Deliverable 9.16: Implementation of the ROUTES ICS action plan first phase - CS discussion and input focused on the first topic identified in the ICS action plan (task 7.2)

(Report of Task 7 on Interaction with Civil Society (ICS): Ethical and legal issues, good transparency, public concerns on shared solutions and case studies)

Work Package 9

The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847593.

Document information

Project Acronym	**EURAD**
Project Title	**European Joint Programme on Radioactive Waste Management**
Project Type	**European Joint Programme (EJP)**
EC grant agreement No.	**847593**
Project starting / end date	**1st June 2019 – 30 May 2024**
Work Package No.	**9**
Work Package Title	**Waste management routes in Europe from cradle to grave**
Work Package Acronym	**ROUTES**
Deliverable No.	**9.16**
Deliverable Title	**Implementation of ROUTES action plan first phase**
Lead Beneficiary	**JSI [EIMV]**
Contractual Delivery Date	**M24**
Actual Delivery Date	**M36**
Type	**Report**
Dissemination level	**Public**
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To be cited as:

Zeleznik N., Swahn J., Haverkamp J., Hooge N.H., Rey H., Daniska M. (2021): Implementation of ROUTES action plan first phase. Final version as of 04/05/2022 of deliverable D9.16 of the HORIZON 2020 project EURAD. EC Grant agreement no: 847593.

Disclaimer

* The authors would like to acknowledge Colin Wales for his proofreading efforts.

Acknowledgement

This document is a deliverable of the European Joint Programme on Radioactive Waste Management (EURAD). EURAD has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 847593.

Status of deliverable		
	By	Date
Delivered (Lead Beneficiary)	Nadja Zeleznik [JSI (EIMV)]	25/07/2021
Verified (WP Leader)	Elisa Leoni (IRSN)	15/11/2021
Delivered (Lead Beneficiary)	Nadja Zeleznik [JSI (EIMV)]	20/12/2021
Reviewed (Reviewers)	François Marsal (IRSN)	11/03/2022
Approved (PMO)	Elisabeth Salat (IRSN)	04/05/2022
Submitted to EC (Coordinator)	ANDRA	04/05/2022

Executive Summary

The work of Task 7 on interaction with civil society (ICS) during year 2 has been mainly focused on investigations in relation to the ROUTES Task 6 on “Shared solutions for European countries”. This topic obtained a lot of attention from the larger civil society (CS) group. In this deliverable D9.16 “Implementation of ROUTES action plan first phase (Good transparency, ethics, public concerns and case studies)”, the results of the investigations are provided, including comments, suggestions, questions, and other observations collected in interaction with EURAD participants and the CS larger group during the related workshop held in year 2 of EURAD.

This report starts with an overview of the ICS action plan with the main issues for investigation of Task 7 in the following years and the focus of the present deliverable. In addition, some general issues of good transparency that direct the overall activities in Task 7 are summarised. In section 2, some key ethical and legal principles for managing radioactive waste are discussed, that have a general value for all different radioactive waste management situations (predisposal and disposal), including for shared solutions of radioactive waste management (RWM). Section 3 deals with the main topic of the year 2 investigation and discusses public concerns related to shared solutions and underscores the importance of a common safety culture and a level playing field, and how both could be achieved in the context of a proper legal framework. The report describes the outcomes from interactions with the CS larger group and presents results of answers to a questionnaire on such issues.

Section 4 presents cases of radioactive waste (RW) shared solutions in different contexts, describing the issues at stake from a CS perspective in the context of related international conventions (Aarhus and Espoo Conventions, but also adopted EU/EURATOM directives). For two more complex cases, longer versions are provided as appendixes. Based on the descriptions and analyses, conclusions with general recommendations from the case studies and interaction with civil society that could more generally apply for RW shared solutions are provided in section 5.

The ongoing interactions and progress of activities in relation to Tasks 2-5 in ROUTES that have taken place during year 2 are reported in section 6. Finally, some ideas of what the next investigations will be for the focus during year 3 are reported in section 7.

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Glossary

ALARA	As Low As Reasonably Achievable
BAT	Best Available Technology
BEPPER	Broad framework for Effective Public Participation in Environmental decision-making in radioactive waste management
BRP	Best Regulatory Practice
CS	Civil Society
D9.16	Deliverable 9.16
DBD	Deep Borehole Disposal
DDU	Double Depleted Uranium
DP	Disposal
DU	Depleted Uranium
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EJP	European Joint Programme
EU	European Union
FOIA	Freedom of Information Act
GD	Geological Disposal
GEN	GEN energija, d.o.o.
HEP	Hrvatska elektroprivreda
HF	Hydrofluoric acid
HLW	High Level Waste
IA	Intergovernmental Agreement
IAEA	International Atomic Energy Agency
IC	Intergovernmental Commission
ICS	Interaction with Civil Society
ILO	International Labour Organisation
ILW	Intermediate Level Waste
JAVYS	Jadrová a vyraďovacia spoločnosť = Nuclear and decommissioning company
LILW	Low and Intermediate Level Waste
LIMS	Large Inventory Member States
LLW	Low Level Waste
MESP	Ministry of the Environment and Spatial Planning
MS	Member State or Member States
NATO	North Atlantic Treaty Organization
NEA	Nuclear Energy Agency

NGO	Non-Governmental Organisation
NPP	Nuclear Power Plant
NRA	Nuclear Regulatory Authority
NRC	Nuclear Regulatory Commission
NTW	Nuclear Transparency Watch
OECD	Organisation for Economic Co-operation and Development
PMO	Programme Management Office
Q/A	Questions & Answers
R&D	Research & Development
RC	Republic of Croatia
Res	Nationally funded Research Entities
RS	Republic of Slovenia
RW	Radioactive Waste
RWM	Radioactive Waste Management
SEA	Strategic Environmental Assessment
SF	Spent Fuel
SFRY	Socialist Federal Republic of Yugoslavia
SIMS	Small Inventory Member States
SNF	Spent Nuclear Fuel
SNSA	Slovenian Nuclear Safety Administration
SR	Slovak Republic
SRPA	Slovenian Radiation Protection Administration
TCT	Treatment and Conditioning Technology
TENORM	Technically Enhanced Naturally Occurring Radioactive Material
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference
TSOs	Technical Support Organisations
UF	Uranium Fluoride
USA	United States of America
VLLW	Very Low Level Waste
WAC	Waste Acceptance Criteria
WMOs	Waste Management Organisations
WP	Work Package

1. Introduction

In the Deliverable 9.15 "Scoping of ROUTES, Initial ICS Input and ICS Action Plan", developed by the CS experts of Task 7 in the ROUTES WP, we focused on scoping the objectives and actions in ROUTES tasks 2-6 in order to identify issues that are deemed of more specific interest in the perspective of developing interactions between Civil Society and EURAD partners along the course of the WP. The first version of the ICS action plan is part of D9.15, but has, after submission of the deliverable, been further reassessed and adopted by Task 7 members as a base for this deliverable 9.16 "Implementation of ROUTES action plan first phase". The context of this report follows the adopted structure of the activities in the ICS action plan that is reproduced in section 1.1. In section 1.2 some general issues of good transparency in decision-making in radioactive waste management (RWM) are discussed based on the so-called BEPPER report published by Nuclear Transparency Watch (NTW). In section 1.3 there is a discussion of the concept of "shared solutions" for RWM. The introduction is concluded by a description of the structure of the report.

1.1 ROUTES Task 7 action plan for year 2-4 for interaction with civil society (ICS)

Based on the outcomes of the Task 7, investigation of tasks 2-6 in the ROUTES WP, additional feedback from EURAD participants and interaction with the EURAD CS larger group, an action plan for Task 7 work with interaction with civil society for the years 2-4 of the project was developed. This action plan is a dynamic proposal and will be further revised each year to include the developments of the work done, the results produced in tasks 2-6 in the ROUTES WP and the interaction activities with the CS larger group. There may also be inputs from other EURAD participants, influence from developments in different international arenas (for instance the European Commission and international organisations engaged in the field), or developments at the national level in participating countries. The **proposed topics for the overall work** for years 2-4 are:

1. In the frame of **Task 2, "Identifying challenging wastes to be collaboratively tackled within EURAD"**, the group of CS experts has identified the work as interesting, among others because there will be a **description of inventories of challenging wastes for many countries**. It may certainly be of interest to Civil Society in those countries to be informed about this and about the on-going plans to manage and dispose of such wastes.
    - Task 7 will therefore work **on understanding and communicating information about the inventories to the CS larger group and where applicable also beyond into general civil society**.
    - The CS experts' group will study and take into account deliverable **D9.4 "Overview of existing work on categorization/classification of radioactive wastes (RWs) in participating states** to assist **communication on the categorisation and classification schemes provided by the participating countries.**
    - During EURAD year 2, the focus will be on **following the production** of the deliverable D9.5 "Overview of issues related to challenging wastes".
    - Method:
        - To follow the deliverable production, with a focus on the inventory descriptions,
        - To develop a summary that can be understandable by civil society,
        - To discuss it and bring feedback to ROUTES participants,
        - To report the findings in deliverable D9.16.

2. In the frame of **Task 3 on "Description and comparison of radwaste characterisation approaches"** and **Task 4 on "Identification of Waste Acceptance Criteria (WAC) used in EU Member States for different disposal alternatives in order to inform development of WAC in countries without WAC/facilities"**, the group of CS experts will primarily follow the work of the tasks in order to be able to assist in communicating the work to the larger CS group.

- Method:
  - To follow the deliverable production in a general way,
  - To develop short summaries that can be understandable by civil society,
  - To discuss the deliverables and bring feedback to ROUTES participants,
  - To report key findings in deliverable D9.16.

3. In the frame of **Task 5, "RWM Solutions for small amounts of waste",** the examination of **how the conditions for CS involvement in small inventory member states (SIMS) differ from CS involvement in large inventory member states (LIMS)** is an issue of interest under Task 7. The work will be commenced in smaller scale in year 2, but larger efforts are planned for years 3-4.
   - Look at CS involvement in SIMS and in LIMS**, search for commonalities and differences**, factors with impact, like transparency level (according to discussions in the BEPPER report produced by Nuclear Transparency Watch (NTW)[1]: information availability, quality and access, participation in decision-making, access to legal recourse, including CS resourcing).
   - Method:
     - We will select a few cases on the basis of still to establish criteria – up to 4 typical cases – 2 from each group,
     - Descriptive approach – establish potential structures,
     - Add a Q/A with representatives from different groups,
     - Discuss draft findings in the CS larger group and with EURAD participants.
   - Important **topics with ethical implications are the consideration of deep borehole repository technology in the CS larger group, as well as long-term interim storage**.
   - Method:
     - Link with the work in the SITEX Network, where NTW is also involved, with analysis of deep borehole repository (DBR).
     - Developing an understanding of positive and negative aspects on and current challenges in long term interim storage.

4. In the frame of **Task 6, "Shared solutions in European countries",** the work of Task 7 will concentrate on the issue of **understanding what "shared solutions" can mean as well as the public perception of transnational or shared nuclear facilities**, particularly storage and repositories for nuclear waste, as a key issue with respect to CS involvement. There will be a focus on this topic in year 2.
   - The CS experts intend to look into **how the understanding of the public perception of shared nuclear facilities between two or more MS differs from public perception of nuclear facilities within one Member State**, if at all, and how a process of localization of a shared nuclear facility, involving all the relevant stakeholders could be structured.
   - Also, the **requirements of European law will be explored**.
   - Some examples of shared solutions will support the investigated topic, like:
     - the **shared responsibility for radioactive waste from the Slovenian / Croatian Krško NPP**,
     - the **management of metal waste from all over Europe at the Studsvik facility in Sweden**[2],
     - the **export of depleted uranium for uncertain management in Russia,**

[1] http://www.nuclear-transparency-watch.eu/a-la-une/new-publication-bepper-report.html

[2] This case study was not completed for this report.

        - **the Bohunice centre in Slovakia**, established to treat the waste from the A1 NPP accident, but now rebuilt for treatment of larger quantities of RW including RW from foreign countries.
    - Method:
        - Develop an understanding of the concept of "shared solutions" and the public perception of such developments with a reference to the Aarhus convention:
            - On the basis of the EU/Euratom legal framework, what are the important issues to consider in shared solutions, who is responsible and what happens concerning transfer of ownership?
            - Review of possible societal concerns and discussion with the CS larger group and others,
            - Examples of shared solutions, problems and open issues from case studies
            - How to structure the shared solution to address different CS concerns?
            - Possible recommendations.
        - Discuss and collect feedback from CS and others.

A focus of the work of Task 7 during year 2 is on point 4 above, i.e., on Task 6 on "Shared solutions for European countries", as this topic obtained a lot of attention also from the CS larger group. In this deliverable D9.16 "Implementation of ROUTES action plan first phase", the results of the investigation are provided, including comments, suggestions, questions, other observations collected in interaction with EURAD participants and the CS larger group.

Also, the ongoing interactions and progress of activities during year 2 in relation to tasks 2-5 are reported in this deliverable, which furthermore includes indications of changes in priorities on content for further work that will be reported later in D9.17 "Implementation of ROUTES action plan second phase" (May 2022), and D9.18 "Implementation of ROUTES action plan third phase" (May 2023).

The CS experts in Task 7 will during the whole project actively follow the development of deliverables by all the Tasks 2-6 and give inputs suggested by both the CS experts group and the CS larger group. The suggestions from the CS experts are meant to be discussed with ROUTES participants to also define R&D activities in the different tasks.

1.2 General issues about good transparency

Nuclear Transparency Watch (NTW) is a European wide network and a non-profit organisation that was founded in 2013 in order to promote transparency and public participation in the nuclear field, in the perspective of the Aarhus Convention. Just before its creation, in July 2011, the Radioactive Waste Directive (2011/70/Euratom) was adopted, including Article 10 on transparency. The first national radioactive waste management (RWM) programmes and reports were to be delivered in August 2015. NTW had early discussions with the European Commission (DG ENER) concerning how it would be possible to evaluate the implementation of Article 10 on transparency in the Member States. In 2014-2015, NTW worked on a project to study how efficient transparency (i.e., public information and participation) in RWM could be described. The result was the BEPPER report[3] (BEPPER stands for "Broad framework for Effective Public Participation in Environmental decision-making in Radioactive waste management"), which was published in December 2015.

[3] The BEPPER report, December 2015 http://www.nuclear-transparency-watch.eu/wp-content/uploads/2016/04/NTW_Transparency_in_RWM_BEPPER_report_December_2015.pdf

The BEPPER report includes a wide range of provisions on what constitutes good transparency:

- First, the paper contains elements on the definition of transparency in the Radioactive Waste Directive, which take the form of broadly formulated requirements for public information and participation during RWM decision-making.
- It also holds some content on transparency based on the Aarhus Convention and its three pillars: access to public information, access to public participation, and access to justice.
- The report sets four Pillars for Effective Transparency which are mainly based on the Aarhus Convention: effective access to information and communication, effective access to public participation and consultation, effective access to justice and decision-making, and effective access to resources. It goes further in establishing a Level System for Evaluation of Effective Transparency in RWM with regards to those 4 pillars.
- The note also settles some Key Components of Effective Transparency in RWM: some principles (e.g., building societal confidence, adopting a multi-generational perspective, considering public perceptions of safety and risk, taking into account energy policy), good practices (e.g., enhancing dialogue in pluralistic spaces, demystifying and democratising, adopting new decision-making processes, setting horizontal as well as vertical information exchanges, implementing and facilitating access to justice), plus components on innovation in resources and transparency assessment (e.g., make sure that civil society has the resources to participate; create the conditions for civil society access to expertise; engage experienced and widely trusted facilitators; develop libraries, compendia, websites of good practices, etc; elaborate standards for transparency assessment).
- It ends with a general reflection regarding transparency in RWM. e.g., all applicable international regimes should be implemented and continuously strengthened at the national level; effective transparency regimes for RWM will result in better quality decision-making processes leading to higher safety and possibilities for higher trust; as part of civil society, environmental NGOs have a special role to play in transparency processes - if properly resourced, they can provide organised and qualified input that improves decision-making leading to more robust and acceptable outcomes.
- In the appendices of the report, one can find relevant research and experience from other processes on transparency in RWM, as well as international and European governance on Transparency in RWM that helped NTW members in producing the report.

Beyond the BEPPER report, the BEPPER project had some broader objectives, e.g., to establish enduring governance models providing resources to NGOs on the international, national and local level; to improve technical and legal capacities of NGO representatives participating in research projects; to promote the inclusion of Civil Society and NGOs as part of the RWM arena; to enable the development of a legal framework for effective public participation in RWM that takes into due account the input of NGOs; to involve Civil Society and NGOs as respected partners in international and European networks.

These objectives are being partly reached in the frame of EURAD. Indeed, this is the first European research programme where Civil Society experts and CS members are involved, following a double wing model of interaction. On the one hand, the CS experts are engaged in the management WP (PMO), plus in the two strategic studies (UMAN and ROUTES) where they directly interact with participants from the three other colleges of the programme (WMOs, TSOs and REs). They are paid for their work and their travel expenses are reimbursed. On the other hand, CS members with various affiliations (from municipalities, NGOs, etc.) composing a larger group are invited to provide comments and to give their views on the work performed in the EJP, through interactions they have with the CS experts (in meetings, or by email). These participate on a voluntary basis, but their travel expenses are also covered.

