of 2002, the Swiss national waste management agency, Nagra, submitted to the government a major project (Entsorgungsnachweis 2002), which is intended to demonstrate that Switzerland can safely dispose of its spent fuel, high-level waste and long-lived intermediate level wastes within its own territory. In addition, however, the Swiss strategy keeps open the option of disposal of HLW in the scope of a multinational project and the new Nuclear law contains explicit requirements that would be applied to such a project. Since the deep repository is needed only around 2050, there is



ample time for examining both national and shared repository options. This is a good example of how a dual track strategy can be maintained by small countries.

Other countries showing specific interest in shared solutions

The fact that numerous countries are interested in shared repositories is illustrated by the responses to the SAPIERR project mentioned above. A commitment to participate in the working group that will direct the project has already been signalled by organisations in a wide range of countries. These include those countries in which Arius members are located as well as the Czech Republic, Latvia, Lithuania, Norway, Romania, Slovakia and Slovenia. The interest of Norway illustrates that even countries with no nuclear power programmes may need access to deep disposal facilities if they have long-lived wastes from medicine, research or industry. The recent official policy document from the Czech Republic recognizes that there is support for international repositories and does not exclude this option for the country – although it acknowledges the difficulties.

Further countries from which positive opinions on the concepts of regional or international repositories have been given include the Netherlands, Taiwan and South Korea, of which only the last has an active R&D programme on disposal. Taiwan is often cited as a clear example of a nuclear power generating country for which international repositories may be necessary, given the small size and complex geological conditions there. In fact, the utility, Taipower, has considered a range of such options, even for LLW. These have included the Solomon and the Marshall Islands, Russia, mainland China and North Korea. Austria is a special case. After its decision not to operate nuclear power plants, Austria still has several thousand drums of LLW that must be safely disposed of. It has looked at various solutions and is currently interested in the possibility of using a solution proposed by the government of Kazakhstan (see below).

Countries that might consider hosting a repository

Despite the political problems that are inevitably associated with any proposal to host a shared repository, some countries have been ready to address the issue. These include Russia, China and Kazakhstan. Further countries and communities interested in exploring the potential benefits of hosting an international facility may well appear, once the "taboo" has been broken.

In Russia, a high-profile initiative for acceptance of foreign spent nuclear fuel, is gathering momentum in Russia, where the government is assembling plans for an international spent fuel repository. In April, the Russian atomic energy minister, Alexander Rumyantsev, re-iterated the resolve of the government to accept spent nuclear fuel from other countries. This is allowed under the law passed in 2001. This law permits import of spent nuclear fuel for storage and reprocessing. Wastes must in principle be returned to the original owners, but the government would like to have the option to dispose of the wastes permanently, in a deep repository, and amendments to the law may make this possible. The Russian locations being considered for international storage and disposal are at Krasnoyarsk and Krasnokamensk, both in Siberia. In May 2003, these plans were presented in Moscow at the Symposium of the World Nuclear Association and at a special seminar on the topic, organised jointly by the Russian Academy of Sciences and the National Academies of the USA. In addition to American and Russian experts, invited speakers at this seminar included experts from Japan, South Korea, Switzerland and the IAEA. Subsequently, a small group of the experts, including one of the authors of this article, was invited to visit the remote site at Krasnokamensk, which was formerly a closed Soviet city developed under the Soviet regime for mining, milling and extracting uranium. Krasnokamensk has excellent technical facilities, an experienced work force and the wish to secure its future when the uranium reserves are exhausted. The group could verify that an extensive infrastructure is available there (including an experienced and motivated work force) and that promising geological conditions exist in the granitic potential host rocks nearby. Before deciding upon the feasibility of safe storage and disposal, studies and site investigations are needed and the Russian experts involved are open for international cooperation already at this stage.

In Kazakhstan, the government has suggested that a safe repository for low-level wastes (LLW) could be constructed and operated in the Mangistan region, using financing provided by countries that could send such wastes to Kazakhstan. The concept is to utilise an extensive, disused open-cast uranium mine and to construct a state-of-the-art LLW disposal facility therein. One obvious candidate for such a transfer would be Austria, which, after its decision not to operate nuclear power plants, still has LLW at Seibersdorf awaiting disposal. As might be expected, the proposal has generated intensive discussion in the Kazakh parliament. Kazatoprom, the company promoting the scheme, says that the proceeds would help to cover the costs (estimated at over 1 billion USD) of managing the country's own LLW. The recommendation of the Government to approve the agreement and change legislation as required is currently before the Kazakhstan parliament. Public opposition to the proposal has led to the concept being put on hold.

China is carrying out geological exploration at its very remote HLW disposal site in Beishan. The programme foresees implementation of an underground laboratory as a preliminary step to initiating disposal in 2040. Wang Ju, one of the directors of the project, has been quoted as agreeing at the 2002 IAEA Safety Conference that the planned repository would be technically suitable for accepting foreign HLW as well, although he pointed out that this would be a political rather technical decision.

