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Multinational/Regional Repository – an Illusion or Solution

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ABSTRACT

The concept and current status of multinational and regional repositories are presented in the paper. Particular emphasis is given to the results and findings of the recent EU project SAPIERR, investigating the feasibility of regional repository concepts in Europe. Prospects for further development of multinational repositories are also brought forward and the impact and potential benefits of this approach to our national disposal programme are discussed as well.

1 INTRODUCTION

The idea of a regional and/or multinational repository has been well known for many years. Since its launching it has aroused great interest in countries with small nuclear programmes, limited financial or insufficient human resources. Due to high costs associated with the development of a repository, especially a repository for spent fuel (SF) and high level waste (HLW), such countries face serious difficulties in developing their own national disposal solutions. Multinational, shared repositories may represent a feasible option for them.

The advantages of a regional/multinational repository are not limited only to economic aspects. Such a repository may also increase the accessibility to a safe disposal facility for many countries which would otherwise delay their disposal programmes, and through this it also contributes to enhanced global nuclear security. Shared facilities for disposal of waste would also reduce the number of required repositories and consequently decrease the environmental impact, provide a wider choice of geological conditions and increased technical potential for their implementation.

In spite of these numerous positive aspects, the idea of a multinational disposal facility has been since the very beginning regarded as highly controversial. On the one hand it has attracted many supporters and advocates, who believe that this is the only reasonable solution for small nuclear programmes, while on the other hand it has provoked strong negative reactions of opponents, claiming that each country is responsible for the disposal of its own waste.

Polemic discussions between pro and contra have blocked further development of the multinational disposal approach for many years. But lately it seems that the acceptability of this idea is increasing and considerable progress, regarding the development of multinational repository concepts, has been made in the last few years. The benefits of the multinational approach are nowadays recognized by many countries and organisations as well as by the IAEA and the European Commission.

2 CONCEPT OF A MULTINATIONAL REPOSITORY

The concept of a shared facility is known under several different names: international repository, regional repository, multinational repository, all with a slightly different meaning. The latter seems to be the most universal and has lately been widely accepted.

The multinational repository concept assumes that the waste originating from more than one country is being disposed in a common repository. Any country - regardless of geographical location - may participate in such a collaborative scheme. In contrast to this, the regional repository concept involves only countries that belong to the same geographical region. It is actually a multinational repository for countries located in the same region of the world. The term "international repository" has a slightly different meaning. According to the IAEA [1], [2] it is regarded as a waste disposal facility for several countries organised under the authority of a supra-national body, such as the United Nations for instance.

So far no regional or multinational repository has been put into operation or is being planned in reality. Based on today's perspective and understanding, there are basically three likely scenarios [2] which may lead to the implementation of a multinational/regional repository: the »cooperation scenario«, the »add-on scenario« and the »international or supranational scenario«.

The best known is the **cooperation scenario**, in which the concept of a shared repository is based on cooperation among a group of countries. Several countries join in a mutual agreement for building a repository in one of the participating countries. If a group of countries belongs to the same geographical region, a repository can be called a regional repository, otherwise it is called a multinational repository.

The **add-on scenario** assumes that the host country, with an already implemented national repository, shall at some later stage offer to complement its national inventory of wastes for disposal by wastes imported from other countries. Motives for such a decision can be of economic nature – share or decrease disposal costs - or else related to safety and security. In practice, in the add-on scenario, the repository remains effectively a national repository, but with a part of the inventory from another country. However, the national infrastructural framework of the hosting country would have to be upgraded to properly cover the acceptance of foreign radioactive waste and to provide adequate interface between the host and the partner countries delivering the waste.

In the **international** or **supranational scenario**, a higher level of control and supervision is implemented. The operation of such a repository would be fully in the hands of an international body. The hosting country would, in this scenario, cede control of the necessary siting area to the international body, which makes this scenario very unlikely in the foreseeable future.