1.3 Definition of shared solutions

When trying to come to terms with the notion of shared solutions in RWM, one of the first things that jumps to mind is that several perspectives are possible: who are sharing the solutions; what are the solutions; what is their aim and who do they benefit; how does the collaboration manifest itself; and what are the underlying conditions of the collaboration. All this makes shared solutions a highly complex issue that calls for clear definitions and a systematic approach.

Regarding the collaborators, in addition to member states (MS) and non-MS countries acting at various levels, they could be private or semi-private entities such as WMOs, TSOs and REs. The aim of shared solutions could be to generate profits, reduce costs, enhance safety and security, and protect public health and the environment. Shared solutions could pertain to ownership, construction and operation of nuclear facilities, transportation of radioactive waste, waste characterisation, treatment, conditioning and storage, decommissioning, recycling and disposal, as well as to RD&D. Also, the question arises, is there a minimum threshold, when speaking of cooperation on a shared solution: Is it enough for stakeholders just to exchange information, or does the exchange need to have a tangible result? Is passive economic burden-sharing sufficient or is active participation in common measures a prerequisite? There could also be cross-cutting issues that might have to be addressed, so all in all it would be fair to conclude that most of the current descriptions of shared solutions are not exhaustive but need to be further developed. On one hand, the notion of shared solutions is a dynamic concept that is bound to develop during the course of the practical cooperation between the stakeholders involved, and on the other hand, it needs to include civil society in the RWM process.

A preliminary definition could be the following[4]: *Shared solutions encompass all the elements, be they tangible or intangible, that are developed and used in concert between entities in different countries, or between the countries themselves at various levels in any phase of the nuclear fuel chain. In the frame of RWM, it includes the research carried out, the knowledge used, the technology developed, and transferred and the facilities constructed and operated through all the phases of the RWM, the legal and institutional arrangements established to run things smoothly and safely, and the process of interaction among the stakeholders, including safety culture and governance issues.*

Many of the shared solutions are uncontroversial from a CS perspective, but this is not necessarily the case for all, and certainly not when it comes to shared nuclear facilities[5]. For the latter, added value is often questioned. Thus, the distinction between shared solutions, which encompass a lot of intangible phenomena, and shared facilities, which are always tangible, becomes an important distinction relative to acceptance of a shared solution by CS. Furthermore**, public concerns related to shared solutions and particularly shared facilities inevitably point to the need of achieving a level playing field for all collaborators. If such a playing field is not in place, the development and localisation of shared facilities might gravitate towards countries with the lowest environmental and social standards, causing environmental and social dumping**. Its objective could also be to develop a common safety culture based on best practices. This necessitates a specification of what constitutes the underlying conditions of the collaboration, including whether a proper deliberative process involving CS is in place, and not least an identification of its legal framework.

[4] During the ROUTES Task 6 workshop in Athens in March 2020, a generic definition of a shared solution was discussed and generally accepted, which included: (i) Knowledge given free of charge. (ii) bi- or multilateral co-operation on shared information, shared resources (in-kind work), shared costs, and (iii) the customer-supplier relationship in commercial services. However, this definition does include CS involvement or take the CS perspective into consideration.

[5] Shared nuclear facilities could be new joint facilities or conversion of existing national facilities to multinational facilities, cf. IAEA 2005. The latter appears to be less controversial from a CS perspective, in the case a societally broadly carried justification exists. According to some of the answers to the ROUTES Task 7, D9.16 questionnaire, the definition of a shared facility should also include facilities that offer services for foreign countries (e.g., radioactive waste treatment) even if the facility itself is built and operated by a single country only.

1.4 Structure of the report

Deliverable 9.16 has the following structure:

- In section 1, the ICS action plan development is presented with main issues for the investigation of Task 7 in the following years and the focus of the present deliverable. In addition, also some general issues of good transparency are summarized which direct the overall activities in the Task 7. Also, there is a discussion of the concept of “shared solutions” in RWM.
- In section 2, some key ethical and legal principles for managing radioactive waste are identified which hold general value for all different radioactive waste management situations.
- Section 3 deals with the main topic of the year 2 investigation and discusses public concerns related to shared solutions as defined by Task 6, including common safety culture, a level playing field, the legal framework for a level playing field, outcomes from interactions with the CS larger group and results of the answer to the questionnaire.
- In Section 4, several cases of radioactive waste (RW) shared solutions are summarised (with details in appendixes for more complex cases) with information on context, implementation of the provisions from Aarhus conventions, findings and derived recommendations from the cases.
- Section 5 concludes with general recommendations from the case studies and ICS that could more generally apply for RW shared solutions.
- In Section 6, the outcomes from other ROUTES tasks are also given, with potential for examination by the Task 7 team in year 3.
- Section 7 provides concluding remarks for further work.

All details for the report are given in the several appendixes.

2. Key ethical and legal principles for managing radioactive waste

The most widespread and convincing argument for submitting final disposal of radioactive waste to ethical considerations is based on the assumption that in order to be legitimate, it has to be evaluated and approved in a societal context in accordance with criteria that are not only technical. The concept of legitimacy must also possess an *ethical dimension*[6]. Considering that the issues related to RWM reach far into the future because of the slow decay of the most problematic categories of radioactive waste, one has to assume the relevant decision-makers have to take more responsibility for the welfare and safety of future generations than is normal in regard to large-scale infrastructure projects. Thus, one of the most crucial starting points for the ethical reflections is *the concept of responsibility*[7] and its interpretation[8].

2.1 Is "radioactive waste ethics" possible?

With respect to the question, whether a radioactive waste ethics is possible, it should be noted that attempts to establish such ethics have already been made and that at least two prominent examples exist: *IAEA's and NEA's 9 ethical principles for RWM from 1995* (see Appendix A) and *The Bure Ethics Group's 7 basic principles of RWM from 2011* (see Appendix B)[9].

If one assumes the objective of a radioactive waste ethics policy is to develop a *modus operandi* which can be applied at all stages of RWM with corresponding criteria that deal with both the process for and content of the decision-making, two fundamental perspectives are possible: RWM can be viewed as an isolated ethical issue or be perceived, in a more general sense, taking advantage of already established types of ethics that, albeit in different ways, relate to RWM. Under all circumstances, the most pressing questions concerning normativity, legitimacy and relevance have to be answered in the light of possible actions and strategies, as well as estimates of risks and uncertainties, when the options for the different types of RWM are under discussion. Here, it makes sense to apply more than one perspective on the issues at hand and focus on in particular, the environmental, risk-related, intergenerational and technological aspects of RWM, and hopefully have these views converge towards the same set of conclusions.

It is also worth mentioning that radioactive waste ethics constitutes a typical example of the paradigm shift that separates environmental ethics from conventional ethics. One of the main characteristics of environmental ethics is that it prescribes an obligation to be informed on every impact on the environment by any activity in society. In this context, adequate knowledge is essential as well as acquisition of knowledge in the field, which demands the most of any stakeholder: No individual is expected to possess this knowledge. Rather, it is a question of collective knowledge based on the best available expert knowledge, which is made available at the right time at the right place. This also means

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[6] Mats Andrén, Nuclear Waste Management and Legitimacy: Nihilism and Responsibility, London and New York: Routledge, 2012, p. 6-46, and Pierre-Philippe Druet, Georges Thill, Peter Kemp, Henimod et teknologisk demokrati, Bearbejdet af Peter Kemp, København: Lindhardt og Ringhof, 1980, p. 130-135.

[7] *The responsibility principle* can be defined as an ethical principle, in which a sense of responsibility plays a central role. To be responsible presupposes that one possesses the causal capability to carry out an act. First and foremost, the sense of responsibility is based on a will to act unselfishly in regard to a valuable object and this responsibility is *prima facie* not reciprocal. To take responsibility implies moral accountability. For a moral agent, this responsibility becomes acute, when such an account is included in the possible consequences of a course of action. Arguably, the responsibility principle is particularly important in technology ethics, because of the way that technology application impacts the world, cf. Hans Jonas, Das Prinzip Verantwortung, Versuch einer Ethik für die technologische Zivilisation, Frankfurt am Main: Suhrkamp, 1979/2003, p. 153-245.

[8] Andrén, Mats, "An Uncomfortable Responsibility: Ethics and Nuclear Waste", In: The European Legacy, Vol. 17, No. 1, 2012, p. 71-82, http://www.tandfonline.com/doi/pdf/10.1080/10848770.2011.640193

[9] One could even argue that a third example could be mentioned, namely the work of a Danish study group from 2014, modelled on the Bure Ethics Group. To a large degree, the thoughts on a radioactive waste ethics in this section is inspired by Niels Henrik Hooge, Anne Albinus, Bendy Poulsen, Kirsten Jacobsen, Atomaffaldsdeponering i etisk perspektiv, København: NOAHs Forlag, 2014, https://www.noah.dk/sites/default/files/2017-03/etikrapport_0.pdf .

that the prognosticating knowledge behind the technical knowledge that empowers the act in question takes on an ethical dimension. If there is a gap between the prognosticating knowledge and the potential impact of an act, it is an ethical problem[10]. This problem can only be solved by acknowledging this lack of knowledge and impose restraint by way of the so-called *precautionary principle*[11]. Considering that all large-scale infrastructure projects, particularly in RWM, possess a risk dimension and are characterised by unknowns and uncertainty factors, the interests of more than just the stakeholders should be a part of the decision-making process. This pertains both to humans and non-human nature. Because no conventional ethics have taken a knowledge deficit with potentially fatal consequences into consideration, the only correct solution is an ethical method that gives the pessimistic prognosis precedence over the optimistic.

2.2 Overlap between legal and ethical principles

The byword that legal principles are ethical principles in disguise pertain not least to RWM. Furthermore, most if not all of the legal principles that apply to RWM can be fitted into an ethical system[12]. Viewing legal principles as ethical principles and establishing that ethical principles sometimes manifest themselves as legal principles is mutually beneficial because it adds a moral dimension to the legal framework and makes ethical principles, in case they are also legal principles, less negotiable and in some cases mandatory.

An example of this is IAEA's and NEA's 9 ethical principles for RWM from 1995 (see Appendix A) that are all integrated into national, European and international nuclear law and particularly into environmental regulations: e.g., they are all found in *Spent Fuel and Radioactive Waste Directive (2011/70/EURATOM)*[13]*,* which next to the Euratom Treaty is one of the most important pieces of European nuclear legislation. Furthermore, Principle 7 on control of radioactive waste generation is part of the so-called waste hierarchy, which at the European level is thoroughly described in the Waste Frame Directive[14] (that does not apply to radioactive waste. However, the principle is still mentioned in Article 4(3a) in the Spent fuel and radioactive waste directive).

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[10] Hans Jonas, Das Prinzip Verantwortung, Versuch einer Ethik für die technologische Zivilisation, Frankfurt am Main: Suhrkamp, 1979/2003, p. 22-30.

[11] Systematically, the precautionary principle is a sub-category of the *prevention principle*, which says that is easier to respond to environmentally harmful activities before rather than after they occur, by preventing them. In the precautionary principle this is further elaborated: If there is a strong suspicion that a certain activity may have environmentally harmful consequences, it is better to act before it is too late than wait until full scientific evidence is available that unequivocally demonstrates a causal connection between the activity in question and its possible impacts. The aim is to stop decision-makers in situations, where a decision to accept new initiatives implies a risk of unacceptable harm to public health and the environment. Both principles are not only ethical, but also legal principles, which are found in a series of international conventions and declarations, as well as in the EU acquis, cf. Jan H. Jans, Hans H.B. Vedder, European Environmental Law, Third edition, Groningen: Europa Law Publishing, 2008, p. 37-40, and Basse, Ellen Margrethe; Anker, Helle Tegner, 'Miljøprincipper og traditionelle retlige principper', In: Basse, Ellen Margrethe, Miljøretten, Almindelige emner, Bind 1, 2. udgave, København: Jurist- og Økonomforbundets Forlag, 2006, p. 124-129.

[12] The systems that are most relevant for RWM are first and foremost *deontological ethics* and to some extent *consequentialist ethics*.

[13] Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32011L0070. For a short description of the directive see ENSREG homepage: http://www.ensreg.eu/nuclear-safety-regulation/eu-instruments/Spent-fuel-and-radioactive-waste-directive

[14] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (waste frame directive): https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098. In its Article 4, the waste hierarchy is applied the following way as a priority order in waste prevention and management legislation and policy: Prevention – preparing for re-use – recycling – other recovery, e.g. energy recovery – and disposal. When applying the waste hierarchy MS must take measures to encourage the options that deliver the best overall environmental outcome. This may require specific waste streams departing from the hierarchy where this is justified by life-cycle thinking on the overall impacts of the generation and management of such waste. Also, MS shall ensure that the development of waste legislation and policy is a fully transparent process, observing existing national rules about the consultation and involvement of citizens and stakeholders. Furthermore, they shall take into account the general environmental protection principles of precaution and sustainability, technical feasibility and economic viability, protection of resources as well as the overall environmental, human health, economic and social impacts.

Finally, it is worth noting that in some respects, European nuclear law constitutes an exception to European environmental law. The Euratom Treaty, which constitutes the basis of European nuclear law, is not subject to the application of the principles of European environmental law, i.e., the precautionary principle[15], the principle of a high level of protection, the prevention principle, that environmental damage should be rectified at source (the source principle) and the polluter pays principle. Euratom suspends Article 191, paragraphs 1 and 2, in the Treaty of Functioning of European Union (TFEU). Obviously, this has an effect on how radioactive waste is managed in the EU. With respect to the nuclear fuel chain, particularly the precautionary principle could provide valuable guidance in decision-making in all of its phases. In terms of RWM, it could be relevant for policy, framework and program establishment, site evaluation, selection and characterisation, and facility construction, operation, closure and post-closure. Not least, it could help determine the choice between short term and long term, and reversible and irreversible options, e.g., between interim storage and disposal, deep geological repositories and deep borehole technology, etc. And because it is an environmental principle, it takes precedence of economic calculations of costs and benefits by putting environmental considerations first.

However, even though RWM constitutes an exception in European environmental law, there is an exception to the exception: The "basic standards" mentioned in the Euratom Treaty's Article 30[16] and the subsequent articles in the Treaty's Chapter 3 on Health and Safety are minimum standards (also known as the "minimum harmonisation clause"). Consequently, MS are allowed to set stricter standards than those laid down in the directives warranted by the Euratom Treaty[17]. European Court of Justice case law seems to require that the consequences of the additional requirement are consistent with the objective pursued by the directive in question. This means that not least the precautionary principle in some respects could come into play in the MS' national legislations[18].

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[15] "In primary law, the precautionary principle is consolidated in Article 191 in TFEU". One of its implications is that the Commission has the right to establish the level of protection of the environment and human, animal and plant health that it deems appropriate, cf. Commission guidelines on how to apply the precautionary principle: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Al32042

[16] Article 30: "Basic standards shall be laid down within the Community for the protection of the health of workers and the general public against the dangers arising from ionizing radiations. The expression 'basic standards' means: (a) maximum permissible doses compatible with adequate safety; (b) maximum permissible levels of exposure and contamination; (c) the fundamental principles governing the health surveillance of workers."

[17] Case C-376/90 Commission v. Belgium (1992) ECR I-6153 and Jans and Vedder, p. 98-101.

[18] Keynote Paper: Preliminary elements for D10.17: Uncertainties in Radioactive Waste Management, Views of the Civil Society's Group, Work Package 10, UMAN/EURAD, June 2020, p. 42-46.

3. Public concerns related to shared solutions

In regard to shared solutions and particularly shared nuclear facilities that by definition involve more than one EU member states (MS) (and in some cases non-MS), more stakeholders in more countries are in play, and, as experience shows, the intensity of their concerns is deeper and public acceptance has a broader meaning. Any form of mutual understanding that involves civil society (CS) is likely to be more complex, as well as its preconditions and the way that it manifests itself. What adds to the complexity of the situation are not only the different types of cooperation on the shared solutions and facilities that could be bilateral, multilateral and supranational, but also the different types of MS that might be involved in the cooperation. In this regard, the following classification is the most relevant: *The Small Inventory MS (SIMS)*, which often do not have the appropriate knowledge or resources to solve their radioactive waste management problems[19] and the *Large Inventory MS (LIMS)* that possess larger capacity than the SIMS, but also face bigger challenges themselves. One of the first questions that arise in any discussion on shared solutions and particularly shared nuclear facilities, is whether the LIMS have a moral obligation to help solve the problems of the SIMS by hosting the shared facilities, at least as a default option, in addition to providing support and sharing knowledge. In terms of practicalities, the supporting argument is in addition to the aforementioned, that national solutions for small amounts of radioactive waste are not cost effective and that the amounts of radioactive waste of the SIMS are insignificant compared to the radioactive waste that are managed and disposed of by the LIMS[20]. The counter argument is – although it is not forbidden that the waste is transferred and disposed of in another Member State - that every country has an obligation to take care of its own waste, which is of course the main argument against all shared facilities for radioactive waste.