Countries with laws or policies requiring national disposal

It is also interesting to look at attitudes towards multinational proposals in those countries that have firmly decided to implement national facilities. This is, of course, a perfectly justifiable position to take. It is explicitly acknowledged in the IAEA Convention and in the EU Directive mentioned above. Despite this, some countries have been apprehensive that discussion on multinational initiatives could

disrupt national efforts. This sensitivity was felt particularly in Sweden and Finland, both of which have been in delicate siting phases during the last few years. Now that the national programmes in both countries are stabilising, it appears les problematic for them to acknowledge that shared options can benefit others, whilst maintaining their own objective of self-sufficient repository implementation.

The United Kingdom has also declared a policy of 'self-sufficiency' in disposal, despite having accepted earlier that wastes from reprocessing of foreign fuels could remain in the UK. Currently, discussion centres upon the feasibility of substitution, a scheme by which the larger volume ILW wastes generated by reprocessing need not be returned if an equivalent quantity of other, smaller volume radioactive wastes (e.g. HLW) is substituted.

The USA is moving into a licensing phase for a spent fuel repository at Yucca Mountain. This facility is intended, in principle, only for US wastes. However, the US government recognises that regional approaches are one way to counteract the potential security threats posed by orphan spent sealed radiation sources discussed above. Moreover, the USA is also showing a positive example in continuing its repatriation of research reactor fuels from several countries around the globe.

In Germany, despite the fact that import and export of radioactive wastes was discussed in an objective manner a few years ago, and despite the fact that Germany disposes of chemotoxic wastes for many countries, the current anti-nuclear government has taken a strong line that these are no longer options. The now disbanded German Government advisory group, AkEND, has also raised arguments in favour of a national repository. The four arguments given against export of German wastes are:

- *strong opposition would be expected in a foreign host country;*
- *it would be difficult to guarantee German safety standards in other countries;*
- *there are no repositories in existence and implementation would be a long process that Germany could not influence;*
- *during this long period, there is a risk of misuse of materials for military purposes following political changes.*

Only the first point is a clear difficulty standing in the way of multinational solutions. Arguments two and three are invalid, as rational regional disposal concepts lay down that no reduction in safety standards can be tolerated for a multinational repository. They also assume that a common repository could be developed as a cooperative venture with all of the participants sharing responsibility and able to influence the project development. The concern about security of fissile materials is actually an argument in favour of multinational solutions. Shared facilities with a high degree of international oversight, financed jointly by several users, are more likely to provide enhanced global security than multiple distributed storage facilities.

A final interesting example of contradictory views with respect to shared disposal facilities is presented by Australia. Following identification of the Australian continent in the Pangea project as one of the most obviously suited environments for a multinational geological repository, the Government immediately reacted by emphasising that this was against their policy and that countries should dispose of their own wastes. Later, publicity that wastes from a new research and isotope production reactor might be sent to Argentina as part of the Australian contract with the constructors, INVAP, caused demonstrations in Buenos Aires. Australian authorities say that the planned L/ILW repository in S Australia and the proposed (but not located) LL-ILW surface store will be able to manage all of Australia's present holdings of radioactive waste and all arisings of radioactive waste for the foreseeable future, including the waste that will arise as a result of the operations of the replacement reactor and the management of its spent fuel. The Argentinean reprocessing option is intended as a back-up in case there are problems with a European option. The debate has underlined the current lack of a disposal solution for long-lived wastes in Australia.

At the end of 2002, the Australian Science minister explicitly mentioned Arius in a statement that concluded, *"Countries deriving benefits from nuclear technology should make their own arrangements to safely dispose of their nuclear waste."* The irony of taking a local or partial view is emphasised, however, by the recent decision of the parliament in South Australia to ignore Federal arguments on the need for communal disposal facilities and to ban the national low-level waste repository proposed by the Federal Government for that State - using the argument that the wastes are generated in New South Wales at the Lucas Heights research reactor. Equally ironic is that the same Minister argues that the Argentinean suppliers of the new research reactor should be able to take the spent fuel back for reprocessing. These points illustrate that the problem of siting is an issue of equal importance in national and multinational contexts.

Conclusions and Prospects

For several years, proponents of shared solutions have been limited to presenting papers at conferences, highlighting the advantages and the difficulties in an abstract manner. Over the last two years, there has been growing acceptance of the arguments put forward and a significant move towards concrete projects and even definite proposals for actual international facilities. The milestones achieved over the past few years have been:

- open discussions at a wide range of international meetings and acceptance that any discussion of global disposal issues must address the multinational concepts as well as national programmes;
- establishment of specific projects and organisations with the objective of promoting the general concept or even specific projects; these include such initiatives as the Non-Proliferation Trust, the now dormant Pangea project and the growing Arius Association;

- the readiness of key international organisations to respond to the wishes of their member countries and directly examine the status of multinational repositories – while the IAEA and the EC have both been active here, the NEA/OECD has not entered the discussion;
- the emergence of specific countries that are willing to consider the option of hosting a shared facility – the increasing intensity of the debate may well increase the numbers of such countries;
- the prospects (through the proposed SAPIERR project) that objective concrete discussions on advantages, drawbacks and potential obstacles can take place between interested countries.

Implementation of national repositories has taken much longer than was originally thought. Multinational concepts face additional challenges. Nevertheless, progress to date indicates that the nuclear communities of the world may well be on the way to optimising radioactive waste management on a global scale.