

Does Dual Ownership of Waste Imply a Regional Disposal Approach?

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ABSTRACT

The construction of the Nuclear Power Plant Krško, being located in Slovenia near the Slovenian-Croatian border, was a joint investment by Slovenia and Croatia, two republics of the former Yugoslavia. The plant was completed in 1981 and the commercial operation started early in 1983. The obligations and rights of both investors during the construction and operation were specified in two bilateral contracts signed in 1974 and 1982. These contracts were fairly detailed on construction, operation and exploitation of the nuclear power plant (NPP), but they said very little about future nuclear liabilities. The electricity production was equally shared between the two countries and both parties participated in management of the NPP.

In 1991, after Slovenia and Croatia became two independent countries, the agreement on the ownership and exploitation of the NPP Krško was re-negotiated and a new contract signed in 2003. By the new contract the decommissioning and the disposal of spent fuel (SF) as well as low and intermediate level waste (LILW) is the responsibility of both parties, and the financial resources for covering these liabilities should be equally provided. Regardless of shared ownership of waste, the agreement opts for a single disposal solution for LILW as well as for SF, but the details are left open.

More clear elaboration of these responsibilities is given in the programme of the decommissioning and disposal of radioactive waste from the NPP which was jointly prepared by the Slovenian and Croatian waste management organisations in 2004. The programme is clearly opting for only one repository for LILW and one repository for spent fuel, which can be located either in Slovenia or Croatia. Irrespective of the country where such a repository will be sited, dual ownership of waste opens up another dimension of such a solution: will such a repository be regarded as a national facility or as a regional or multinational facility? Both options – national and regional/multinational – may have a strong influence on future agreements on waste disposal, but so far these aspects have not been addressed either in Slovenia or Croatia.

The paper brings reflections and discussion on these aspects of waste management in Slovenia and reveals the current situation of the waste disposal project in the country.

INTRODUCTION

In the seventies Slovenia and neighbouring Croatia, two republics of the former Yugoslavia, decided for the joint construction of a nuclear power plant. Initially two nuclear power plants were planned – one in Slovenia, another in Croatia – both to be jointly financed, constructed and exploited. The construction of the first NPP, being located near Krško in Slovenia, started at the end of 1974 and was completed by 1981, when the trial operation started, and 1 January 1983 was regarded as the beginning of the commercial operation of the NPP Krško. The construction

of the second NPP in Prevlaka near Zagreb was never realized. Plans were stopped by the moratorium on further construction of NPP until 2000, adopted by the former Yugoslavia in 1986. Later the moratorium was adopted also by Slovenia, which withdrew from further activities on NPP Prevlaka.

The whole investment into the construction of the nuclear power plant was governed by the contract between Slovenian and Croatian utilities on combining the financial resources for joint construction and joint exploitation of the NPP Krško based on the prior agreement between the two Governments on construction of a joint nuclear power plant. In 1982, after successful construction, a new contract was signed between the two investors - the Slovenian and the Croatian utilities – and the newly established company of NPP Krško, specifying the details of operation and exploitation of the NPP. Both contracts are rather detailed on financial arrangements between the parties concerning the construction and mutual exploitation relations during the operation phase of the nuclear power plant, but they are both extremely stingy with regard to post-operation phase and future nuclear liabilities. They are mainly satisfied with very general statements like »the two investors should equally share all rights and responsibilities during the exploitation phase«. The issue of radioactive waste is first briefly mentioned in the contract from 1982, stating that the company of NPP Krško, being established in equal shares by both investors, is responsible for storing the radioactive waste according to the relevant rules and regulations and ensuring that the cost of storing of spent nuclear fuel and radioactive waste should be covered by the founders of the NPP Krško company from both republics. Liabilities in connection with future decommissioning of the facility are not mentioned in the contract.