These three basic scenarios should be recognized as representative only. New scenarios or combinations of these scenarios may emerge in the future, depending on mechanisms that would lead to their development. From today's perspective the most likely seems the add-on scenario as it is host country driven. It requires only one potential host to achieve the necessary level of national agreement and then to make an offer to partner countries. Attributes of this scenario can be recognized in the recent Russian initiative from 2001 for storage and/or reprocessing of spent nuclear fuel.

The cooperation scenario is more partner country driven. A group of countries may join together and work together, without having a potential host. This is actually the greatest threat to this scenario. If a potenatial host can not be identified in a reasonable time period the motives for joining will fade and the group will cease to exist.

For the supra-national repositories the most plausible driver might be the global efforts to reduce the threat of terrorism by ensuring that radioactive materials are as inaccessible as

possible. In the past this scenario was not regarded as very likely. However, the increased concern for global security makes this scenario more relevant and more feasible.

3 SAPIERR – PILOT INITIATIVE FOR EUROPEAN REGIONAL REPOSITORIES

The topic of regional repositories has recently been addressed also in the European Union. In 2003 the European Commission - under the Euratom Research and Training Programme on Nuclear Energy within the Sixth Framework Programme - has launched a two-year project SAPIERR, regarded as a pilot initiative for the European regional repositories. The main objective of this project was to bring together representatives of the European countries interested in the shared solution of deep geological disposal of radioactive waste and to investigate and assess the feasibility of regional repository concepts in Europe. The results and findings of the project were also aimed at helping the European Commission to scope further research and technical development in this field that may be needed to facilitate the implementation.

Altogether 21 organisations from 14 countries have taken part in the SAPIERR project: from Austria, Belgium, Bulgaria, Czech Republic, Hungary, Italy, Latvia, Lithuania, the Netherlands, Romania, Slovakia, Slovenia and Switzerland. However, the organisations involved in the project represented only themselves and not the official views of the respective countries.

The scope of the project covered three aspects important for assessing the feasibility of shared facilities: waste inventory [3], legal aspects [4] and possible options and scenarios of regional disposal [5].

On the basis of these investigations and studies, recommendations for future research and investigations were given [6].

3.1 Inventory

The project first investigates present and expected future quantities of spent fuel and high level waste in European countries. Nuclear power still plays an important role in EU electricity supply. Altogether 161 nuclear power plants are in operation in EU, together with Romania, Bulgaria and Switzerland. Out of this number only 37 nuclear power plants are located in countries with small nuclear programmes, that took part in the SAPIERR project. The installed nuclear capacity in the SAPIERR group in comparison with other EU countries is presented in Figure 1.

The installed nuclear power in SAPIERR countries represents only about 17 % of the installed power in EU. The total nuclear capacity of all 14 SAPIERR countries is less than the nuclear capacity of France and comparable to the nuclear capacity of Germany.

Similar correlations can be found also in quantities of generated spent nuclear fuel. In 2003 the total SF inventory in all 14 countries involved in the SAPIERR project amounted to 9260 t HM. With the existing fleet of nuclear power plants and no lifetime extensions the spent fuel inventory increase until 2040 may be estimated to ~ 26000 tHM. If compared to the inventories of the countries with large nuclear programme, it is seen that the current inventory of SF in France is 10800 tHM which is ~15 % larger than the inventory of SAPIERR countries. Taking into account the present policies of individual SAPIERR countries [3], it can be expected that also in 2040 the spent fuel inventory of all SAPIERR countries together will still be less than the SF inventory of France alone and will be only twice as big as the SF inventory of Germany.

These numbers and figures provide good justification for investigating the feasibility of regional repository concepts in Europe.