One could argue that shared solutions constitute a special field within radioactive waste ethics, in which in particular the following questions are relevant. Many of these issues were also touched on in the answers to the ROUTES Task 7, D9.16 questionnaire: Who are the stakeholders in the shared solutions, i.e., who should have moral and legal standing in the decision-making process?[21] The time perspective:

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[19] A preliminary definition of SIMS has been given by the EURAD ROUTES Task 5 Group. According to the group, a "small" inventory is an amount of low-level waste mainly with short half-life (T1/2<32y) suitable for disposal in a near-surface disposal facility, which is less than 10.000 m³ per country and intermediate / high level waste requiring disposal in a deep geological disposal facility, less than approximately 100 m³ per country (amounts for conditioned waste). Also, some further characteristics of SIMS: They have small amounts of waste from research reactors (incl. prototype reactors) and from medicine, industry and research, but typically not from nuclear power plants. Their management strategies are less advanced, under development or in some cases not yet established or implemented as required by EC regulatory framework. Solutions are in most cases not available regarding safety, time and costs. Often, the SIMS do not have sufficient resources (human, financial, infrastructure, etc.) or the expertise for planning, licensing, erection, operation and closure of a pre-disposal or disposal facility. Downscaling of disposal concepts for small amounts of waste are failing and special concepts for SIMS are needed, including relevant predisposal activities. Based on these criteria, there are approximately 7-8 SIMS and the rest are by exclusion LIMS (Large Inventory Member States). However, there are also candidate states (Serbia, Albania, North Macedonia) and EU neighbouring countries (e.g., Norway) with the same characteristics as SIMS. See: Nadja Zeleznik, Johan Swahn, Jan Haverkamp, Niels Henrik Hooge, Honorine Rey, Deliverable 9.15: Scoping of ROUTES, Initial ICS Input and ICS Action Plan, EURAD, 2021, p. 26, https://ejp-eurad.eu/publications/eurad-deliverable-915-scoping-routes-initial-cs-input-and-ics-action-plan-task-71

[20] The moral argument for a LIMS responsibility could be the following: By way of their many nuclear power plants that are often placed near a national border, the LIMS have put their neighbours at risk, of which many are SIMS. This has not been the case for the SIMS that typically do not have nuclear power programs. Shared LIMS/SIMS facilities located in LIMS could even out the equation.

[21] Different categories of actors involved in each phase of a RW disposal programme in terms of safety case-related activities has been identified in Deliverable D10.10 from Subtask 4.1 of the EURAD UMAN WP. The stakeholders regarding public acceptance should be found in the second category, but all the actors in both categories are influential in this regard. The first category are WMOs, TSOs and REs. The second category (as identified by the first category) are: RW generators, RW owners, regulators, governments / legislators, ministries, municipalities, state authorities, civil society, environmental actors, NGOs, geological surveys, technical surveys, operating companies, technical consulting companies and miscellaneous actors. According to the Deliverable, the actors and their functions in different phases of a RWM programme depend on: (i) The current phase of the national RWM programme, (ii) the applied approaches and strategies, (iii) the national legislative, regulatory and organisational framework ('national framework') for spent fuel and RWM, (iv) political and administrative systems and finally (v) the stage of adaptation of older RWM programmes to the obligatory international standards. See: EURAD, Deliverable 10.10: UMAN - Analysis and description of groups of different actors, May 2020: EURAD - Deliverable 10.10 Analysis and description of groups of different actors | Eurad (ejp-eurad.eu)

Particularly in regard to shared facilities, how many stakeholders in how many MS are in play at the same time and who might subsequently be relevant? What constitutes "public acceptance"?[22] How many of the afore mentioned have to agree? Is a "municipality veto" or some other kind of stakeholder veto a requirement for e.g., localisation of interim facilities and repositories for nuclear waste? Should local, regional or national referendums be a requirement? Does a certain deliberative process of decision-making have to be in place and if so, which one? What means of persuasion are legitimate, particularly among uneven collaborators? Money, other benefits, etc.? Should there be increased demands on access to information, public participation and access to justice and resources for civil society (CS), where the shared facility is projected to be built? Are the cost efficiency and possible safety and security benefits of a shared nuclear facility more important than a principle, ensuring that every MS takes care of its own radioactive waste on its own territory? And the broader question, particularly in regard to environmental and future ethics: Should future generations and even the biosphere or parts thereof in themselves have a moral and even a legal standing in the decision-making process and if that is the case, how should it be done?

3.1 A common safety culture?

One of the prerequisites for shared solutions and shared facilities to work in a satisfactory way is a safety culture based on consistent application of the best available technology (BAT) and best regulatory practice (BRP) at least in the EU member states (MS), where the shared solution is applied, or the shared facility located. A common safety culture based on the highest standards could be a means to avoid e.g. environmental dumping among the collaborators in the shared solutions. Although application of BAT is necessary, it is not in itself a sufficient condition for reaching the best possible safety practices (see also 3.2). If safety culture can be defined *as an assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, RWM safety issues receive the attention warranted by their significance*[23], safety becomes a question of more than just application of technology. Since the conception of this definition, which originates from the IAEA INSAG-4 report, the notion of safety culture has evolved to a "culture for safety", i.e., from a relatively compartmentalised to a more systemic approach to safety. According to IAEA, safety culture is not an entity that can be implemented or removed from an organisational culture. Rather, it is an outcome of an organisation's culture as such that it influences every aspect of how the organisation's members behave, from how the management system is developed to how defence in-depth principles manifest themselves. As such, the goal for any organization is to create a culture that is working to achieve safety on a daily basis[24]. Thus, culture for safety (as well as safety culture) is both attitudinal and structural and relates both to organisations and individuals. It follows from this that the starting point is always intangible, but leads to tangible manifestations, and that a principal requirement must be the development of means to use the tangible manifestations to test what their preconditions are.

The highest level affecting RWM and safety at nuclear facilities is the legislative level, where the European and subsequently the national basis for safety culture is set. This legislation is backed by advisory and regulatory bodies in order to protect individuals, the public and the environment. Crucial for the safety are also the technical support organisations (TSOs) of the advisory and regulatory bodies, the operators that are the first responsible for the design, manufacture, construction and quality of the

[22] The concept has two parts: "public" (how wide is the circle – does it go further than just to CS and if so, how much?) and "acceptance" (what is the basis of acceptance and how does it manifest itself? E.g. does it relate only to the information basis or the premises of the RWM decision-making or also to its outcome?) Preliminary definitions of public acceptance and non-acceptance of shared facilities could have the following content: *Acceptance*: If all of the above-mentioned stakeholders agree to make an informed decision based on effective access to all relevant information on placing a certain kind of nuclear facility in a certain location, public acceptance is assured and an affirmative decision is guaranteed. *Non-acceptance*: If all of the above-mentioned stakeholders agree to make an informed decision based on effective access to all relevant information not to place a certain kind of nuclear facility in a certain location, public acceptance is not assured and rejection is guaranteed. Everything in between these extremes could be subject to interpretation.

[23] IAEA: Safety Culture, A report by the International Nuclear Safety Advisory Group, Safety Series No. 75-INSAG-4, Vienna 1991, p. 4.

[24] IAEA, Culture for Safety, Nuclear Safety and Security Programme, https://www.iaea.org/sites/default/files/culture_for_safety_leaflet.pdf.

nuclear facilities, and the waste management organisations (WMOs) responsible for the waste. It should be noted though that the roles of each organisation are country-specific and can be different. All these entities require proper management structures supported by adequate resources and safety policies with clear definitions of responsibilities and accountability in safety, facilitated by unique and clear lines of authority, particularly in the WMOs. A high degree of independence for WMOs is necessary in order to avoid "professional bias" and avoid pressure from the most powerful stakeholders. At the same time, it will make interaction with stakeholders easier and increase the capacity of the WMOs to generate public trust because independence increases their credibility. Independent oversight mechanisms implementing best regulatory practices should be an integrated part of all decision and implementation processes that WMOs are involved in. The safety policies in the case of the WMOs should, as proposed by the IAEA, include definitions and control of working practices, qualifications and training, rewards and sanctions, communication, and audits, reviews and comparisons[25].

However, it should be noted that not everything is covered by the above-mentioned notions of safety culture. Some issues are omitted or not sufficiently covered. Among those are transparency (public information, public participation and access to justice*) and inclusion of civil society (CS) as a genuine stakeholder*. Good transparency governance is a key topic for CS engagement and a prerequisite for any deliberative process involving CS in the radioactive waste management (RWM) decision-making process. Important here is the Aarhus Convention, which links environmental with human rights. Particularly, in regard to the safety of nuclear facilities, *whistle-blower protection* could also be seen as a necessary precondition for transparency and access to relevant information. Finally, ***citizens' science,*** i.e., inputs from independent citizens, including citizens measurement networks, citizens' sampling, but also access to, for instance, laboratories for second opinions could also be relevant. Citizen laboratories should be recognized as important players in culture for safety and safety culture.

In conclusion, it should be recognised that a satisfactory safety culture is the result of a collective effort, involving all the relevant stakeholders – operators, regulators, WMOs, TSOs, REs and CS – and that they all operate within a legal framework that defines the content and scope of their roles and the boundaries of their rights and obligations. A step towards a common safety culture based on best practices could be common licensing standards across the MS. However, RWM is excluded from the Integrated *Pollution Prevention and Control Directive*[26]. Instead, the legal basis of licensing is found in the *Spent Fuel and Radioactive Waste Directive*. It provides that each MS must have a licensing system for radioactive waste management and/or facilities and ensure that the radioactive waste license holders maintain adequate resources to fulfil their obligations for safety of RWM, cf. Articles 5 and 7 (for more on this directive, see Section 3.3).

3.2 A level playing field is essential to shared solutions

First and foremost, the objective of a radioactive waste ethics for shared solutions and in particular shared nuclear facilities, which is the main focus of this section, is to achieve a level playing field for the collaborators. If such a playing field is not in place, the development and localisation of shared facilities might gravitate towards countries with the lowest environmental and social standards, causing environmental and social dumping[27]. Its objective could also be to develop a common safety culture based on best practices. The idea of a level playing field is already present in the Waste Frame Directive,

[25] IAEA: Safety Culture, A report by the International Nuclear Safety Advisory Group, Safety Series No. 75-INSAG-4, Vienna 1991, p. 5-13.

[26] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control): https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010L0075 .

[27] One could argue that the two concepts are interrelated, i.e., that deteriorating environmental standards lead to poverty and that low economic and social standards are one of the root causes of overexploitation of the environment. It is also fair to assume that the argument of environmental and social dumping trumps the level paying field's most feasible counter argument – that too strict demands for best practices tend to jeopardise shared solutions – considering that their added value is dependent on the absence of environmental and social dumping.

however that does not apply to radioactive waste management (RWM). Pursuant to the Directive's Article 4, EU member states (MS) must, when they apply the waste hierarchy, "take into account the general environmental protection principles of precaution and sustainability, technical feasibility and economic viability, protection of resources as well as the overall environmental, human health, economic and social impacts". Furthermore, the idea is generally supported by the principle of a high level of environmental protection and the polluter-pays principle - both pillars of EU environmental law.

A preliminary definition of a level playing field could have the following content: *In regard to the planning, constructing, operating and closing of shared facilities, a process where all or most of a set of relevant criteria are met. These pertain to best practices concerning emission, environmental quality, safety and security standards, procedural rules, including rules on permit schemes, environmental impact assessment and public hearings, liability, citizens' rights, including access to information and resources, participation in decision-making and access to justice, and monitoring rules*.

The overriding principles framing the level playing field could be the following: *Any bilateral, multilateral, European and international cooperation on planning, constructing, operating and closing of shared nuclear facilities, must involve partners that follow the same technical, legal and ethical standards in their home countries. If they do not have the same standards, they should follow the highest standards in the categories mentioned below among the parties that are involved in the cooperation. The standards must apply to all the phases of the development and functioning of the shared facilities, including policy, framework and program establishment, site evaluation, selection and characterisation, and facility construction, operation, closure and post-closure. Also, in any collaboration, the starting point for localisation of shared nuclear facilities must be national legislations in all these countries that do not prevent importation and exportation of radioactive waste in order to dispose of it*[28]*.*

Generally, shared solutions regarding technologies are more easily accepted by CS, if they are based on BAT ("best available technology") or ALARA ("as low as reasonably achievable"), i.e., if they achieve the highest possible[29], or at least higher standards and overseen by means of BRP ("best regulatory practice"). However, it should be noted – a fact that has also been pointed out in some of the answers to the ROUTES Task 7, D9.16 questionnaire - that aiming at the highest standards, or the best possible solutions, does not in itself guarantee safety. Only aiming at the safe solution for all does that. It should also be noted that it is not possible to claim in an uncertain situation that a problem has been resolved merely by demonstrating how much time and effort have been invested in order to solve it. This also applies to the general standards used in risk assessments of nuclear installations – including for BAT and ALARA.

3.3 Identification of the legal framework for a level playing field

In order to identify the parameters that underpin a level playing field, the legal framework must be described (at least rudimentarily) in order to give as full picture as possible of the issues that might arise from the shared solutions and facilities. In terms of any checklist for these parameters, a definition of the relevant legislation and answers to why it is relevant must be provided. Also, it is in the legal framework that the conditions for applying the best practices and most of the tools to solve the problems are found.

The legal frame sets the outer limits for legislative, judicial and executive power, some basic obligations and rights, and guiding principles. On the face of it, identifying the legal framework for a level playing

[28] Restrictions on exportation and importation of waste for disposal based on the origin of the waste in the EU can be generally justified by the principles of self-sufficiency and rectifying damage at source (e.g. see Walloon-ban, C 2/90 on landfill of waste). However, this does not pertain to restrictions on exportation of waste for recovery. In the latter case, restrictions can only be justified if a planned shipment to another country, because of the recovery activities there, would not be in accordance with national legislation in the country of origin relating to environmental protection, public order, public safety or health protection.

[29] In some of the answers to the ROUTES Task 7, D9.16 questionnaire, the WENRA Safety Reference Levels were recommended as an example of highest international standards.

field for shared solutions and particularly shared nuclear facilities in the EU is a challenging task due to the overall size and complexity of the European legislationAnother challenge is the fact that collaboration on shared solutions and facilities might involve countries that are not members of the EU, which could raise questions of extraterritorial jurisdiction. In the EU itself, each member state (MS) must comply with Community Law in its own territory, which is recognised by all other MS. Thus, a decision made by an authority in MS A on applying a uniform EU standard must be treated equal to a decision in MS B. The MS are also free to adopt a higher level of environmental protection if it is not in conflict with the internal market or violates the principle of non-discrimination. But within the EU, there are incomparably different legal systems, traditions, and institutions in the MS, which in some cases make uniform national implementation of European environmental law difficult. The relativity also relates to national divisions of competences between central government, regions and local councils. Hence, there could be confusion concerning the implications of adopted legislation and the understanding of legal standards, which could result in alternating perceptions towards a problem: i.e., Each perception might come up with different technical, political, economic, institutional and legal answers and solutions[30].

As mentioned in section 2 of this report, *the Euratom Treaty* provides the basis of European nuclear law and in some respects this nuclear law constitutes an exception to European environmental law. Presently, only aspects of nuclear health and safety are covered by Community law. Because of opposition from some MS, there are no rules setting standards for design, construction and operation of nuclear installations or for radioactive emissions into air or water[31], although a legal framework exists. EU's Seveso directive[32], which requires that adequate measures be taken to prevent risk of major accidents at chemical plants or industrial enterprises, does not apply to nuclear installations and processing facilities. Instead, the main protection that European law and the Euratom Treaty offer MS is the right of the Community to be consulted or notified in certain circumstances. EURATOM's Article 34 obliges MS to consult the Commission when they intend to conduct particularly dangerous nuclear experiments in their territories and to obtain its consent if these are liable to affect other MS. This is stronger than the consultation requirements of customary international law, because it gives the Commission a power of veto. Article 37 also requires notification to be given to the Commission, when radioactive substances are to be discharged that may contaminate other MS, e.g., by disposal into the atmosphere, at sea or into rivers. However, the Commission can only comment on the proposal. Neither article requires that other MS be consulted at any stage. Community (EURATOM) law also requires MS to give urgent notice to their neighbours of any accident, which might expose the population to radiation. Nonetheless, EURATOM has a clear advantage over the IAEA, because it can give legal force to its safety measures (as hard law) and its wider and more explicit consultation requirements in cases of transboundary risk. Furthermore, the Commission has the power to propose further health and safety measures under the Euratom Treaty, covering the possible application of emission standards to nuclear installations, the harmonization of safety criteria, the transport of dangerous materials and management of radioactive waste[33]. A disadvantage of EURATOM is that regulations are not submitted to approval by the European Parliament, but only the European Council. This somewhat undermines the democratic legitimacy of EURATOM law.