Nevertheless the concern for radioactive waste was not ignored, and in the late eighties the increased awareness of the need for the long-term solution induced the first activities for siting and construction of the repository for LILW. It was agreed between the two countries that each country would perform its own site selection project and that the decision as to whether each country would dispose of its own waste or whether they would decide for a joint solution would be taken in later stages. Over the next years the simultaneous site selection processes progressed and, as a result of these activities, the initiative was also given for establishing waste management organisations to carry on the siting projects. At the beginning of the nineties both countries identified several candidate sites for an LILW repository, and in 1991 they both also established waste management agencies: ARAO – Agency for Radwaste Management in Slovenia – and APO – Agency for Hazardous Waste in Croatia. But the siting period coincided with the disintegration of the former Yugoslavia and formation of new independent countries. In 1991 Slovenia and Croatia became independent democratic countries. This turbulent time was not in favour of taking serious decisions on long-term waste management. The resistance against the project grew stronger every year. In Slovenia the site selection project ultimately failed in 1993, in Croatia it was strongly slowed down until all activities were stopped.

DUAL OWNERSHIP OF THE NPP

Nuclear liabilities in the new contract on NPP Krško

The issue of nuclear liabilities was re-addressed after the political changes in 1991. The declarations of independence by Slovenia and Croatia in 1991 resulted in strong changes not only in the political, but also in the economical and social life of the two countries. Many other aspects, relations and connections between different actors in Slovenia and Croatia had to be

reviewed through the new optics and put on a new stand, if necessary. Also the contract on joint exploitation of the NPP Krško and the relations between the partners had to be newly agreed and redrafted. The negotiations between Slovenia and Croatia on the ownership and exploitation of the NPP Krško have remained a hot issue between the two countries for more than a decade. The real progress was achieved only in 2002, when the new contract was drafted. It has been effective since March 2003 (Official Gazette of the RS, No. 5/03).

Many difficulties in negotiations were due to undefined nuclear liabilities from the original contracts from 1974 and 1982, which served as the basis for the new agreement. No matter how much it was wanted, real progress regarding future nuclear liabilities was difficult to achieve. Compared to the previous contracts, the improvement is relatively modest.

In the new contract from 2003 all long-term nuclear liabilities are covered in two articles. According to these articles, decommissioning and waste disposal are the responsibilities of both parties. Both parties agree that they will provide an economic, effective and environmentally acceptable joint solution for decommissioning as well as for waste disposal. Disposal of low and intermediate level waste and spent nuclear fuel will be performed in accordance with the *LILW and SF disposal programme* and the decommissioning of the facility in accordance with the *Decommissioning programme*, which both need to be prepared by waste management organisations from both countries within 1 year after contract ratification. Details on LILW and SF disposal and on decommissioning, including the cost assessments of proposed solutions, are to be elaborated in these two programmes. Programmes are approved by the Inter-governmental commission, composed of the representatives of both countries.

Further on it is agreed that the site of the NPP can be used for the storing of radioactive waste as well as of spent fuel until the end of the operational period. If by the end of the projected lifetime in 2023 the parties have not agreed on a joint disposal solution, each party is liable to take one half of LILW and one half of SF and remove both from the site. In case of extended operation of the NPP, newly generated waste must be regularly transported from the site at least every 5 years.

According to the contract, the parties are also liable to financially cover the cost of waste disposal and the cost of decommissioning. In case of joint disposal solution, both parties should finance the projects in equal shares from the planning to the implementation phases. In the opposite case, each party is financially responsible for its own disposal.

Symmetry is required also in making financial provisions for future nuclear liabilities. Financial resources are to be collected in two Funds, established in each of the two countries within one year after contract ratification.

Joint Decommissioning and Waste Disposal Programme of NPP Krško

Both programmes - a programme of decommissioning and a programme of LILW and SF disposal - were prepared by the waste management organisations from Slovenia and Croatia between 2003 and 2004, and in March 2004 submitted as one document (The Joint Decommissioning and Waste Disposal Programme of NPP Krško – Joint Programme) to the Inter-governmental commission for adoption. The Programme was primarily aimed at providing a good estimation of future liabilities of the NPP Krško [1], [2]. A cost estimate for NPP Krško decommissioning, for disposal of LILW and for long-term management of SF is required as a necessary input to the two national funds which, according to the agreement, take the responsibility of collecting the funds for implementing the decommissioning and disposal

programmes. For this purpose, the disposal of LILW as well as long-term spent fuel management - as the most important future liability - were addressed seriously and the disposal options investigated in greater detail.