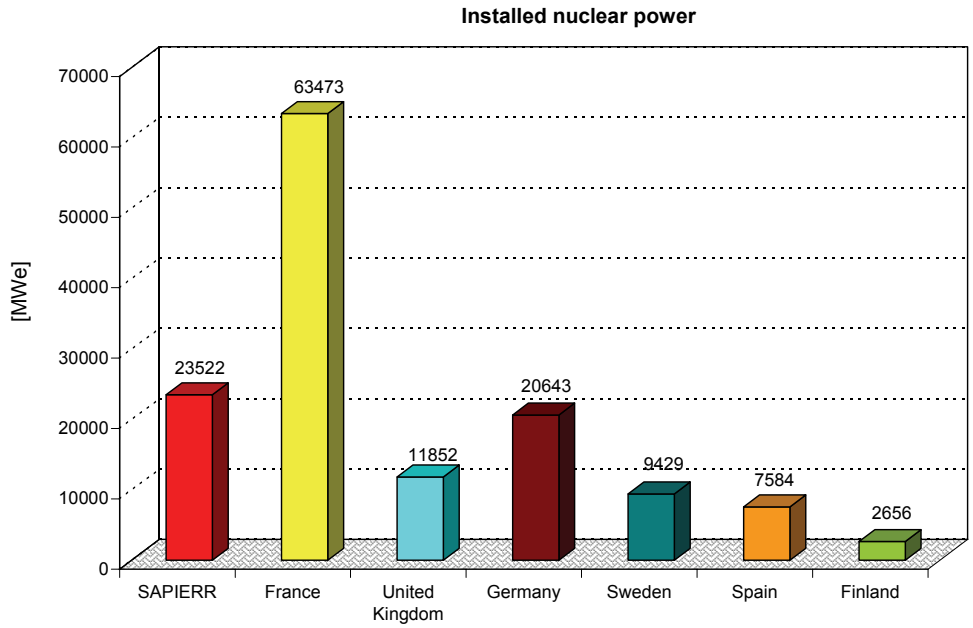

Figure 1: Installed nuclear power in countries participating in the SAPIERR project, in comparison with other EU countries.

3.2 Legal aspects

The project further investigates and documents the current legal and regulatory framework in participating countries relating to the option of a regional repository. Legal aspects are one of most important pre-conditions for implementation of a regional or multinational repository.

Legal and regulatory systems in countries manifest a variety of different attitudes towards shared disposal concepts. The decisive question for participation in a shared disposal option is whether the exports and/or imports of radioactive waste and spent fuel are permitted. In the legislation of individual countries, the responses to this issue may be that: it is ignored, left open, imports and/or exports can be allowed, prohibited, or allowed under prescribed conditions.

The analysis shows that many countries currently ban import of wastes for disposal, very few legally ban the export. In a few countries the export and import of waste is explicitly allowed, and there are some countries having no formal position on this issue. The results are summarized in Table 1.

Great consensus among the EU countries has been achieved about the geological disposal. Most of countries have decided that geological disposal is the preferred option for SF and HLW, however, many countries, especially those with small nuclear programmes, keep other options open. The dual track policy gives the long term management of HLW and spent fuel a flexibility to adapt to future developments, in particular the development of a regional or multinational repository.

On the international level, organisations such as the EC and the IAEA have officially given support to the concept of shared disposal facilities. International legislation represents no barriers to the implementation of regional or multinational repositories. It is hoped that

more international support for the shared repositories will help increase acceptance for this concept in individual countries.

Table 1: Legal requirements for import and export of radioactive waste in different European countries.