Considering that radioactive waste management (RWM) is excluded from the Waste Frame Directive, the most important piece of legislation concerning waste management in the EU, the most relevant directive for RWM is *the Spent Fuel and Radioactive Waste Directive (2011/70/EURATOM)*[34]. The

[30] For more information on this subject, see e.g.: Jan H. Jans, Hans H.B. Vedder, European Environmental Law, Third edition, Groningen: Europa Law Publishing, 2008, p. 87-124.

[31] Patricia Birnie and Alan Boyle: International Law and the Environment, Second Edition, Oxford: University Press, 2002, p. 465.

[32] For information on the Seveso Directive, see: Seveso - Major accident hazards - Environment - European Commission (https://ec.europa.eu/environment/seveso/)

[33] Patricia Birnie and Alan Boyle, op.cit., p. 466.

[34] Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste: EUR-Lex - 32011L0070 - EN - EUR-Lex (https://eur-lex.europa.eu/legal-

directive aims at ensuring a high level of safety, avoiding undue burdens on future generations and enhancing transparency. It supplements the basic standards referred to in the Euratom Treaty as regards to the safety of spent fuel and radioactive waste without prejudice to *the Basic Safety Standards Directive*. Its main elements are the following: MS must set a high standard for safety of RWM by having national policies on spent fuel and RWM; by taking responsibility for the radioactive waste (RW) they generate, also, if it is shipped for treatment in another country; by ensuring that costs of RWM are covered by those that generate the waste; by ensuring the RW is not shipped to countries forbidden by *the Directive on the Supervision and Control of Shipments of Radioactive Waste and Spent Fuel*; by having a national legislative, regulatory and organisational framework for RWM; by making a self-assessment every 10 years of their national framework, including an international peer review; by having a national programme for RWM, including important milestones, plans or concepts for radioactive waste management, and assessment of costs; by giving responsibility of RW to the generators of the waste; by having national requirements for public information and participation, ensuring workers and the public are informed and can participate in decision-making processes regarding radioactive waste management; by having an independent regulatory authority for the safety of radioactive waste management with enough resources and separated from anybody promoting or using nuclear energy; by having a licensing system for radioactive waste management and/or facilities; and by ensuring that the RWM license holders maintain adequate resources to fulfil their obligations for safety of RWM.

With respect to *liability*, four international conventions create a special regime of civil liabilities for nuclear accidents: In Western Europe, they are covered by the *OECD Paris Convention* of 1960, to which all Western nuclear states are party. *The Vienna Convention* of 1963 offers a similar scheme for global participation. Revisions to the Vienna Convention in 1997, coupled with a new Convention on Supplementary Convention for Nuclear Damage have encouraged participation by all Eastern nuclear states, except for Russia. Finally, *two more treaties* deal with nuclear ships and maritime carriage of nuclear materials. All four treaties seek to harmonise important aspects of nuclear accidents and incidents in national legislations, without requiring complete uniformity in every respect. Furthermore, the conventions cover most, but not all potential sources of nuclear damage. The Paris and Vienna conventions apply to “nuclear installations”, a term broadly defined to include reactors, reprocessing, manufacturing and storage facilities, where nuclear fuel, nuclear material, and radioactive products or waste are used or produced. They also apply to the transport of nuclear material and the handling of nuclear waste. Although there are variations, the overall scheme of the four conventions is based on the same five components: (i) Liability is absolute. No proof of fault or negligence is required as a condition of liability. Certain exceptions such as war, natural disaster, or negligence of the victim may be allowed. (ii) Liability falls exclusively on the operator of the nuclear installation, and all other potential defendants are protected. In certain cases, a carrier or handler of nuclear material may be treated as an operator. (iii) Limitations may be placed on the total amount and duration of liability. (iv) Payment up to the prescribed limit of liability is supported by compulsory insurance or security held by the operator and guaranteed by the state, where the installation is located. For accidents covered by the Paris and Vienna Conventions, additional public funds are provided under supplementary conventions. (v) Rules determine which state or states have jurisdiction over claims. All other recourse to civil proceedings elsewhere is precluded[35].

The following international conventions on nuclear safety, emergency response, proliferation and nuclear security also merit mentioning: *Conventions on nuclear safety and emergency response*: Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, Convention

content/EN/TXT/?uri=CELEX%3A32011L0070). For a short description of the directive see ENSREG homepage: Spent fuel and radioactive waste directive (http://www.ensreg.eu/nuclear-safety-regulation/eu-instruments/Spent-fuel-and-radioactive-waste-directive).

[35] Patricia Birnie and Alan Boyle, op.cit., p. 476-484. For an overview of liability amounts, see: https://www.oecd-nea.org/jcms/pl_31866/table-on-operator-liability-amounts-and-financial-security-limits-non-official-updated-october-2020.

on Early Notification of a Nuclear Accident, Convention on Nuclear Safety and Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. *Conventions on non-proliferation and nuclear security*: Treaty on the Non-proliferation of Nuclear Weapons, Convention on the Physical Protection of Nuclear Material, Amendment to the Convention on the Physical Protection of Nuclear Material, International Convention for the Suppression of Acts of Nuclear Terrorism, Comprehensive Nuclear-Test-Ban Treaty[36]. IAEA, OECD and ILO have been instrumental in developing these conventions.

Finally, *transparency (public information, public participation and access to justice)* are key topics for CS engagement in nuclear issues[37] and crucial for developing a level playing field for shared solutions and shared nuclear facilities. Good transparency governance is also a prerequisite for any deliberative process involving CS in the RWM decision-making process. Important here is *the Aarhus Convention*, which aims to link environmental with human rights. Here, all stakeholders must be involved in order to achieve sustainable development and future generations must also be taken into account. The rights guaranteed by the Convention relate to three areas: (i) The public's right of access to environmental information vis-à-vis administrative authorities and private parties with public responsibilities for environmental protection. (ii) The public's right to participate in certain environmental decision-making processes. (iii) The public's right of access to courts or tribunals in environmental matters. Transparency in the nuclear sector includes informing all persons and stakeholders in a way that they can assess the risk of a nuclear activity. Information has to be provided complete and early enough. Participation means that all stakeholders, among those especially environmental NGOs, siting communities and the public, can take part in legal proceedings, hearings and in consultation fora. Especially important is the question of public participation in the decision-making process[38]. *It could be argued that a high as possible access to information, public participation and access to justice and resources should be available to CS, where the shared facility is projected to be built (e.g., the highest implementation levels on the BEPPER scale - LI5-LI6, LP5-LP8, LJ2-LJ6, LR2-LR5[39])*. Although EURATOM does not see itself as a Party to the Aarhus Convention, MS are bound to the obligations under this Convention on the basis of their own participation[40].

An additional instrument for transparency is *the Espoo Convention on Environmental Impact Assessment in a Transboundary Context*. It enables affected countries and their public to participate in Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) procedures[41] in other countries for projects that may have significant transboundary impacts. The importance of good transparency governance specifically in the nuclear sector is widely recognized, also at the legal level,

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[36] For a general overview of nuclear-related international conventions, see NEA website: OECD/NEA - Multilateral Agreements Adherence Status - Nuclear energy and environmental treaties and conventions (https://www.oecd-nea.org/law/multilateral-agreements/status-treaties.html#liability-compensation).

[37] Keynote Paper: Preliminary elements for D10.17: Uncertainties in Radioactive Waste Management, Views of the Civil Society's Group, Work Package 10, UMAN/EURAD, June 2020, p. 38-42.

[38] However, in a recent decision, the European Court of Justice has determined that an environmental impact assessment of a life-time extension of a nuclear power plant can be temporarily suspended, if this is justified by overriding considerations relating to the need to exclude a genuine and serious threat of interruption to the electricity supply in the MS concerned, which cannot be addressed by other means or alternatives, inter alia in the context of the internal market, cf. Court of Justice of the European Union, Press release No 100/19 Luxembourg, 29 July 2019, on Judgment in Case C-411/17 (https://www.politico.eu/wp-content/uploads/2019/07/CP190100EN.pdf).

[39] The BEPPER (Broad Framework for Effective Public Information and Participation in Environmental Decision-making in Radioactive Waste Management) report can be found here: http://www.nuclear-transparency-watch.eu/a-la-une/new-publication-bepper-report.html

[40] Along with all the MS, the European Union is itself also party to the convention, and has adopted a lot of legislation, implementing it (https://ec.europa.eu/environment/aarhus/legislation.htm).

[41] *The SEA Directive* (Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment) applies to a wide range of public plans and programs, including nuclear power programs and other plans for nuclear installations. The SEA Directive is supplemented by *the EIA Directive* (Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment) that applies to a broad range of concretely defined public and private projects, including nuclear projects.

cf. the Spent Fuel and Radioactive Waste Directive and some of the other EURATOM directives[42]. According to the Spent Fuel and Radioactive Waste Directive, MS have to implement Article 10 of the directive, which says that MS "shall ensure that necessary information on the management of spent fuel and radioactive waste be made available to workers and the general public". This obligation includes ensuring that the competent regulatory authority informs the public in the fields of its competence". It also provides that MS "shall ensure that the public be given the necessary opportunities to participate effectively in the decision-making process regarding spent fuel and radioactive waste management in accordance with national legislation and international obligations". **This opens up the possibility of a common European approach on transparency governance within RWM.** As Article 10 is rather vague, there is a need for elaboration on what efficient transparency in RWM might mean[43]. However, generally there is a tendency in the political community to increasingly support measures that provide the public with an opportunity to involve itself more comprehensively in decision-making that might negatively affect the environment[44].

3.4 Feedback from ICS workshop no.2

In the frame of the Interaction with Civil Society (ICS) activities performed within EURAD, the Civil Society (CS) experts involved in the EJP have organized the second ICS workshop on March 25-26, 2021. This workshop takes place once a year, gathering the CS experts and the members of the CS larger group involved in EURAD, plus some EURAD participants who have a specific interaction with the CS members. The aim is that the CS experts and the CS larger group members exchange on the work performed in EURAD, bringing their views, comments and suggestions. The members of larger CS group were defined true the process which is described in the Deliverable 1.13 report[45] and consist of representatives from local, national and international associations, from West and East EU members and from advanced and early-stage RWM programme countries.

During the meeting, the CS experts involved in ROUTES Task 7 organized a session that was dedicated to their work on shared solutions. They presented 2 case studies:

- One on the Krško nuclear power plant (NPP) in Slovenia, which is an example of shared NPP and waste management between Slovenia and Croatia;
- One on the Bohunice Centre in Slovakia, which experienced a switch from a national to an international provider of treatment and conditioning services.

In addition, the presentation of draft deliverable 9.16 was given in which also some basic points were presented to CS representative and other participants. The description of the case studies was followed by a discussion in small groups that was led by some guiding questions. Below are the main outcomes of the discussion. The workshop summary is given in Milestone n°137 report on Interaction with Civil Society (ICS) Workshop n°2 (July 2021), available on EURAD ProjectPlace.

1/ What does in your opinion represent the best practices for civil society interaction?

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[42] For an overview of the Euratom Basic Safety Standards, Nuclear Safety, Drinking Water and Information on Radiological Emergency Directives, the Early Notification Convention and the Aarhus Convention in the context of stakeholder involvement, see: Nadja Zeleznik and others: Deliverable 9.85 - Rationales and frameworks for stakeholder engagement in radiation protection in the medical field (Part 1), nuclear emergency and recovery preparedness and response (Part 2) and indoor radon exposure (Part 3), EJP-CONCERT, May 2019.

[43] An attempt to do this was carried out in the afore-mentioned BEPPER project by Nuclear Transparency Watch.

[44] An example is the recent decision in the European Parliament to amend an EU regulation in order to give the public greater ability to challenge any EU MS action that negatively affect the environment, cf. European Commission, Proposal for a regulation of the European Parliament and of the Council on amending Regulation (EC) No 1367/2006 of the European Parliament and of the Council of 6 September 2006 on the application of the provisions of the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters to Community institutions and bodies, Brussels, 14.10.2020, legislative_proposal_amending_aarhus_regulation.pdf (europa.eu)

[45] Dewoghélaëre Julien, Rey Honorine, Hériard-Dubreuil Gilles. (2020): List of members of the Civil Society group, Final version as of 09.03.2020 of deliverable D1.13 of the HORIZON 2020 project EURAD. EC Grant agreement no: 847593, https://www.ejp-eurad.eu/publications.

For the participants in the small group discussion, the best practices for civil society interaction include a clear communication from the authorities towards the public. It is crucial that the authorities make the information available and accessible for everybody, regardless of their level of knowledge in the nuclear field. Conducting an Environmental Impact Assessment (EIA) is satisfying in terms of public participation, but enough time has to be dedicated to it. In a shared solutions/facilities context, some civil society representatives from countries involved should be part of the advisory board that is consulted before taking any collaborative decision. There is, for example, often a lack of representativity of municipalities in such projects.

Concerning how the interaction should look like, the CS members pointed out the importance of meeting physically when it is possible, instead of virtually (as it is now unfortunately, because of the pandemic). They also emphasized that in order to raise the interest of the civil society members on technical topics, researchers should share information in such a way that civil society members are willing to react and to raise issues. CS members must be given the maximum space for expression in the meetings, and also some time to digest information and form a viewpoint.

The case studies described before the small group discussions have been seen by the participants as worst practices, e.g., for the Bohunice Centre there is a clear lack of transparency, and for Krško the information is unclear because of the diverging views of different actors.

2/ Should the participation only be from the local community where the site/facility is located or should it be enlarged? (e.g., to international NGOs, and to NGOs from the countries of origin of the waste)

To this second question, the participants answered that yes, the participation should be enlarged. The main argument is that countries are responsible for their radioactive waste, but not only the radioactive waste that is on their own territory. Communities from countries whose territory is affected by the shipment of radioactive waste from other countries should also participate in the decision making. By “communities”, the participants meant the whole public. This being said, civil society members are aware that there are some practical problems with organising such participation. Possible solutions should be investigated further (e.g., research programs, experimentation, etc).

In the context of shared facilities/solutions, there are no real positive examples of extended public participation, except for SEAs and EIAs. The Slovenian case study, where there are two repositories, is an example of a challenging situation. However, extending public participation to international NGOs that are specialised in related matters could be an added value for all, including for WMOs. Indeed, safety issues do not only concern local communities. It is essential to include all the people concerned about the production of the waste and about the shared solutions, in order to help them to understand and to raise questions. A high standard of transparency must be ensured, as well as a tight control of the implementation.

3/ What are the main challenges and advantages of shared solutions for the countries which are involved in collaboration?

The biggest challenges of shared facilities/solutions that have been identified by the participants in the small groups’ discussion are the following:

- Self-sufficiency: sharing a facility reduces drastically the independence of the countries involved in the collaboration.
- Responsibility: it is unclear what country/organisation would be responsible in case of, for example, a serious accident. This issue can put undue burdens on future generations.
- Governance: the standards regarding transparency and safety are higher, which is much more demanding. The question of which regulator should take the lead over the process (from the waste producer country? from the other?) also arises. It is also more difficult for

regulators from two countries to agree on the management programme, on the finances, etc. than when there is only one regulator that takes the decisions.

- Public participation: the level of public participation may differ from one country to another. Thus, the harmonization of communication and of the involvement of the public may be challenging. Plus, the more people there are to keep informed/involved in the decision-making process, and the more people there are to be responsible for sharing the information and organising participation, the more it gets difficult to have a clear communication and a clear process.

As for the main advantages of shared facilities/solutions, the CS members found the following:

- Lower costs: sharing the costs implies more than one country will finance the facility/solution. Thus, costs are reduced.
- More knowledge and capacity: having two countries involved in a collaboration means having more people involved, potentially more and varied knowledge available.
- Larger geological opportunity: two countries represent a larger geography and potentially a more varied geology to work within the frame of a disposal process, thus more options, which gives more chances to find a more appropriate host rock.

4/ Do you think that collecting knowledge and using technology in operation in a foreign country tends to increase the confidence of the civil society and if so How?

The CS members who have taken part in the discussion answered that collecting knowledge and using technology in operation in a foreign country tends to increase the confidence of the civil society, but under certain circumstances. First, the confidence of CS can increase if they have access to information on available knowledge and technology. This should be channelled through a proper platform. Then, in addition to being accessible, the information must be understandable for civil society members, otherwise they will not have the possibility to challenge it and this would not be relevant. Thus, it is not only about collecting and transferring technologies, but more about translating the information and aiming at creating a common language between technical experts, researchers, and civil society members. Having enough information on this knowledge and technology would allow civil society members to judge whether it works well and it is trustworthy. Anyway, the knowledge and technology will have to be adapted to local specificities.

3.5 Related UMAN findings

The main objective of the UMAN Work Package is to develop a common understanding among the different categories of actors (WMOs, TSOs, REs and Civil Society) on uncertainty management and how it relates to risk and safety in RWM. In cases where a common understanding is beyond reach, the objective is to achieve mutual understanding on why views on uncertainties and their management are different for different actors. Another objective is the sharing of knowledge and know-how and discussing common methodological and strategical challenging issues on uncertainty management.