The Joint Programme assumes that the operation of NPP Krško will end in 2023. It also assumes that all LILW will be disposed of in a single near surface repository with sufficient capacity to accommodate operational as well as decommissioning LILW from NPP Krško. The total volume of disposed waste is estimated at 17.500 m³. The repository will be available before the decommissioning is due to start. According to the programme the LILW repository operation is planned in 2018. The Programme avoids any discussion on the site of the future repository. The whole project is prepared for the generic site either in Slovenia or Croatia. The decision on where the repository will be sited is left open.

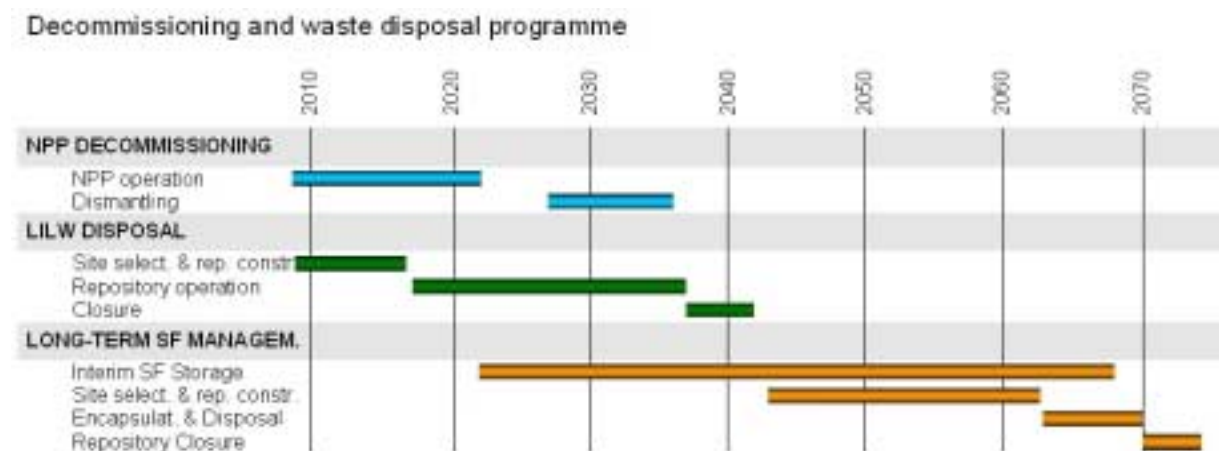


Fig. 1. Planned decommissioning and disposal of waste from the NPP Krško.

One deep geological repository is assumed also for the disposal of spent fuel. The reference scenario is developed for a generic location in hard rock media. Where required, area-specific magmatic and metamorphic rock properties are applied. The repository design as well as the packaging of spent fuel follow the Swedish disposal concept. The underground part of the repository is situated at a depth of 500 m below the ground surface. The above ground facilities include also an encapsulation plant for spent fuel. The repository operation is scheduled to start in 2065, and the capacity of the repository is 620 tons of heavy metal. Disposal of spent fuel will start during the second year of repository operation. A total quantity of 420 canisters will be deposited within four years. After 5 years of operation all SF will be disposed of and the repository will be backfilled and closed.

For the decommissioning of the nuclear power plant the immediate dismantling strategy has been adopted. Several variations of this strategy are being investigated, mainly differing from each other by the dismantling period. The decision on decommissioning of NPP was taken only after combining the decommissioning scenario with the LILW and SF disposal options and optimizing the integral scenario.

The adopted Joint programme represents a step forward regarding future nuclear liabilities of the NPP Krško. The scenarios for the dismantling of the NPP and for the disposal of radioactive waste and spent nuclear fuel have been elaborated and costs for their implementation have been

estimated. However many aspects of future decommissioning and especially of long-term waste management and waste disposal are still left open. The Programme avoids any discussion on the site of the future LILW as well as of the SF repository. The projects are prepared for the generic sites either in Slovenia or Croatia. The decision on where the repositories will be sited will require further negotiations and close co-operation of both parties to deal with the issue. Nevertheless, irrespective of the country where they will be sited, such repositories will have the characteristics of a regional repository.