Country	Import of foreign RAW for disposal permitted ?	Export of RAW permitted ?	Disposal Policy for RAW, Attitude towards multinational repository
Austria	No	Yes (conditions)	Return to USA
Belgium	Yes (conditions)	Yes (conditions)	Dual track; 1st priority national
Bulgaria	No	Yes	Return to Russia
Croatia	No	open	No official policy
Czech Rep.	No	Yes (conditions)	Dual track; 1st priority national
Finland	No	No	National only
France	No	Yes (conditions)	National only
Germany	Yes (conditions)	Yes (conditions)	National only
Hungary	No	Yes	Dual track
Italy	No	Yes (conditions)	No official policy
Latvia	No	Yes (conditions)	Dual track
Lithuania	No	Yes (conditions)	Dual track
Netherlands	Yes (conditions)	Yes (conditions)	Dual track
Romania	No	Yes (conditions)	No official policy
Slovakia	Yes (conditions)	Yes (conditions)	Dual track; 1st priority national
Slovenia	Yes (conditions)	Yes (conditions)	Dual track
Spain	Yes (conditions)	Yes (conditions)	No official policy
Sweden	Yes (small quantities)	Yes (conditions)	National only
Switzerland	Yes (conditions)	Yes (conditions)	Dual track; 1st priority national
UK	Left open	Left open	No official policy

3.3 Options and scenarios for regional disposal

Possible technical options for a regional/multinational repository were considered only for newly developed shared facilities. Designs were outlined for four different combinations of shared disposal facilities: repository only for SF and HLW, repository for SF/HLW and long-lived ILW, two repositories for SF and HLW and separate repository for SF and long-lived ILW, all in two alternatives – one for hard rock and one for softer sedimentary rock. All designs are based on the concepts and designs of the Swedish, Finnish, Swiss and Belgian repository projects and adapted to the size of inventory of the SAPIERR group. The project includes also an encapsulation plant which can be located either at the repository site or elsewhere.

The main intention of this study has been to gain at least rough insight into the economic aspects of shared disposal. Expected economic advantage is actually the strongest driving force for shared repositories. Economy of scale in large repositories is well illustrated with a diagram in Figure 2, presenting the disposal cost against the SF inventory in different countries. The disposal cost in dependence of the SF inventory can be in double logarithmic scale approximated by a linear function.