In its first 17 months, the UMAN CS expert group focused on developing an understanding of uncertainties perceived by the CS larger group, including trying to answer questions such as: What are the notions of the different CS group members of uncertainty, risk and safety? What are the views of the CS Group on important uncertainties in different phases of RWM and how should and could CS participate in dealing with uncertainties?

In a questionnaire[46], prepared for the members of the CS larger group[47] before the UMAN Working Group Day, the 36 members of the larger group answered a series of questions, which also included comments on uncertainties related to shared solutions and to other issues connected with shared solutions. The questions and answers were asked and given in the perspective of all phases of RWM, i.e. (i) policy, framework and program establishment, (ii) site evaluation, selection and (iii) characterization, (iv) facility construction, (v) operation and closure, and (vi) post closure.

As can be seen from Figure 1, shared solutions and export/import of RW is not perceived as one of the most pressing issues in RWM. However, considering all the topics are interrelated, it clearly signals what issues connected with the shared facilities are the most important.

Figure 1: Clusters of named uncertainties, total over all six phases of RWM[48]

According to the members of the CS group, uncertainty mainly arises from the size and characteristics of a RW inventory in a shared facility because of the impact it might have on the acceptance in society. If the amount of waste to be stored is minuscule, it might mean less perceived risk in the larger society, but locally it could be seen as just as risky, and in some cases more "unfair" if the inventory is small ("If it is so small, why can't it be stored elsewhere?"). Shared nuclear facilities also increase the amount of RW that is transported over long distances and borders. Hence, there are serious international impacts which require an increased focus on the transportation and import of wastes and characterisation of the RW and the waste streams. For these activities, there must be clear criteria.

[46] Julien Dewoghélaëre, Gilles Hériard-Dubreuil, Niels Henrik Hooge, Gabriele Mraz, Honorine Rey, Preliminary elements for D10.17: Uncertainties in Radioactive Waste Management – Views of the Civil Society's Group, Work Package 10, UMAN, p. 9-31.

[47] Obviously, the views of CS on RWM cannot be represented in its full scope by only 36 CS experts within the EURAD project. Not even the opinions and approaches of all European NGOs engaging in nuclear issues can be fully represented. Still, it provides a broad and rudimentary overview of some of the CS positions on the most pressing issues, as they are perceived by parts of CS.

[48] UMAN, Preliminary elements for D10.17, p. 11.

3.6 Results from the questionnaire to all ROUTES participants

3.6.1. Collection of the results

With the aim to obtain the positions of ROUTES participants and CS larger group the Task 7 members elaborated a questionnaire to collect the opinions on shared solutions/facilities for radioactive waste management. The questionnaire included some socio-demographic data (name, sex, type of actor (WMO, TSO, RE, CS), organisation, country) and several questions related to shared solutions for RWM and various societal aspects (challenges and added value), conditions for shared solutions and the concepts of a level playing field and governance. It is given in Appendix 9.3 together with main socio-demographic data from respondents.

In total, 71 participants of ROUTES and/or members of the Civil Society involved in EURAD (i.e., CS experts and members of the CS larger group) were invited to fill in Task 7's questionnaire in the frame of the development of deliverable D9.16. Out of the 71 persons to whom the questionnaire was sent, 24 gave an answer, which represents 34% of participation.

Most of the respondents were civil society members (38%). WMO representatives also participated well: they represented 33% of the respondents. Slightly less answers came from the REs (25%), and a lot less from the TSO representatives (8%). In terms of geographic representativity, the panel of respondents is quite balanced: 58% of the respondents come from European Western countries, and 42% come from European Eastern countries.

Participants from all the ROUTES Tasks answered the questionnaire, with a majority being involved in Task 6 as it deals with shared solutions.

Representatives of different types of institutions participated, but the summaries from the responses do not give an agreed opinion or position to the answers. The collection provides the basic ideas and suggestions from those involved in the questionnaire and the (dis-)agreements on the reactions are not traced.

3.6.2. Analysis of the results

The participants recognised that the subject needs to obtain more reflection than a reply to a questionnaire. Some participants stressed that shared facilities can be a good solution for specific problems of small countries, but they need to be dealt with great care, scientifically, technically, legally, politically and socially. The outcome of the questionnaire does not have any statistical value and mainly provide the positions among participants. The report hereafter gives the information collected, but does not present a global consensus or agreement between different actors who participated.

Challenges of shared solutions

The participants provided the following challenges for RWM shared solution: political willingness and engagement, fulfilment of safety (operational and long term to the highest adopted international levels), legal harmonisation and liabilities, transfer of ownership, (financial) compensation, transparency information, risks and benefits, participation, access to justice, acceptance, governance with clear definition of responsibilities, obligations and regulatory framework, building of trust and keeping the commitments, strong information, expertise, financial and power asymmetry between actors.

Concerning knowledge sharing there are no particular challenges experienced, but big differences in competence levels could be a challenge. Sharing of reports, methodologies could be challenging if one or more parties have commercial interest in the product (IPR). There could be potential challenges in sharing of pre-disposal technology and facilities in relation to legislation, public acceptance etc. In the case of foreign RW treatment the most challenging aspect is the objective assessment of all direct and indirect impacts of such activity and providing transparent information about these impacts (based on data evidence). When it comes to shared repository facilities, the siting process could obviously be a challenge, and a very open and participatory process is needed, as is also to a certain extent that of harmonised conditioning, characterisation, packaging methods etc.

Shared solutions for RWM could work if several member states from the start work towards such a solution, but less so if member states want to attach to an existing solution (or a solution that is about to be implemented). A deliberative process is key, structured with a bias favouring CS inclusion at national and local levels (and even multinational) focused on where siting operations could be carried out and, importantly, between local CS levels across the participating nation states. The deliberative process could open the debate on challenges not only on national level, but also to the discussion from a pan-European perspective. Financial resources should be made available from the start of the process to ensure that CS feels both included and, importantly, views the process to be fair. The other point to consider concerning any potential siting operations is to ensure CS views in the wider siting geography (10-50Km) are also accounted for. This is, of course, the ideal situation and increases the chances to avoid conflicts of interest, to generate questions related to technology transfer etc. Some transnational organisation would need to play a leading role, like the EC or the ERDO working group, in supporting "from scratch" programmes for developing shared solutions.

The RWM decision-making related to shared solutions has to be based on a full implementation of the Aarhus Convention, i.e., provide the public with the opportunity to participate, access to resources, full transparency of decision-making, and access to justice. A broader definition of the public might also be relevant, because a shared solution involves multiple stakeholders from more than one MS. Furthermore, a level playing field for the stakeholders based on best practices should be in place in regard to in particular shared facilities.

Added value of shared solution

The participants believe that the shared solutions for RW disposal would provide best added value for small inventory countries that don't have the infrastructure, know-how to deal with the waste, financial and other resources required for the exercise. A shared disposal may also have good economic and safety impacts. In general, sharing is a good thing. The best benefits occur when sharing pre-disposal activities and in sharing of R&D activities as implemented in EURAD or under bilateral agreements. For small inventories it could be more efficient to use mobile equipment than to develop a new technology.

If a shared facility is in a country with stable democratic structures and a democratic culture, better participation for the public might be possible than for those with less democratic standards. Shared solutions could be based on cooperation between LIMS and SIMS, because they provide the SIMS with additional resources in terms of knowledge, safety and capacity. In these cases, shared solutions for HLW and SNF could be very helpful, because for these, special storage facilities, large investments and robust regulatory system, etc. are needed.

However, some respondents argue that there is no net added value in shared solutions (the cons exceed the pros in the long-term) apart from sharing knowledge and experience and maybe providing RW treatment solutions for very small states (e.g., Luxembourg or Liechtenstein). The main argument is that shared solutions result primarily in transfer/getting rid of negative impacts related to nuclear energy exploitation to other countries.

It is stated that sharing should start with predisposal activities, as mentioned above, and after that slowly progress towards sharing of disposal activities and facilities if public acceptance and siting is feasible. Sharing of activities and facilities can present several benefits and opportunities, but also challenges in areas related to economics, environment, safety and security, technical aspects, socio political, ethical, and institutional aspects, regulatory oversight, non-proliferation, and public acceptance and support. All are dependent on the scale of the radioactive waste and SNF programme in a member state and a lot of other factors such as RD&D capacity, capability and competence, regulatory oversight, geological environment suitability for repository siting, overall national policy and strategy, financing and funding arrangements, etc. Sharing activities and maybe repositories can provide a viable alternative for member states that may, due to political, social, geological, economic or other concerns, face difficulties in domestic siting of such facilities. For a multinational disposal solution to be successful, the benefits for all stakeholders involved must be sufficiently attractive to outweigh challenges and any perceived or real disadvantages. ROUTES Deliverable D 9.12 [19] presents the ongoing programmes addressing the feasibility of shared disposal facilities and the related challenges. The reader can refer to deliverable D 9.12 for further details.

Conditions for sharing

The respondents in general agree that all shared solutions which are needed are worth further discussion. However, some conditions should be followed. The safety requirements for shared solution (in view of nuclear facility and in particular for RW disposal) should be applied to the highest international standards (e.g., WENRA Safety Reference Levels), which also includes an appropriate type of facility in relation to the inventory. Fair collaboration between involved states should be established to avoid any enforcement or power imbalance. A deliberative process should be developed, with proper representation from local, national and multinational actors beside officials. The elements of such a process should be investigated, agreed and tested, also using the lessons from the existing national RWM practices. If a shared solution is not supported and agreed by locals, it should not be implemented (also valid for export to a third country). There should be a societal consensus concerning the standards to be used. If the standards are not met, then the shared facility should not be allowed to be constructed or operated.

Vulnerable parts of the Earth or even extra-terrestrial spaces should not be used for shared solutions. The responsibility for establishment or even long-term control should not be in private responsibility. The governance arrangements should be sensitive towards corruption problems, low democratic standards or ethical issues. A level playing field for the collaborators aiming at preventing ecological and social dumping is the most important precondition. If e.g., shared solutions aimed at final disposal of RW and safety concerns are raised, the possibility of retrievability and recoverability of the RW should be assured as well as reversibility of all crucial decisions in the RWM process.

For existing RW management shared solutions, a possibility for discussion should be available together with the objective to improve the operation in accordance with the characteristics of RW, changed regulations and requirements, changed environmental conditions, etc. Transparency and correct public information shall be ensured by all stakeholders involved in this process.

Further steps for shared solution

To be able to start a shared solution, and in particular a shared GD, some high-level guidance should be developed as a basic starting point with incorporation of the Aarhus and Espoo Convention principles. It might be seen as very trivial to produce such guidelines, but some research should be devoted on the international level as to how to approach it. Responsibilities have to be legally fixed and backups have to be installed. Modes of decision have to be established, enabling effective public participation. An independent control has to be established under the participation of Civil Society (including, or at some point in time converting to a rolling stewardship model). A budget has to be provided for hundreds of years. Safety, security, all RW management steps, including record keeping, data and knowledge management have to be institutionalised. A Plan B (and Plan C) has to be developed, if safety might not prove as good enough or if legal challenges cannot be solved.

A level playing field

A level playing field[49] for cooperation on shared solutions and particularly shared facilities in order to avoid environmental and social dumping among the co-operators could be defined as: “Any bilateral, multilateral, European and international cooperation on planning, constructing, operating and closing of shared nuclear facilities, must involve partners that follow the same technical, legal and ethical standards in their home countries. If they do not have the same standards, they should follow the highest standards in all the relevant categories among the parties that are involved in the cooperation. The standards must apply to all the phases of the development and functioning of the shared facilities, including policy, framework and program establishment, site evaluation, selection and characterisation, and facility construction, operation, closure and post-closure.” In general, participants agree with such a definition. In addition, some concerns are pointed out, such as the difficulty to achieve such a high standard and consequently jeopardising the shared solutions. It is good to remember that aiming for the highest standards or the best possible solution does not guarantee safety. Only aiming for the safe

[49] A level playing field is presented in section 3.2 from ethical point of view and based on the discussion with CS larger group. Further on, in section 3.3, some legal framework for a level playing field is given.

solution for all, does that. However, just following the highest standards is not enough. The independent institutions and institutions of European level and Civil Society have to evaluate them regularly.

Such definition should be broadened with application of the standards to transparency, access to information (FOIA), public participation, anticorruption measures and law enforcement. The definition of a shared facility should explicitly also involve facilities that offer services for foreign countries (e.g., RW treatment) even if the facility itself is to be built/operated by a single country.

However, there are also opposite opinions, i.e., the countries that enter into such international partnership must accept the national framework of the host country. Or that there could not be a level playing field of participating countries as nations with nuclear power plants having funds for decommissioning and disposal of waste and SIMS who do not have access to funds.

Governance of shared solution

According to the participants the governance is a very important question in a shared solution of RW disposal. The involved countries would need to develop the process in accordance with the legal requirements, stepwise approach, following the highest standards, and assuring for public participation (real, contextual, meaningful, long term, financially supported …). The generic frame would need to be developed as part of research activities on an international level, the details should be set by those involved. They would need to obtain support for the identified gaps.

A shared solution is a complex issue with technical, societal, and political dimensions and implications and its governance is also complex and has to keep into account interdependence on different levels.

All countries which use the shared facility have to ensure their ultimate responsibility for their nuclear waste. Therefore, all countries have to take over shared responsibility for safety, security, availability and quality human resources, transparency, budgetary resources, liability etc. All countries together have to introduce a data and knowledge management system also for long-term memory keeping and data preservation. A rolling stewardship model should be introduced by all countries together. There should be some type of monitoring/advisory board installed including Civil Society to watch over the shared facility.

Some ideas for governance of shared solutions already exist: It is likely the facility operator will be a private or state-owned company, where the participating countries are represented in a Board of Directors or similar. Countries would be major players with shared responsibilities and shared duties, EU/EURATOM would be involved in the governance structure.

Veto rights

Participants in general agree that the public should have their say according to democratic principles, whether it is a shared solution or not. From a project progress point of view, it would be best done and implemented at the early stages of the project, and after that the project fate would be determined by the regulatory authority (meaning; that if they found it not to be fulfilling the requirements, they can demand extra measures). The approach to the veto (who, the question, when) should be part of the governance procedure to address the particular needs of participating countries. There are also ideas that a veto right would be connected with a certain amount of already spent resources for establishment of a shared solution (i.e., 10% of the building costs).

Some also argue that a veto right is not necessary: “If decision making processes are grounded in a framework of cooperation by all actors as elaborated in previous answers, then, when a Socio-technical argument is made for siting a facility even at large scale a veto should not be necessary.”

4. Case studies

ROUTES Task 6 focuses specifically on “Shared Solutions” and aims to describe and assess knowledge on and approaches to sharing technology and facilities between members states, to provide an overview of the interest in and experience with sharing technology/facilities in the different steps of waste management and finally to identify gaps and define needs for R&D, strategic priorities and opportunities for collaboration between Member States.

Examples of studies and plans for developing shared solutions and technologies for radioactive waste management in Europe have been summarised in ROUTES Task 6’s Deliverable 9.12 [19] where the difficulty to clearly define a “shared solution” and the lack of concrete examples of development of **joint facilities** (e.g., safety assessment research of geological disposal) were pointed out. Deliverable D9.12 concludes that the “definition” of sharing needs to be broadened taking into account experiences of transnational cooperation. In this framework a number of case studies was, then, analysed in the ROUTES subtasks 6.2. Detailed outcomes and findings will be published in Deliverable D 9.13, but it is already clear that most of the case studies analysed, pose or have posed issues related to transparency and civil society information and acceptance. From this perspective three case studies have been selected and are presented in the next paragraphs. Each of them reports a different situation and addresses specific issues from the civil society perspective.

The three case studies of radioactive waste (RW) shared solutions are summarised (with details in appendixes for more complex cases where separate references are provided) with information on context, implementation of the provisions from Aarhus conventions, findings and recommendations.

The first one addresses issues related to the current management of a shared facilities between two Member States, heritage of a historical situation, the breakup of the Socialist Federal Republic of Yugoslavia (SFRY). This case describes in details issues related to the shared management of a nuclear facility including RWM from a technical and historical perspective. The second one describes a quite common situation where foreign nuclear waste is transported, treated and conditioned in a different MS facility. Although the export and import of spent fuel and radioactive waste is subject to strict controls, the issues that this kind of quite usual situation can raise in terms of civil society acceptance, transparency and information to the public are discussed.

The third one describes a quite controversial situation where depleted uranium is exported to be re-enriched. It is clear that each Member State remains free to define its nuclear fuel chain policy and depleted uranium is by some, regarded as a valuable resource or by others as radioactive waste that is destined for disposal. Nevertheless, as the previous case study, this raises issues related to transparency.

The case studies of radioactive waste (RW) shared solutions are summarised (with details in appendixes for more complex cases where separate references are provided) with information on context, implementation of the provisions from Aarhus conventions, findings and recommendations.