REGIONAL REPOSITORY

The idea of a regional and/or multinational repository has been well known for many years. It is especially interesting for 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 and high level waste, such countries encounter serious difficulties in developing their own national disposal solutions. Multinational, shared repositories represent an option which may help in solving these deficiencies.

So far no regional or multinational repository has been put into operation or is being planned in reality. All discussions on regional/multinational disposal are based only on theoretical considerations. There could be various circumstances leading to the development of a repository shared by several countries. They could be based on economical, safety or ecological motives [3]. Based on today's perspective and understanding [4], there are basically three likely scenarios 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 cooperation scenario may be developed in various ways. In the IAEA document [4] three possibilities are outlined:

- Several industrialised countries with relatively small nuclear energy programmes decide to cooperate for the disposal of their radioactive waste in a host country satisfying all necessary technical requirements.
- Countries with small quantities of radioactive waste, and in varying stages of development, seek assistance from each other and cooperate to ensure that one of their number acquires all the necessary technology and institutional structures.
- In a process of optimization, certain countries may specialize in the disposal of specific types of waste and develop specialized repositories, possibly combined with arrangements for international exchanges.

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.

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.

Comparing these scenarios of multinational repositories to the disposal scenario from the Joint decommissioning and waste disposal programme for the waste from NPP Krško, we can easily draw parallels and analogies with the »cooperation scenario«: Slovenia and Croatia agreed to provide a joint disposal solution for the waste from both countries. According to the contract, this solution should be jointly developed and implemented 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. Even so, irrespective of the hosting country, a repository with an inventory from two different countries may be regarded as a multinational or - more precisely - a regional repository.

It is interesting to note that the shared repositories for LILW and for SF as proposed in the Joint Programme have never been discussed from the perspective of regional repositories. This aspect has been ignored so far, and the conditions relevant for the implementation of the regional repository have not been examined. According to the IAEA document [4] these conditions are related to:

- security and environmental safety,
- economic and financial arrangements,
- technical aspects,
- legal and institutional aspects, and
- socio-political aspects.

Some of these conditions seem not to represent a particular problem in further implementation of the shared repository. Security, safety and safeguards in waste management are already being practised now, and all necessary infrastructure for their implementation is in place in both countries. Most probably it will also not be an insurmountable problem to agree on technical aspects of the shared repository, especially if cooperation on the project is to continue through the whole period of project development and implementation. It is very likely that the main challenge rests with the financial arrangements, legal and institutional requirements and socio-political aspects. These aspects will certainly require thorough consideration in the future.

Financial arrangements have partly been addressed in the recent contract from 2003 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 will become 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.

Above all, however, the implementation of a regional repository will require sufficient political and public support. Recent experience with the siting of national LILW repositories in Slovenia and in Croatia, as well as avoidance of tackling the issue of long-term management of radioactive waste and spent fuel in the contracts on shared ownership of the nuclear power plant, do not inspire much optimism. Public opinion is not in favour of accepting foreign waste, either in Slovenia or in Croatia. Politics is cautious, delicate decisions are postponed. At the moment there are no indications that such a decision will be taken soon. It seems more probable that it will be delayed as long as possible. Such a situation may jeopardize the cooperation scenario for a regional repository, especially for the LILW repository, planned for 2018, and future development may take another course.

LILW REPOSITORY IN SLOVENIA

In parallel with the efforts for the joint disposal solution together with Croatia, Slovenia is also conducting its own long-term waste management programme. The main goal – LILW repository construction – was set many years ago and reaffirmed in 2002 by the new Nuclear Law which requires a site for a repository to be known by 2008 and the repository to be in operation by 2013. The LILW repository siting and construction is also a vital part of the Slovenian National Waste Management Programme, approved by the Government in 2005 [5].