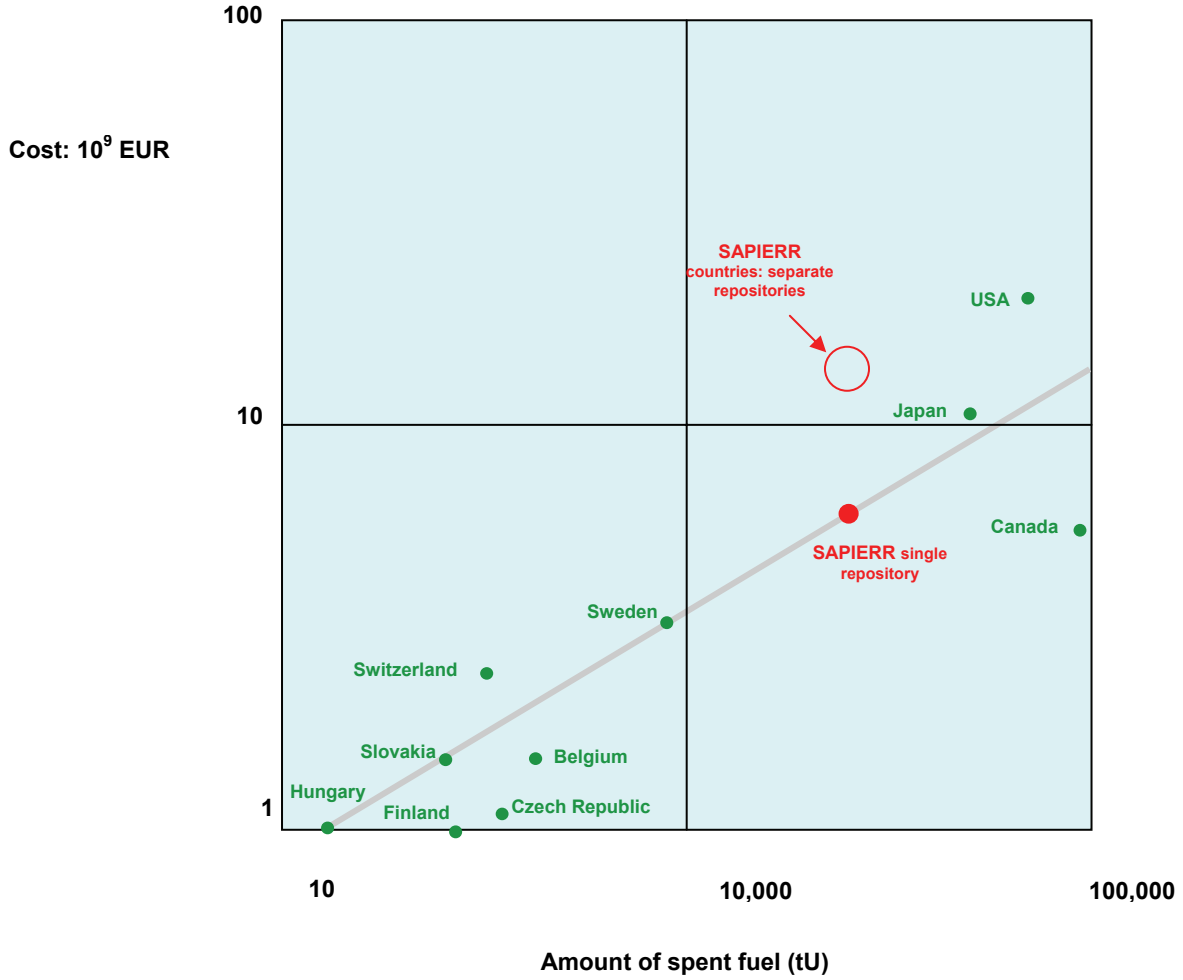

Figure 2: Geological disposal costs as a function of spent fuel inventory.

By using this correlation between the disposal cost and SF inventory the corresponding disposal costs were summed over all SAPIERR countries and compared to the disposal cost of a single repository for the whole SAPIERR group. In the case of individual repositories in each of the SAPIERR countries the disposal cost amounts to 14 billion EUR while in the case of a shared repository the total cost is about 6 billion EUR.

These figures nicely demonstrate the potential economic advantage of a shared repository. If such a facility is to be implemented, the optimal date according to the SAPIERR project findings is around 2030 for encapsulation plant and 2035 for a repository. However, the crucial problem on the way to the implementation of a shared facility - finding a hosting country – remains open.

3.4 Future development of the multinational option

Although the acceptance of regional and multinational disposal concepts is evidently increasing, and the potential benefits of shared repositories are widely recognized in EU and worldwide, it is also evident that implementation of such a facility is even more challenging than the implementation of a national repository. On the top of the problems that need to be tackled by national disposal programmes, the implementation of a regional/multinational repository will have to address some additional issues, specific for a multinational project, in particular in the legal, technical as well as financial area. Bringing into line different legal requirements and criteria, adequately addressing increased transportation needs and a greater variety of waste sources and waste forms, and overcoming economic, financial and socio-political risks of a decades-long undertaking will remain highly challenging.

Some of these issues will already be addressed and investigated in the new two-year project SAPIERR-2 which is expected to be launched by the end of 2006. The objective of this second phase of the SAPIERR project is to develop a practical implementation strategy and organisational structures that will enable a formalised, structured organisation for working on shared EU radioactive waste storage and disposal activities. The main tasks within the project include the management study on the legal and business options, legal liability issues, economic implications of a European regional repository and safety and security impacts. ARAO – Agency for Radwaste Management decided to take part also in this second stage of the SAPIERR project.

4 DISPOSAL PROGRAMME IN SLOVENIA

The multinational disposal concept is an option of topical interest also for Slovenia. The interest is not limited only to the expected economic advantage of a regional or multinational repository. In our case the multinational concept is important because of another aspect – i.e. the shared responsibility for the waste from the NPP with neighbouring Croatia.