4.1 Shared responsibility between the Republic of Slovenia and the Republic of Croatia for radioactive waste and spent fuel from the Krško NPP

4.1.1. Introduction

The Republic of Slovenia (RS) and Croatia (RC) are sharing the nuclear power plant (NPP) Krško (NEK), located in Slovenia, which was constructed as a joint venture during the 1970’s in the Socialist Federal Republic of Yugoslavia (SFRY) as part of the larger nuclear programme on the use of nuclear energy. NEK is a two loop PWR Westinghouse (USA) design with all supporting infrastructure on site, including the buildings for radioactive waste (RW) and spent fuel (SF) management. The licensing was performed by the Republic Committee for Energy, Industry and Construction as the responsible authority in the Republic Slovenia for matters relating to the safety of nuclear facilities. All other authorities were coordinated by this Committee, including the Expert committee on nuclear safety with its Technical Support Organizations. A safety report with safety analyses has been developed in iterative steps, mainly based on the provisions from USA NRC legal framework as the NPP was of USA design. The

trial operation was granted in 1981, in 1983 commercial operation started, and a license for normal operation was obtained in 1984 according to the SFRY and Slovene legislation.

4.1.2. Context of the shared facility

NEK d.o.o. is currently organized as a limited liability company in 100 % state ownership from entities of two republics: 50 % is owned by GEN energija d.o.o from Slovenia and 50 % by HEP d.d. from Croatia, both in 100 % ownerships by their states and the successors of the initial investors. The owners of NEK are equally responsible for ensuring all material and other conditions for safe and reliable operation of NPP, whereas the regulation and supervision of nuclear and radiation safety for NEK is the sole responsibility of the Republic of Slovenia. The regulatory framework for nuclear and radiation safety consists of the Ionizing Radiation Protection and Nuclear Safety Act with a set of regulations and decrees that are harmonised with international developments. All other legal requirements are incorporated in other legislation in Slovenia. The responsible authorities are primarily the Slovenian Nuclear Safety Authority (SNSA) within the ministry responsible for environment and the Slovenian Radiation Protection Administration (SRPA) within the ministry responsible for health.

After the breakup of the SFRY in 1991, NEK continued to operate under the legal framework of the Republic of Slovenia, although co-ownership with the Republic of Croatia was recognized and never argued but was not well defined under the new legal systems of both countries. Next to one major dispute on the energy supply which finished with lawsuits by both owners, the governments agreed to define in more detail the mutual relations regarding the status of NEK, its exploitation and decommissioning and adopted in 2001 the Agreement between the Government of the RS and the Government of the RC on the Regulation of the Status and Other Legal Relations Regarding the Investment, Exploitation and Decommissioning of the Krško NPP[50] (Intergovernmental Agreement – IA), ratified by both parliaments in 2003. The most vital points in the IA are the establishment of NEK decision making bodies, most importantly the Intergovernmental Commission (IC), in order to monitor the implementation of the IA, responsibilities in relation to the production of electricity, transmission, costs, recruitment, education, contractors and support for equal opportunities for workers. A very important part of the IA is devoted to decommissioning of NEK and RW and SF management, where several provisions are agreed:

- Decommissioning of NEK, the disposal of all generated RW and SF, as specified in the IAEA Joint Convention on safety of RW management and safety of SF management, is **a joint obligation of the parties**.
- **Parties agree to provide an effective joint solution for the decommissioning and disposal of RW and SF from an economic and environmental point of view.**
- Two programmes are determined:
    - Programme of RW and SF disposal: developed in accordance with international standards with the participation of NEK by responsible organizations (ARAO as WMO in Slovenia and the Fund for financing the decommissioning of the Krško NPP in Croatia). The programme includes proposals for the possible division and takeover of RW and SF, acceptance criteria for the disposal and assessment of the necessary financial resources, and deadlines for implementation and revised at least every five years.
    - Decommissioning programme: includes the management of all radioactive and other wastes generated during the decommissioning, until their removal from the NEK site, an estimate of the necessary financial resources and deadlines for its implementation, revised at least every five years.
- The location of NEK may be used for temporary storage of RW and SF for the rest of its lifetime.

[50] Agreement between the governments of Slovenia and Croatia on the status and other legal issues related to investment, exploitation, and decommissioning of the nuclear power plant Krško (Official Gazette RC, International Agreements 9/2002; Official Gazette RS 23/2003)

- If parties do not agree on a common solution for the disposal of RW and SF by the end of its regular lifetime (that is until 2023), they shall undertake removal of RW and SF from the NEK site no later than two years thereafter (until 2025), each half. Further removal of RW and SF will take place in accordance with the RW and SF disposal programme and the decommissioning programme, at least every five years, unless otherwise specified by the approved programmes.
- Financing of the costs of the preparation of the decommissioning programme, the costs of its implementation, as well as the costs for the RW and SF disposal programme shall be shared in equal parts.

4.1.3. On site RW and SF management and transparency

Due to the fact there are no available repositories (for RW, nor for SF), some related projects have been implemented on the site of NEK. For improvement of safety and due preparation of NEK lifetime extension, a dry SF storage is under development with the construction license issued in December 2020[51]. An EIA and transboundary EIA were implemented due to pressure from NGOs, and NEK has also to take into account some measures and conditions to mitigate adverse effects including zero monitoring before facility construction, protection of soil and water, and emergency preparedness. The Waste Manipulation Building intended for storage and further manipulation of RW in drums was constructed in 2018. After the initial presentation of the project by the investor NEK, the municipality council of Krško decided not to be included in further steps. By a decision from the Environmental Agency of the Republic of Slovenia (ARSO), no EIA process was implemented, and therefore no public participation took place[52]. It is not known how that decision was adopted, but also NGOs with the status of third party did not appeal. Also, NEK's lifetime extension for 20 years, which is inevitably linked with RW and SF generation was initiated. First, SNSA took in 2012 a decision in principle, referring to the results of two Periodic Safety Reviews in 2023 and 2033. However, such an approach did not follow non-nuclear legislation (environmental protection act, where the EU EIA directive is transposed) and NEK had to file an application for lifetime extension to the responsible body ARSO in 2016. Only after an appeal from NGOs and a judgement from the Administrative Court in October 2020[53], ARSO decided that for the NEK lifetime extension an EIA is obligatory[54]. The process will take several years, but information and participation will be assured.

4.1.4. Long-term RW and SF management and transparency

The long-term RW and SF management from NEK is defined in the Programme of NPP Krško Decommissioning and SF & Low and Intermediate Level Waste (LILW) Disposal (DP) which was so far adopted with two revisions. The main purpose of the DP is to propose technical solutions, to estimate decommissioning and RW and SF disposal costs for NEK, and to calculate annual instalments for devoted funds in Slovenia and Croatia. DP Rev.1 was approved by the Intergovernmental Commission, adopted by Slovenian government and Croatian parliament at the end of 2004. In 2011, the DP rev.2 was developed with new boundary conditions, including the option of NEK lifetime extension, but this was never adopted. There were no clear statements as to why there was no agreement. DP rev. 3 was developed again under new boundary conditions (like the NEK lifetime extension, dry SF storage as part of NEK's operation, so only three projects were still to be addressed: NEK decommissioning, LILW disposal and SF disposal) and was adopted in 2020 by the same main authorities: the IC[55], the Slovenian Government and the Croatian Parliament. A joint LILW repository was rejected by the council of the municipality of Krško[56], so in the DP Rev. 3 two separate RW disposals are taken into account: one in Slovenia on the selected site Vrbina, next to NEK, and one in the potential RW centre Čerkezovac in Croatia, although the latter is still in the licensing process. Therefore, the division of operational and

[51] https://www.gov.si/assets/ministrstva/MOP/Dokumenti/Graditev/gradbena_dovoljenja/suho_skladiscenje_goriva_NEK.pdf
[52] https://www.krsko.si/DownloadFile?id=80963
[53] https://a9g3u8k4.stackpathcdn.com/wp-content/uploads/2020/02/sodba-o-NEK-feb2020.pdf
[54] https://www.arso.gov.si/novice/datoteke/043411-NEK.pdf
[55] https://www.energetika-portal.si/nc/novica/n/slovenija-in-hrvaska-potrdili-revizijo-programa-odlaganja-radioaktivnih-odpadkov-4386/
[56] https://www.krsko.si/objava/176551, https://www.krsko.si/DownloadFile?id=168298

decommissioning RW is analysed and included in this revision, starting with the removal of existing waste from NEK in 2023. Regarding SF disposal, a joint solution is still foreseen between the two states. During the development of the DP, no public participation took place and all decision making was entrusted to the Intergovernmental Commission and its advisory committees.

In the interim, the Slovenian LILW repository has evolved, and a site licence[57] was obtained in 2010 for a modular silo version of the repository at the Vrbina, Krško site, which is just next to the NEK. Information and public participation were broader than required and during site selection local partnerships were functioning, although later ceased. In the EIA report, two silos were included, thus creating the possibility that the disposal contains all radioactive waste generated at NEK. The construction licencing procedure[58] is now in its final stage, while in parallel an EIA procedure with prescribed public participation, including a public hearing and 30 days for comments and suggestions, and a transboundary EIA (including also Croatia) was undertaken.

4.1.5. Challenges of shared responsibility for RW and SF from NEK

Until the adoption of the IA in 2003, the management of different issues of NEK were also bringing disagreements between the co-owners. One of the major ones being the issue of costs for NEK operation and the related decommissioning, RW and SF management, to be set in a dedicated fund. The dispute ended with lawsuits and ended with the decision that Slovenia had to pay a total of around 40 million € due to the non-supply of electricity to Croatia in 2002 and 2003.

After the adoption of the IA in 2003, relations have become much more defined with procedures on how to approach in case of divergences. For on-site RW and SF management a decision-making process is in place and no disagreement is reported publicly (e.g., in media). However, for several new RW and SF buildings on site or even for the lifetime extension of the NPP, NEK tried to minimise public participation. EIA processes started only after successful appeals by NGOs with the status of third party, administrative court rulings and new decisions of ARSO: the EIA for the Waste Manipulation Building, an EIA process for the Dry SF Storage, and an EIA for the NEK lifetime extension.

With regards to long-term decisions for the RW and SF management from NEK operation and future decommissioning, the issues are less conclusive and more complex. The main decision-making body defined in the IA is the Intergovernmental Commission. The basic documents[59] that define the future decommissioning and disposal activities are the Programme of RW and SF Disposal and Decommissioning, which should be developed every five years. The mechanisms for development of these programmes are also in place: two responsible organizations – ARAO and the Croatian Fund – with sufficient knowledge and resources for development of work, based on a Terms of Reference (ToR), adopted by the IC and further confirmed by the Slovenian Government and Croatian Parliament. However, the process of regular adoption of new revisions every five years was not successful. After the DP, Rev. 1, adopted in 2004, the Revision 2 of the DP scheduled to be adopted in 2009, although started on time, was never adopted. Only in the 2020, Revision 3 of the DP was adopted, but the joint solution for LILW management was not agreed and 2 separate LILW repositories are planned for. The reasons for rejection of a joint LILW repository establishment were never set out in writing, but the basic principles as proposed by the advisory body to the IC (on safety of solutions, disposal of all RW in Slovenia and Croatia, optimization of costs and equal participation of entities from both countries) were already rejected at the level of the Krško municipality and were just taken over by the IC.

According to the IA, the decision making is limited to the official representatives of both countries, namely the members of the IC and its advisory body (this time called the Implementation Coordinating Committee), basically represented by appointed high ranking politicians or heads of responsible organizations. There is no other decision making foreseen, as programmes are seen as a kind of strategic documentation. However, there is a question whether such documents should also be also

[57] http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED5417
[58] http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED541
[59] http://www.fond-nek.hr/en/zbrinjavanje-rao-ing/program-razgradnje-nek-odlaganja-rao-ing/

open for public participation (in terms of any kind of environmental assessment or other unofficial discussions) and, would such broadening of transparency increase the acceptability of projects. Arguments for such public participation can be found in the Aarhus Convention[60], article 7, which obliges public participation for plans, programmes and policies related to the environment, the Kiev Protocol to the Espoo Convention on strategic environmental assessments and the EU Strategic Environmental Assessment Directive 2001/42/EC.

4.1.6. Findings and conclusions

Experience with co-ownership of NEK is, especially after the adoption of the Intergovernmental Agreement, in principle good. The performance of NEK is rated very high according to performance indicators and safe and stable operations are ensured while respecting high standards.

The issue, in a way typical for NEK activities, is transparency in terms of Nuclear Safety and Waste Directives requirements: the approach used is to go for construction license to the MESP where SNSA provides consent for the nuclear safety and radiation protection part. Such an approach definitely shortens the procedure, but also excludes any public participation. Only lately can we perceive a change, basically due to the appeals from NGOs to require EIA procedures for projects. It is not clear what is the major concern or drawback not to perform an EIA. But, the lack of willingness for transparency by NEK is in a way its weak point and more should be done by the owners and governments (as NEK is publicly owned) to improve transparency and to fulfil all legal requirements in national and international legislation.

In relation to development of long term RW and SF management solutions for NEK, the implementation of the IA is not so effective and successful, the functioning of the IC is somehow limited. The fact is that the members of the IC are changing with the governments: the lead from each country is the responsible minister, a state secretary in the ministry and some other state officials. Therefore, the composition changes whenever new governments are elected. It would be important to stabilise the future functioning of the IC and perhaps to think about professionalisation of the body. If the members would not change every two years (the current rate of government changes in Slovenia), they would be much more knowledgeable in the area, and also much more independent in decision making processes. Currently, the IC is perceived as a political body and also the broader context of relationships between the countries impacts its functioning (like the disputed border on the sea).

Transparency, including information provision and public participation (not to mention access to justice) of developed programmes decided by the IC is real weakness. Decisions are taken by the IC, on websites there is no further information on how decisions have been taken, the public is informed on press conferences about the outcomes. The programmes are published only after they are adopted and there is no public participation. However, individual projects (like the LILW repository) are going over all the steps as prescribed in legislation, including an EIA process. The Law on environmental protection already requires that for strategies or plans, a strategic environmental assessment (SEA) should be performed, to include public participation for important national strategies. Following the definitions in the Aarhus Convention, the Kiev Protocol to the Espoo Convention and the SEA Directive, the DP has to be understood as a national programme which directs RW and SF management from NEK. Also, some other ways of transparency could be implemented to provide opportunities for the public (e.g., local population, interested public, NGOs) to get the information about the plans and to participate effectively in the decision-making process. The lack of public participation could be one of the reasons for not accepting the joint solution for the LILW repository. An open discussion on the shared option and a structured dialogue with interested parties from both countries would enable a more flexible approach in which disagreement could be addressed and potentially mitigated and solved.

[60] https://unece.org/fileadmin/DAM/env/pp/documents/cep43e.pdf

4.2 Foreign radioactive waste (RW) treatment in Jaslovské Bohunice, Slovakia – transformation from a national to international treatment centre

4.2.1. Introduction

Since 2013 (at the latest) foreign LLW and VLLW has been treated at RW Treatment and Conditioning Technologies in Jaslovské Bohunice (RW TCT), Slovakia, mainly through incineration. Hundreds of tons of RW from the Czech Republic, Italy and Germany have been incinerated or contracted for incineration at RW TCT (see the sec. 4.2.3 for details). The transformation of RW TCT from the exclusively national facility to an international RW treatment provider was done without prior consultation with, and approval by the public and municipalities which, according to, e.g., one of the mayors[61] might have found out about it only in 2018 (i.e., after approx. 5 years). The foreign RW share incineration varied between approx. 35-45% during 2015-2019 and exceeded 50% for the first time in 2020. Foreign RW treatment, especially by means of incineration, was originally categorically rejected by the vast majority of the affected municipalities. However, multiple municipalities later turned their position by 180 degrees on the condition, among others, that they received economic and non-economic incentives[62]. Unusually strong refusal arose also among the public, e.g., approx. 3 000 citizens signed a petition against capacity increase of RW TCT and demanding prohibition of foreign RW treatment in Slovakia. Meanwhile, the operator applied for an increase of the RW TCT treatment limits from 8343 to 12663 t/year in total (including an increase from 240 to 480 t/y by incineration) and a second incineration plant has been constructed. There is some evidence supporting an opinion that Slovakia itself does not need such an increase of treatment (or at least incineration) capacities and a suspicion that the second incineration plant might be purpose-built to better fit the specific RW from the Caorso NPP, Italy. The Slovak Atomic Act allows import, treatment and conditioning of foreign RW on condition that the radioactivity level of the imported RW equals the radioactivity level of the reexported (after treatment and conditioning) RW. Since the change of government in March 2020, the new Minister of Environment has been trying to ban foreign RW incineration by law. On 6 October 2021, the Slovak Parliament approved a bill which aims at banning future contracts for incineration of foreign RW on the Slovak territory. The already signed contracts for incineration of foreign RW from Italy (617 m^3 and 865 tons) and Germany (21.7 t) will not be affected by the bill[63].