The siting process is based on a mixed mode site selection approach, which is a combination of technical screening and volunteer siting - with full recognition of public participation and local communities' involvement in the decision-making process - as the essential component of this process [6], [7]. At present the siting of the repository is in full swing [8]. In November 2004, the official spatial planning procedure for the LILW repository was started, aiming at the preparation of a detailed site development plan for a repository. The first step in this administrative procedure was the official invitation to local communities to participate, with clear instructions and rules for participations and publicly announced benefits to the participating parties. Several local communities volunteered, three of them were preselected for field investigations and site

characterisation. According to current plans the site characterisation and site selection should be completed by 2008.

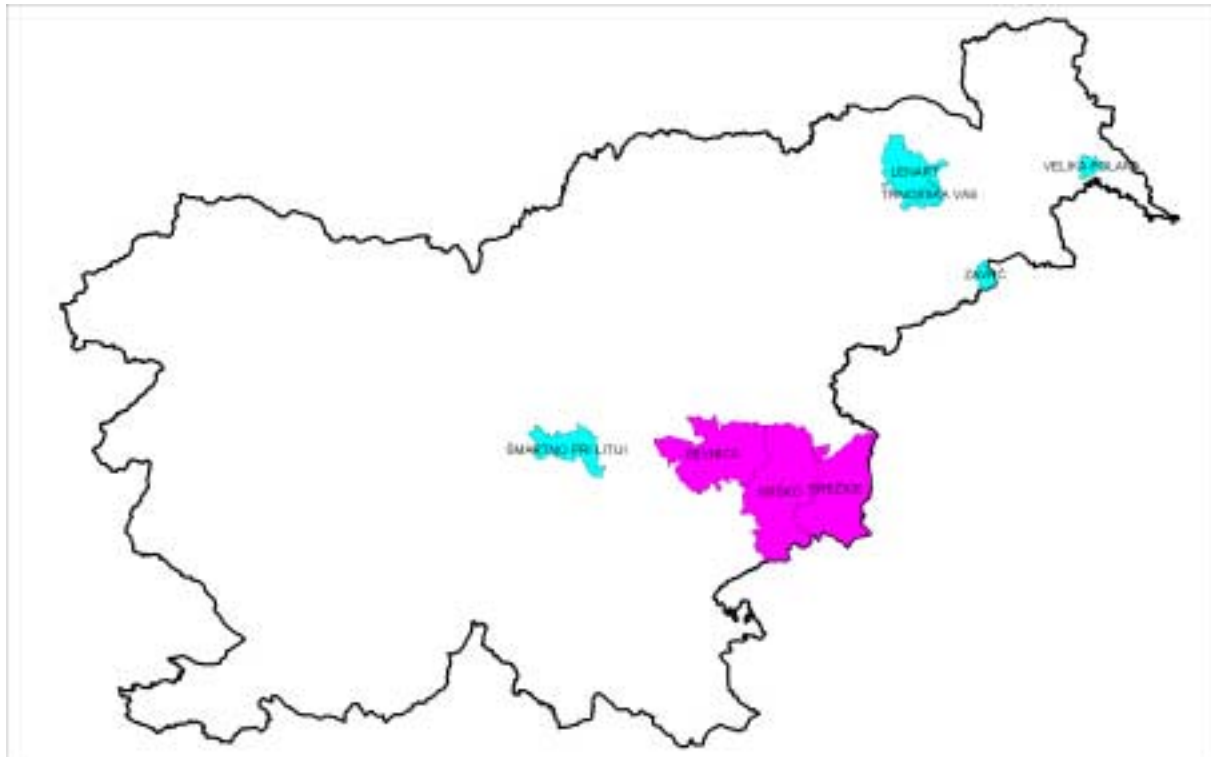


Fig.2. Three local communities (pink) preselected for field investigations and site characterisation for the LILW repository out of eight volunteered communities.

In spite of excellent progress in siting of a repository so far, and good prospects of successful accomplishment of the whole disposal project in Slovenia, there still remain several open questions which raise concern and call for answers.