According to the agreement between Slovenia and Croatia on the joint ownership and exploitation of the NPP Krško, being effective since March 2003, the management of radioactive waste and spent nuclear fuel is the responsibility of both countries. By the Joint Decommissioning and Waste Disposal Programme for NPP Krško [7], adopted by the Slovenian and Croatian governments in 2004, the preferred solution for the waste is one repository for LILW from both countries and one geological repository for the entire spent fuel inventory. In fact, the Joint Programme proposes two shared facilities for the waste inventory from the two neighbouring countries. According to the IAEA terminology these two repositories may also be regarded as multinational repositories, or more precisely, as regional repositories. Furthermore, if the proposed joint disposal solution is compared to the scenarios for multinational repositories, parallels can easily be drawn with the “cooperation scenario”, in which Slovenia and Croatia agreed to jointly develop and implement the disposal solution in one of the two countries.

However, the hosting country for the repository remains undefined. In the existing version of the Joint Programme, the repositories for LILW as well as for the SF are developed for generic sites. Decision on the hosting country is left to future discussions and negotiations between the two parties. According to the Joint Programme, the LILW repository should be in operation by 2018 and the geological repository for SF and high level waste by 2065.

4.1 LILW repository in Slovenia

In spite of these agreed intentions for shared disposal facilities, the siting and construction of the LILW repository in Slovenia is not being conducted as a joint project.

Slovenia, following the requirements of the 2002 Nuclear Act, needs to provide the repository operation by 2013 and is at present making great efforts to successfully conclude the siting of a repository. The project is conducted as a national project. Croatia is not taking part in this project and the question of whether it will join the construction of the LILW repository in Slovenia remains open [8]. So far no explicit initiative to clarify this issue has been given from any site. If in the future the cooperation of the two countries on this project will be readdressed, there are in principle two possibilities for jointly continuing the project:

- If Slovenia is agreed as a hosting country for the LILW repository, different time schedules of the national LILW disposal programme and joint disposal programme and other plans for the shared repository may be adjusted to the Slovenian plans. Further development of a regional repository may follow the »cooperation scenario«, if financial arrangements for implementation would include also the previous Slovenian investments into the development and siting of a national repository.
- If Slovenia is not agreed as the host country, or if the agreement is not achieved in time, an option of »add-on scenario« for development of a regional repository may also be considered. The Slovenian national repository may be upgraded into a regional repository at some later stage, if finally successfully negotiated between the two countries. The agreement should include a decision on future long-term liabilities as well as adequate consideration of the fact that this option does not lead towards the real "regional" repository, but instead the repository remains a national facility with waste inventory from both countries.

Both options have many variations which depend on adjustments and fine tuning during the negotiations between the partners. But it is important to note that possibilities exist and that options suggested by multinational scenarios may be helpful in further addressing the joint solution.

4.2 Joint or national disposal solution?

From this perspective the developments of the regional/multinational concept and findings of the SAPIERR project are relevant also for our disposal programme. Important aspects and conditions identified through this project as essential for implementation of the regional repository may also have an impact on our disposal projects and therefore need to be carefully examined. Financial arrangements, legal and institutional requirements and socio-political aspects are very likely to play the decisive role in implementing the joint disposal solution, and will certainly require thorough consideration in the future.

Financial arrangements have partly been addressed in the contract on shared ownership of the nuclear power plant, but at a very general level. In case of a joint disposal solution, both parties are liable to cover the cost of its implementation. The two Funds should equally finance all activities related to the disposal of LILW and SF, previously approved by the Inter-governmental commission. These financial arrangements may be sufficient for the initial stage and preparatory phase, but at the latest time when the hosting country becomes known they will certainly have to be upgraded and details specified, taking into account the asymmetric situation of the hosting and partner country. Decisions will have to be made on revenues allocation, on the involvement of private organisations in the development and construction of the repository and - most importantly - on the securing of financing. Careful consideration will also be needed for financial arrangements regarding the siting project for a repository and, in particular, public involvement in the siting process and incentives to local communities. Sharing of financial risks of increased costs, extra expenses due to delays in construction or obtaining licences, unexpected additional work etc. will also have to be

clarified. No such mechanism has been included in the present contract on shared ownership of the NPP.