4.2.2. Historical context

RW TCT is a part of a larger nuclear site near Jaslovské Bohunice, Slovakia, that also includes NPP A1 and V1 (both being decommissioned), NPP V2 (in operation), interim SNF storage and other nuclear installations. In addition, a new nuclear reactor is planned in this locality (EIA process completed in 2016). NPP A1, commissioned in 1972, was the first NPP in the former Czechoslovakia. Being operated only for 5 years, NPP A1 was permanently shut down after two serious accidents in 1976 and 1977. Shortly after the process of decommissioning had slowly begun and continues currently. The core of the RW TCT was designed to ensure the process of treatment of RW produced during the decommissioning of NPP A1. As a result of gradual development, the RW TCT in its current state includes e.g., two incinerators for solid, liquid RW and saturated sorbents; facilities for super-compaction of solid RW;

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[61] "*We found out about it* [foreign RW treatment] *in either 2018 or 2019, I am not sure.*" A statement made by Mr. Gilbert Liška, the mayor of the municipality Veľké Kostoľany in the investigative videoreportage broadcasted on 15.06.2020 (part of "Reportéri RTVS" series) available at: https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu (time 03:55-04:03)

[62] See, e.g., a statement of selected municipalities (in Slovak) available at https://www.jaslovske-bohunice.sk/evt_file.php?file=26988&original=stanovisko_obci.pdf and resolutions no. 2/28.10.2019, 3/28.10.2019 and 4/28.10.2019 of the Council of the Association of the municipalities in the region of the Bohunice NPP

[63] http://www.nuclear-transparency-watch.eu/activities/radioactive-waste-management/slovak-parliament-approved-a-bill-to-ban-future-contracts-for-incineration-of-foreign-radioactive-waste-according-to-the-slovak-ntw-members-some-concerns-still-remain.html

metallic RW remelting; fixed RW pre-conditioning; concentration of liquid RW; solid RW sorting; bituminisation and other installations. The first of the two incinerators is a shaft furnace type (as in Seibersdorf, Austria), was built between 1993-1999 and has been operated since 2000. The second incinerator has a rotary kiln, its project dates back to February 2017 at the latest, has been constructed between 2019-2021 and is going to be commissioned soon.

RW TCT is owned and operated by JAVYS (**Ja**drová a **vy**raďovacia **s**poločnosť = Nuclear and decommissioning company), a state-owned stock company (the Ministry of Economy of the Slovak republic holds 100% of the company stocks). Originally, before JAVYS was founded in 2005, RW TCT belonged to Slovenské elektrárne (i.e., "Slovak power plants") company. Prior to its privatisation in 2006 Slovenské elektrárne had been a state-owned company which operated all the power plants in Slovakia including the nuclear ones and the related infrastructure (e.g., RW and SNF management facilities). JAVYS was founded by separating it from Slovenské elektrárne in 2005. JAVYS was not a subject of privatisation and, as a result, has remained completely state-owned. At the time of its founding JAVYS consisted of selected nuclear assets in which the Italian ENEL company, the winner of the business competition for privatisation of the Slovenské elektrárne, was not interested. In addition to RW TCT, these assets included the NPP A1 and V1 (and their decommissioning), the Interim SNF storage (in Bohunice) and the National repository for LLW and VLLW in Mochovce. At the moment, JAVYS is also responsible for the deep geological repository project, holds the *de facto* monopoly position in interim storage of Slovak SNF, decommissioning and management of RW and, through a 51% share, takes part in the project of the new NPP in Jaslovské Bohunice.

4.2.3. Foreign RW treatment history and plans for RW TCT capacity increase

At RW TCT, the foreign RW is treated mainly by incineration which, until the second incinerator is commissioned, takes place exclusively at the first incinerator. The incineration of foreign RW dates back to 2013 when 8.8 tons of Czech RW were incinerated[64]. In 2012 the volume of the incinerated Slovak RW reached its historical minimum after it had decreased from approximately 140t to 50t a year between 2007-2012. Gradually, the Nuclear regulatory authority of the Slovak republic (NRA SR) issued permissions for incineration of (1) 39.64t RW from NPP Temelín and Dukovany, Czech republic (31.10.2013); (2) 7t +16m^3 institutional RW from Italy (03.09.2015); (3) 145.2t RW from NPP Temelín and Dukovany, Czech republic (27.11.2015); (4) 800t ion-exchange resins in urea formaldehyde and 65t sludge from the decommissioned NPP Caorso, Italy (04.06.2018); (5) 21.7t institutional RW from Germany (22.01.2019) and (6) 617m^3 institutional RW from Italy (25.01.2019)[65]. Incineration of approx. 1600 tons of foreign RW (Czech rep., Italy, Germany) was contracted in total, out of which approx. 300 tons have already been incinerated between 2013 – 2020. In comparison, approx. 1100-1200 tons of Slovak RW were incinerated between 2007-2020. In the period 2015-2019 approx. 110-130t of RW in total were incinerated annually, out of which the Slovak RW represented 60-85t, the share of foreign RW at incineration oscillated between 34-46% (43-56 tons annually) and exceeded 50% for the first time in 2020[66]. Although the current legal limit for RW incineration is 240 t/year, according to JAVYS it is in practice not technically feasible to incinerate more than 130-150 t/year of RW at the first incineration plant[67]. In case the capacity increase (in case of incineration from 240 t/year to 480 t/year) is approved and the second incineration plant becomes operational, the volume of incinerated RW in practice may

[64] Historical records of volumes of RW incinerated at RW TCT from 2007 to 2019 were provided by the NRA SR in a response to the request on information, letter no. 3921/2020 dated 19.05.2020. The data is presented also in the section "*Foreign RW treatment history*" of the long version of this case study, see chapter 9.5 in the appendix.

[65] A list of permits containing more details (e.g. permit number, issue date, ...) is presented in the table 3 in the section "*Foreign RW treatment history*" of the long version of this case study, see chapter 9.5 in the appendix.

[66] This overview is based on historical records of volumes of RW incinerated at RW TCT from 2007 to 2019 provided by the NRA SR, data about incineration provided by JAVYS on monthly basis to the mayors of 9 affected municipalities since summer 2019 and annual reports of JAVYS. See section "*Foreign RW treatment history*" of the long version of this case study in the appendix.

[67] see ruling of the Ministry of Environment of the Slovak republic no. 2764/2019-1.7/zg-R dated 19.02.2019

increase to approx. 420-460 t/year[68] (i.e., approx. 3 to 5-fold increase if compared to the current state), and the foreign RW share at incineration might exceed 70%[69].

The public did not participate in the authorization processes for import and incineration (treatment) of foreign RW in Slovakia held by NRA SR which resulted in the six permits mentioned above[70]. The available information does not indicate that mayors of the affected municipalities were aware of the ongoing foreign RW incineration until about 2018[71]. However, at least since 2014 the mayors have been considering the risk of such activities, although only as a theoretical option in the future. During various EIA processes, the municipalities regularly (as a precaution) expressed their disapproval of foreign RW treatment in the Jaslovské Bohunice locality until 2019[72]. Nevertheless, we have not found any evidence that the municipalities were explicitly notified of the ongoing foreign RW treatment (incineration) during the EIA processes before 2017/2018. The EIA process "*RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location*"[73] (December 2012 – November 2014), during which the already existing and operated RW TCT were assessed for the first time on the basis of modern EIA legislation, might be used as a particular example. During a public hearing, which took place in March 2014, the mayors directly and indirectly asked about the possibility of treatment of RW from locations other than Jaslovské Bohunice[74]. In response JAVYS did not inform about foreign RW treatment (e.g., incineration) that had already been carried out (8.8 tons RW from the Czech Republic incinerated in 2013) or that which had already been contracted. The statement of JAVYS was formulated in a conditional way, as if the treatment of RW for other companies (aside from RW from Mochovce NPP) was not a reality yet. Although it was admitted that contracts for RW treatment and conditioning were being sought, it was not directly mentioned that the RW would come from abroad. In addition, "*foreign RW treatment*" was not even once explicitly mentioned, neither in the EIA plan, EIA report nor in the minutes from the public hearing. Finally, the Environmental Impact Statement (EIS) from this EIA process[75] (issued in November 2014, with minor changes valid until today) explicitly states that RW TCT serves the treatment and conditioning of VLLW, LLW and ILW from (1) decommissioning of the Slovak NPPs A1 and V1; (2) operation of Slovak nuclear installations; or (3) institutional RW (IRW) and captured RW (CRW). The list of purposes does not explicitly mention treatment (incineration) of foreign RW. In March 2021 the Slovak Ministry of Environment stated that "*the ongoing foreign RW treatment*

[68] See the treatment plan for variant No. 1 in 2019-2023 on p. 52 in the expert judgment on the EIA report within the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" – a corrected version of Table A.II.10/05 from the EIA report within the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*"

[69] The estimate of the share of foreign RW is based on the predictions of the total volume of incinerated RW (approx. 420-460 t/year) and a highly overestimated volume of the incinerated Slovak RW - 120 t/year. See section "*Foreign RW treatment history*" of the long version of this case study in the appendix. During the period January 2021 – October 2021 94.78 and 37.81 tons of foreign and Slovak RW, respectively, were incinerated. i.e. the foreign RW share at incineration was 71.49% in this period (Source: data about incineration provided by JAVYS on monthly basis to the mayors of 9 affected municipalities since summer 2019).

[70] The permits do not mention any public participation in the authorization process

[71] See, e.g., the statement of Mr. Gilbert Liška, mayor of the municipality Veľké Kostoľany, "*We found out about it* [foreign RW treatment] *in either 2018 or 2019, I am not sure*" made in the investigative videoreportage broadcasted on 15.06.2020 (part of "Reportéri RTVS" series) available at https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu (time 03:55-04:03) and a statement of mayors of the affected municipalities dated 15 October 2018 demanding list of permits for incineration of foreign RW at RW TCT issued by the NRA SR and categorically refusing the foreign RW incineration (see p. 5-6 of the ruling no. 2764/2019-1.7/zg-R available (in Slovak) at: https://www.enviroportal.sk/eia/dokument/287520).

[72] See section "*Corresponding EIA processes*" of the long version of this case study (chapter 9.5 in the appendix) for details and references.

[73] Documents available at https://www.enviroportal.sk/sk/eia/detail/technologie-pre-spracovanie-upravu-radioaktivnych-odpadov-javys-v-loka

[74] See pages 27-29 of the EIS (in Slovak only) available at https://www.enviroportal.sk/eia/dokument/221746 or section *"EIA process I. "RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location""* of the long version of this case study (chapter 9.5 in the appendix).

[75] ruling no. 2276/2014-3,4/hp of the Ministry of Environment of the Slovak republic issued on on 14.11.2014

(incineration) is inconsistent" with the EIS mentioned above[76]. However, the treatment of foreign RW at RW TCT continues.

It was not until the beginning of 2018 that information on the treatment (incineration) of foreign RW resonated for the first time among municipalities and a part of the public. There were two main sources – (1) the press conference of then opposition MPs Mr. Igor Matovič and Mr. Marek Krajčí about incineration of RW from the decommissioned Italian NPP Caorso and their failed attempt to ban incineration of foreign RW by law (February 2018)[77] followed by (2) publishing the EIA plan "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" (March 2018)[78] where foreign RW treatment was mentioned among the purposes of RW TCT. However, the treatment and especially incineration of foreign RW gained more significance and repeated media attention only in the middle of 2020, after the February 2020 elections and the consequent change of government (Mr. Matovič and Mr. Krajčí became the Prime Minister and the Minister of Health, respectively)[79].

4.2.4. Corresponding EIA processes

The environmental impact assessment (EIA) project "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" stands for capacity increase of RW TCT, from 8343 to 12663 t/year in total (all technologies). It also covers the second incinerator and an increase of the incineration limit from 240 to 480 tons per year (corresponding to the real incinerated volume increase from approx. 130t/y, the technical limit of the first incinerator, to approx. 420-460t/y if both incinerators are in operation); capacity increase of the metallic RW remelting from 1000 to 4500t/y, and so on[80]. In April 2018, the vast majority of the municipalities categorically refused foreign RW treatment, especially incineration, and the proposed RW TCT capacity increase, reasoned with arguments of (protection of) a healthy environment for their citizens (not by unmet financial requirements)[81]. An individual EIA process for the second incinerator was only launched in September 2018 under the name "*Optimisation of incineration capacities of the nuclear installation RW Treatment and Conditioning Technologies*", thus accelerating the authorization process of the second incinerator[82]. JAVYS justified the second incinerator with an expected approx. 50% increase in production of domestic combustible RW[83] in 2020-2023 and the necessity to have an operational incinerator capacity within the assessed limit of 240 tons/year (the technical limit of the first incinerator is approximately 130t/y only) in order to "*meet emerging requirements for RW treatment from decommissioning and also from the operation of NPPs in the Slovak Republic*". Based on this justification, the majority of the municipalities approved the second incinerator providing that the limit 240t/y (for both incinerators together) is

[76] See p. 90 of the English version of the EIS available at https://www.enviroportal.sk/eia/dokument/326075 or p. 86 of the Slovak version available at https://www.enviroportal.sk/eia/dokument/323308

[77] See e.g. http://www.obycajniludia.sk/aktualita/marek-krajci-zda-sa-ze-slovensko-ma-ambicie-stat-sa-spalovnou-radioaktivneho-odpadu-europy/ and the section "*Legal framework and efforts to outlaw import and treatment of foreign RW in Slovakia*" of the long version of this case study (chapter 9.5 in the appendix) for further details and references.

[78] Documents available at https://www.enviroportal.sk/sk/eia/detail/optimalizacia-spracovatelskych-kapacit-technologii-pre-spracovanie-upr

[79] See e.g., https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu or https://spectator.sme.sk/c/22604566/environment-ministry-wants-constitutional-ban-on-incineration-of-foreign-radioactive-waste.html

[80] Data available at https://www.enviroportal.sk/sk/eia/detail/optimalizacia-spracovatelskych-kapacit-technologii-pre-spracovanie-upr

[81] See e.g., statements (in Slovak) on pages 6-10 in the document available at https://www.enviroportal.sk/eia/dokument/295013

[82] Documents available at https://www.enviroportal.sk/sk/eia/detail/optimalizacia-kapacit-spalovania-jz-tsu-rao

[83] more precisely (according to a statement of JAVYS dated 17.12.2018 – see p. 9-11 of the ruling no. 2764/2019-1.7/zg-R available (in Slovak) at: https://www.enviroportal.sk/eia/dokument/287520): 50% increase in production of RW from NPP decommissioning combined with the start of production of combustible RW from operation of (to be commissioned) NPP Mochovce blocks 3 and 4 from 2020 onwards, i.e. 50% increase in the number of operated reactor blocks in Slovakia – from 4 to 6. However, the reactor blocks Mochovce 3 and 4 have not been commissioned yet.

preserved and no foreign RW is incinerated at the second incinerator[84]. These conditions, explicitly accepted by JAVYS, were transposed into the final ruling issued in this individual EIA process[85]. Under these conditions, the municipalities did not obstruct the authorisation process and already in June 2019 the NRA SR could have issued a construction permit and the construction of the second incinerator could have begun.

On 24.03.2021 the Ministry of Environment of the Slovak republic issued the EIS no. 417/2021-1.7/zg from the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*"[86] which, however, has not entered into force yet due to appeals lodged. This EIS approved the proposed capacity increase and set no restrictions on foreign RW treatment. The Ministry of Environment argued that 1.) it cannot interfere with or restrict business activities if significantly negative impact on the environment had not been demonstrated and 2.) there is a constitutional right to engage in business and other gainful activity[87]. Once the EIS from the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" comes into effect, the EIS from EIA process "*RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location*" and the ruling from the individual EIA process for the second incinerator expire. Therefore, the restriction prohibiting incineration of foreign RW at the second incinerator will expire as well, unless the EIS no. 417/2021-1.7/zg is amended as a result of the appellate procedure and such restriction is added to the EIS.

It is important to point out that JAVYS agreed to exclude foreign RW treatment at the second incinerator in December 2018, i.e., in a situation when the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" was already in progress and permits for incineration of foreign RW valid today had already been issued by NRA SR or the permits had already been requested. Also, the condition prohibiting incineration of foreign RW will be de facto applied only after the second incinerator is commissioned.

In 2019-2020 the volumes of incinerated Slovak RW reached approx. 60 tons per year (1/8 of the proposed increased limit 480t/y) which means an approx. 25% decrease if compared to the period 2016-2018 (approx. 80-85 t/y)[88]. This data does not seem to be in accord with the statement of JAVYS from 17.12.2018 when it expected an approx. 50% increase in Slovak RW production from NPP decommissioning in the period 2020-2023 and used it as the primary reason for justification of the second incinerator[89]. Also, according to the National policy for management of SNF and RW in the Slovak republic (2015)[90], the current capacity of RW treatment lines (i.e., without the second incineration plant) is sufficient (with reserves) for treatment of RW from both operation and decommissioning of the Slovak nuclear installations. These conclusions are consistent with the data volumes of incinerated Slovak RW (60-85 t/y in 2015-2019) which is significantly below the technical capacity of the first incinerator (approx. 130t/y).