There is a certain inconsistency between the national disposal plans and the Joint disposal programme. While in the Joint programme the LILW repository operation is foreseen in 2018 as a shared facility, the national programme requires operation of a national repository already in 2013. There is also some ambiguity relating to the capacity of the repository. At this moment it is still unclear whether the repository should be planned to accommodate all LILW inventory from NPP Krško, or only the Slovenian part.

This dual track policy calls for harmonization. Open questions, such as national or regional repository, disagreement of time schedules, capacity of planned repository and similar will have to be clarified. Searching for the solution may go in different directions, but in principle there are two main options:

- If Slovenia is agreed as a hosting country for the LILW repository, different time schedules and other plans for the shared repository may be adjusted to 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 of a national repository.

- If Slovenia is not agreed as a 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 that 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.

POSSIBLE FUTURE DEVELOPMENTS

Further development of this complex situation is unclear. At present there are no clear indications on future progress towards a joint solution. There are some positive achievements, such as the preparation and adoption of the Joint Decommissioning and Waste Disposal Programme and good cooperation between waste management organisations from both countries, but there are also drawbacks. Croatia delays in establishing its Fund for covering decommissioning and disposal liabilities and violates the provisions of the 2003 contract, which represents a strong obstacle to further development of the joint solution. On the other hand, Slovenia proceeds with its national disposal plans for the LILW repository without previous harmonization with Croatia or the Joint disposal programme. The Inter-governmental commission meetings are postponed, instead of efforts being made to smooth down the problems and find an acceptable solution for both partners.

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 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.

The time-distant plans for the disposal solution for spent fuel still allow for a relatively relaxed approach, since it is hoped that in the coming decades - before the siting and construction of a repository is to start - the existing problems and ambiguities will be removed and clarified; however, such an ease is not possible in the case of an LILW disposal. Short time spans for implementing the solution call for immediate action and harmonization of plans.

If there is sufficient political will to reach a common solution, and if fair agreement between the two partners will be achieved soon enough, then plans for implementing a shared LILW repository may proceed either according to the »cooperation scenario« or the »add-on scenario«. Both options still remain possible.

However, there is also a pessimistic scenario of the future development of the Slovenian-Croatian joint disposal solution. The worst case is a complete failure of negotiations between the partners and no agreement on a shared repository. In this case, 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 contract on shared ownership of NPP allows for the waste and SF to be stored on the premises of the NPP until 2025. This possibility is not stimulating an early decision on the disposal option. At present Croatia may not be interested in entering into any new agreement on LILW disposal with Slovenia. This may put Slovenia in a very difficult position. The repository construction will proceed as a national project. But 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.

CONCLUSION

Sharing responsibility for the disposal of waste from one nuclear power plant between the two countries is unique in the world. Slovenia and Croatia, being found in such a situation, have decided to encourage a joint disposal solution for LILW as well as for SF. A shared repository for LILW is planned to be in operation by 2018, and a shared repository for SF in 2065.

However, the implementation of these plans is not straightforward and further strong engagement of both parties will be required. There are still many open questions regarding long-term waste management which will have to be addressed and resolved before proceeding with the joint project. Non-compliance with the already agreed financial provisions for covering future nuclear liabilities on the Croatian side, and unharmonized Slovenian national disposal plans with the Joint Disposal Programme, are at present at a critical stage. But no real progress in developing the joint solution can be achieved if the two countries do not agree on the hosting country.

As Slovenia proceeds with its national disposal plans, time for achieving agreement is running out. But with sufficient political support and full engagement of all involved actors, the plans for implementing a shared LILW repository may proceed either according to the »cooperation scenario« or the »add-on scenario«. Both options are still possible. If successfully implemented this will be the first regional repository worldwide, and the lessons learned from this case may provide a good guide for all interested parties in shared repositories.

The painful experience in the process of negotiating the duties and responsibilities of both partners regarding future decommissioning and disposal of waste from NPP Krško, inherited from initial contracts on joint construction and exploitation of the NPP, may also be a good lesson to all interested parties of shared facilities. Clear allocation of all nuclear liabilities at the very beginning is vital for successful implementation of such a facility.

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