Regarding the legal aspect, an important question that will have to be addressed in the future is the ownership of waste and its transfer from partner country to the host country. This may prove to be complicated in the case of spent fuel. Although at present SF is considered as waste in both countries this may change in the future, and SF may be recognized as a resource. Clear agreement will be needed for liabilities extending far into the future and a decision will have to be taken on whether to share liabilities also in the future or to transfer them to the hosting country. In the case of a shared repository for spent fuel, an agreement on safeguard will also be needed. Since the spent fuel is of United States origin, the clarification regarding the consent rights may also be required.

Transport and transboundary movement of waste and SF seem not to be a problem. Export and import of waste are conditionally allowed in both countries and - as Slovenia and Croatia are two neighbouring countries - no third country will be involved in the transboundary movement.

There are also other issues important from the perspective of long-term waste management, which have so far been ignored by both partners. The question of possible NPP lifetime extension is more and more frequently discussed in both countries but its influence on the disposal plans has so far not been addressed. Another delicate issue is that of the radioactive waste not originating from the nuclear power plant; although in limited quantities, both countries have such wastes. But the existing plans for a joint solution are developed exclusively for the NPP, therefore limited only to waste from the NPP. In case of a shared repository the disposal of non-energy wastes remains open.

Above all, however, the implementation of a regional repository will require sufficient political and public support in both countries. Recent developments do not inspire much optimism in such support. The relations between the countries are charged with some unresolved issues, such as delays in establishing the Croatian Fund for covering decommissioning and disposal liabilities according to the 2003 contract, or the lawsuit against Slovenia for undelivered electricity for the period before the ratification of the contract. In such an athmosphere, progress towards a joint solution is not very likely.

In case of a complete failure of negotiations between the partners and no agreement being reached on a shared repository, the Slovenian LILW repository - if successfully constructed - will remain a national repository, intended for 50 % of LILW inventory from NPP as well as for LILW from other nuclear applications. Croatia is liable for its own waste. According to the provisions of the contract on shared ownership of the NPP Krško, the Croatian part of the waste needs to be removed from the site and transferred to Croatia by 2025 at the latest.

The LILW repository construction will proceed as a national project. However, for the emplacement of waste into the repository, the criteria for splitting and sharing the waste will have to be agreed upon between the partners. In the opposite case, sharing of waste may not be possible. No such criteria exist so far. If such an agreement is not reached in time, the acceptance of waste into the LILW repository may be delayed. Similar problems of sharing - but much more complicated - will emerge also in the case of spent fuel, if the joint solution should fail.

5 CONCLUSIONS

The concept of multinational repositories is gaining more and more support worldwide. As shown by the EU project SAPIERR, the economic advantages of shared facilities are quite convincing. However, in the implementation phase, the multinational repositories will face

even more problems than national disposal programmes. In particular the siting of such a facility will be a highly challenging project, and to achieve sufficient political support and public acceptance may be time consuming and costly. However, shared disposal facilities remain interesting, not only because of expected economic advantages, but other aspects like safety, safeguards and reduced risk of nuclear proliferation are becoming an important driving force.

Because of shared responsibility for the disposal of waste from the NPP Krško with the neighbouring Croatia the shared disposal concept is of high interest also for Slovenia. The two countries decided to encourage a joint disposal solution for LILW as well as for SF. It was agreed to have a shared repository for LILW in 2018 and a shared repository for SF in 2065. However, the present siting and construction of LILW repository in Slovenia is being conducted as a national project. It remains unclear whether or not Croatia will join the project. Such a possibility still exists if there is sufficient political and public support for a joint solution.

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