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[84] See p. 5-6 of the ruling no. 2764/2019-1.7/zg-R available (in Slovak) at: https://www.enviroportal.sk/eia/dokument/287520

[85] ruling no. 2764/2019-1.7/zg-R available (in Slovak) at: https://www.enviroportal.sk/eia/dokument/287520

[86] available online at https://www.enviroportal.sk/eia/dokument/326075

[87] See p. 76 of the English version of the EIS available at https://www.enviroportal.sk/eia/dokument/326075

[88] This comparison is based on historical records of volumes of RW incinerated at RW TCT from 2007 to 2019 provided by the NRA SR, data about incineration provided by JAVYS on monthly basis to the mayors of 9 affected municipalities since summer 2019 and annual reports of JAVYS. See section "*Foreign RW treatment history*" of the long version of this case study in the appendix.

[89] Since the reactor blocks Mochovce 3 and 4 have not been commissioned yet, the missing contribution to increase in production of RW from NPP operation due to these blocks, originally expected by JAVYS in 2018, is not addressed here.

[90] The Slovak version is available at http://www.njf.sk/wp-content/uploads/2020/01/N%C3%A1vrh-Vn%C3%BAtro%C5%A1t%C3%A1tnej-politiky-a-Vn%C3%BAtro%C5%A1t%C3%A1tneho-programu-nakladania-s-VJP-a-RAO-v-SR.pdf

There were two public hearings during the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" - on 26.08.2019 and 16.12.2019. Among others, JAVYS declared on 26.08.2019 foreign RW treatment as "*a complementary activity*"[91] (compare this to a 34-46% share of foreign RW at incineration in 2015-2019 and a possible expected increase to over 70% in the future); on 16.12.2019, JAVYS, among others, claimed that foreign RW share at incineration was 12% only[92]. The public obtained data about volumes of incinerated domestic and foreign RW only in the middle of 2020 (e.g., through a request of information sent to NRA SR[93]).There have been attempts to obtain more detailed data about incineration of foreign RW (e.g., activity streams, production and management of the secondary RW) which, however, have led to very limited success.

Currently, after a position change in 2019, the majority of the affected municipalities and the association of municipalities explicitly approved both the RW TCT capacity increase and foreign RW treatment (up to 30% share) on the condition (among others) that new economic and non-economic incentives for municipalities in the region are established[94]. Two county towns (Hlohovec and Piešťany) and some other municipalities continue opposing the project. Approx. 3000 citizens signed a petition against capacity increase of the RW TCT and demanding a prohibition of foreign RW treatment in Slovakia[95].

The affected villages that now consent to the project received 10000€ each from JAVYS in December 2019. On the contrary, the opposing affected villages received only 2500€ or 0€[96]. The following year in December 2020, after this fact was published in the media, all 9 affected municipalities received 10000€ each from JAVYS.

4.2.5. The Caorso contract

The Caorso contract for incineration of more than 30-year-old 800 tons of ion-exchange spent resins in urea formaldehyde and 65 tons of radioactive sludges (5881 tanks) from the shutdown Italian NPP Caorso, holds an exceptional position among the 6 contracts for foreign RW incineration at RW TCT. The main reason is the allegedly challenging nature of this RW is that it is said to lead to difficulties during incineration in the shaft furnace of the first incinerator and a suspicion that the second incinerator with a rotary kiln might be purpose-built to better fit the RW from Caorso and thus overcome these difficulties[97]. These doubts can be supported by (1) the original construction contract stating that the second incinerator must (with special regards) be capable of incineration of ion-exchange spent resins in urea-formaldehyde which shall be proven by successful hot tests with 100 tons of ion-exchange resins

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[91] See minutes of the public hearing.

[92] See minutes of the public hearing.

[93] The NRA SR responded to the request of information by the letter no. 3921/2020 dated 19.05.2020

[94] See, e.g., a statement of selected municipalities (in Slovak) available at https://www.jaslovske-bohunice.sk/evt_file.php?file=26988&original=stanovisko_obci.pdf and resolutions no. 2/28.10.2019, 3/28.10.2019 and 4/28.10.2019 of the Council of the Association of the municipalities in the region of the Bohunice NPP

[95] The author serves as the petition committee representative. The electronic version (there is also a paper one with additional signatures) is available at https://www.peticie.com/peticia_proti_dovozu_a_spracovavaniu_zahranineho_radioaktivneho_odpadu_na_uzemi_sr

[96] See https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu at 11:22-12:50

[97] E.g., (1) news article dated 12.08.2020 available at https://www.aktuality.sk/clanok/813522/stali-sa-zo-slovakov-pokusne-mysi-olano-prudko-otocilo/ (translated from Slovak): "*Sceptics are convinced that JAVYS needs the new incineration plant, because the sludges from Italy cannot be incinerated at the old one*. *Even people who have been employed in the nuclear energy sector for years have no doubts about it.*"; (2) statement of the mayor of Veľké Kostoľany (one of the 9 affected municipalities) in the investigative videoreportage broadcasted on 15.06.2020 (part of "*Reportéri RTVS*" series) available at https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu (time 04:27-04:46): "*We suppose that the new incineration plant is being purpose-built, since the RW imported from Italy cannot be incinerated at the old one*"; (3) official statement of the town Piešťany dated 28.04.2020: "*At the time of signing the contract, it became apparent that treatment of this type of RW at the old incineration plant would be very difficult.*" See the section "*The Caorso contract – 865 tons of radioactive ion exchange resins in ureaformaldehyde and sludges"* of the long version of this case study (chapter 9.5 in the appendix) for further details and references.

in urea-formaldehyde and 20 tons of other RW[98]. In May 2021 the NRA SR explicitly confirmed that "*exactly the urea-formaldehyde resin represents the foreign RW*"[99]; (2) the Caorso contract was signed in 2015, but hot tests at the first incinerator took place only in 2019, after a brand new pre-conditioning line was commissioned[100]; (3) the hot tests at the first incinerator took almost half a year (21.01.2019 – 02.07.2019) and large volumes (43 tons reduced by preconditioning to 15,5 tons) were incinerated[101]; (4) almost a threefold reduction of RW mass through pre-conditioning; (5) the contracting process for construction of the second incinerator took place 20 months after the Caorso contract was signed (February 2017 vs. June 2015)[102]; (6) incineration at the second incinerator does not result in alpha cross-contamination of the (foreign RW) ashes; (7) the residual capacity of the first incinerator (i.e. after incineration of the Slovak RW) is approx. 60-80 t/y, which does not seem to be sufficient to meet the Caorso contract deadline in 2023[103] (assuming the contract volume 865 ton and also other contracts, e. g. 617m^3 of institutional RW from Italy).

However, a direct connection between the second incinerator and the Caorso contract has not been confirmed, neither by JAVYS nor by the nuclear regulator NRA SR. Transparency is deficient not only in the clarification of the relation between the Caorso contract and the second incinerator (and the preconditioning line), but also in the Caorso contract itself. The Caorso contract was, after a significant portion of relevant data had been redacted, published online in November 2020[104].

4.2.6. Prohibition of future contracts for foreign RW incineration by law

Since the change of government in 2020, the new Minister of Environment, Mr. Ján Budaj, has been trying to ban foreign RW incineration by law. These efforts encountered a significant obstacle represented by huge financial penalties in case the Caorso contract is terminated[105]. Different positions of the Ministries of Environment and Economy on this topic led in February 2021 to a compromise proposal that the ban would not affect the already signed contracts for foreign RW incineration. A corresponding legislative bill was submitted in the Slovak parliament at the end of May 2021[106]. On 6 October 2021, after significant changes were made to the wording of the bill at an advanced stage of discussion in the Parliament, the Slovak Parliament approved a bill which aims at banning future contracts for incineration of foreign radioactive waste on the Slovak territory[107]. After the president of the Slovak republic signed the bill on 25 October 2021, which will come into effect on 1 January 2022. The already signed contracts for foreign RW incineration will not be affected by the bill. This concerns 617

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[98] The contract is available at https://www.uvo.gov.sk/vyhladavanie-dokumentov/detail/838123, see p. 19 and 25. The public procurement order was published on 26.01.2017.

[99] see NRA SR ruling no. 164/2021 P dated 24 May 2021, p. 20

[100] The pre-conditioning line was commissioned by the NRA SR ruling no. 361/2018 dated 19.12.2018

[101] The report from the hot tests, p. 6 and 8

[102] https://www.uvo.gov.sk/vyhladavanie-zakaziek/detail/405486

[103] JAVYS states that the RW treatment and return of the products of this treatment to the country of origin is expected to be completed by 2023 (see e.g. https://www.javys.sk/sk/cinnosti-spolocnosti/komercne-aktivity/spracovanie-sorbentov-z-je-caorso or https://e.dennikn.sk/2078275/spalovat-cudzi-radioaktivny-odpad-kollar-a-sulik-su-za-zvysok-koalicie-proti/). Also according to https://www.sogin.it/en/closureoftheitaliannuclearcycle/italian-nuclear-sites/caorsonuclearpowerplant/decommissioningprojects/resins-treatment.html: "*Therefore, Sogin launched, on January 29th 2020, the second and final phase of the transfer program (with 33 transports) of the remaining drums, approximately 5,600, to the Slovakian plant, whose conclusion is expected in 2022.*" and "*Treatment of 5.600 drums and shipment operations are expected to conclude by 4 years (2020-2023)*."

[104] See the redacted version of the Caorso contract (in Slovak and Italian) published by JAVYS in November 2020: https://www.javys.sk/sk/cinnosti-spolocnosti/komercne-aktivity/spracovanie-sorbentov-z-je-caorso

[105] https://www.enviroportal.sk/clanok/mzp-spalovanie-zahranicneho-radioaktivneho-odpadu-by-sa-mohlo-v-sr-zakazat https://www.minzp.sk/spravy/stanovisko-ministerstva-zivotneho-prostredia-sr-k-tlacovej-besede-richarda-sulika-spalovani-zahranicneho-radioaktivneho-odpadu-slovensku.html

[106] https://www.nrsr.sk/web/Default.aspx?sid=zakony/zakon&MasterID=8287

[107] http://www.nuclear-transparency-watch.eu/activities/radioactive-waste-management/slovak-parliament-approved-a-bill-to-ban-future-contracts-for-incineration-of-foreign-radioactive-waste-according-to-the-slovak-ntw-members-some-concerns-still-remain.html

m3 and 865 tons of RW from Italy and 21.7 t from Germany, i.e. amounts that significantly exceed the volumes of incinerated domestic RW (about 60 – 85 tons annually during the period 2016-2020).

4.2.7. Challenges related to the foreign RW treatment

Correct and complete impact assessment of the foreign RW treatment is a challenging task. For example, tracking down where all foreign radionuclides might end up could be highly relevant. One of the reasons is that the ratio of radioactivity retained in ash after incineration compared to radioactivity of the input RW is variable and significantly below 100% (on average approx. 60% in the period March 2020 – October 2021)[108]. At the same time wastewater from wet filtration of flue gases from RW incineration, which might contain a significant share of foreign radionuclides, ends up permanently in the RW repository in Mochovce[109]. In order to analyse the fraction of foreign radionuclides that remain in Slovakia and how these missing radionuclides are replaced by Slovak radionuclides the public requested, mostly unsuccessfully, data about radioactivity streams during RW preconditioning, incineration and post-treatment (e.g., how much radioactivity is carried to the wastewater) and the production of secondary RW. This data is crucial in order to analyse the impact of the foreign RW treatment, especially by incineration. However, when requested[110], the nuclear regulator NRA SR could not provide (did not have) detailed data about activity streams in the treatment process. The data cannot be obtained from JAVYS either, since it claims not to be a liable entity according to the Slovak Freedom of Information Act.

Financial impacts should be assessed in detail as well. For example, the foreign RW owners do not participate in the future decommissioning of the RW TCT (especially the incinerators and the pre-conditioning line). The corresponding costs are expected to be covered by the National Nuclear Fund that collects money from Slovak electricity consumers. It could be worth analysing whether the Slovak taxpayers do not subsidise the foreign RW treatment in any (hidden) way (incl. construction, operation and future decommissioning costs, indirect costs – e.g., if the incinerator lifetime was negatively affected by the foreign RW treatment).

One can also argue that foreign RW treatment might challenge the ALARA principle. Slovakia is not legally or morally responsible for foreign RW, so it is reasonable not to incinerate/treat it and thus avoid any kind of unnecessary negative effects or risks. The Public Health Authority of the Slovak republic, Section of radiation protection justified its 2017 legislative proposal to ban foreign RW incineration by this argument.

4.2.8. Findings and conclusions

The crucial issues here are transparency, public access to information, evidence-based decision making and effective public participation, which, among others, represent some of the key principles of the Aarhus Convention and the European Council Directive 2011/70/EURATOM. We consider it important to take into account that JAVYS is not a private but state-owned company and that most technologies of the RW TCT received necessary permits when the public and the municipalities implicitly assumed that RW TCT served management of the Slovak RW only and RW from decommissioning of NPP A1 in particular. First of all, the public discussion about foreign RW treatment should have taken place prior to RW treatment services being possibly offered to foreign customers, not years after foreign RW treatment in Slovakia started. The eventual ongoing discussion, which was initiated mainly by the public and the municipalities, is strongly affected by the risk of huge financial penalties in case the already

[108] see data about incineration provided by JAVYS on monthly basis to the mayors of 9 affected municipalities since summer 2019

[109] In the response to the request of information NRA SR confirmed in the letter no. 7622/2020 dated 05.11.2020 that "*the waste water from wet flue gas scrubbing is used for cement grout of the fibre-concrete containers*" [in the national RW repository in Mochovce]

[110] Requests of information according to the Freedom of Information Act sent by the author

signed contracts are terminated. This significantly reduces the set of options (de facto) available for discussion and subsequently impacts the results.

The second important issue are the difficulties in access to (objective and complete) information, information verification and consulting with independent experts in the case of the public and the municipalities. In practice the main source of information about activities at the nuclear site J. Bohunice for the general public are the corresponding EIA processes, since the EIA documentation is easier-to-read for non-experts, is published online and often also the public hearings take place in the affected municipalities. On the other hand, documentation from processes held by the nuclear regulator NRA SR is expert-oriented, can be accessed usually only via physical inspection and sometimes is even declared confidential. However, even in the EIA processes, the effectiveness of public participation is limited by information asymmetry between the public and municipalities on one hand, and the project proposer on the other. In case of nuclear installations, this asymmetry is further enhanced because of higher complexity of the problem. Due to limited time, expertise and financial resources the public and municipalities are reliant mostly on information provided by the project proposer, either in the EIA documentation or in reactions to additional questions (raised e.g., during the public hearing). Consultations with independent experts appear to be a theoretical option only, not only because of short procedural deadlines and financial constraints, but also due to a lack of suitable independent nuclear experts and/or insufficient free capacities of these experts. Even the Ministry of Environment failed while attempting to obtain an additional independent (expert) opinion on the EIA report within the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" in autumn 2020[111].

Effective public participation in the decision-making process requires that the public and municipalities are provided with correct and complete information about the project, its impacts and purpose as well as tools for easy information verification. The public should not be dependent on extensive and time-consuming investigation and information verification based on independent sources. The situation is negatively affected by the fact that JAVYS claims not to be a liable entity with respect to the Slovak Freedom of Information Act. This is difficult to understand, since this company is state-owned, carries out a public service and receives millions of euros from the public budget (through the National Nuclear Fund) each year, de facto holds a monopoly position in management of RW and SNF in Slovakia and, on top of that, it is also responsible for the project of the Slovak deep geological repository.

If the decision-making process is to be evidence-based, the project proposer shall be required to support all claims by objective and verifiable data.

Besides the deficiency in transparency and public participation and limited public access to information, the challenges related to the foreign RW treatment include (1) missing publicly available analyses of radioactivity streams, secondary RW production and corresponding data on the fraction of foreign radionuclides that remain in Slovakia and how these missing radionuclides are replaced by Slovak radionuclides; (2) non-participation of the foreign parties in the future decommissioning of RW TCT and in the legal responsibility in case of accidents or other indirect impacts; (3) missing publicly available detailed financial analyses including also of all indirect costs (it could be worth analysing whether the Slovak taxpayers do not subsidize foreign RW treatment in any (hidden) way); (4) reasonable doubts about the need of the second incinerator (in perspective of the Slovak needs) and clarification of the relation between the Caorso contract and the second incinerator (and the preconditioning line); (5) possible conflict of interests – e.g. some members of municipal councils employed at JAVYS; (6) financial power asymmetry between the proposer and the public. The distribution of substantial financial benefits from JAVYS to the affected municipalities in 2019 is highly correlated to the (dis)approval of the proposed RW TCT capacity increase by these municipalities; (7) law enforcement – the Ministry of

[111] See p. 49 of the English version of the EIS available at https://www.enviroportal.sk/eia/dokument/326075

Environment confirmed that "*the ongoing foreign RW treatment (incineration) is inconsistent*" with the still valid EIS. However, the treatment of foreign RW at RW TCT continues.

4.3 Exports of TENORM[112] to Russia - A case of lack of transparency and research[113]

4.3.1. Introduction

From 1996, the uranium enrichment facilities URENCO Almelo (Netherlands) and URENCO Gronau (Germany) regularly sent shipments of depleted uranium (DU) in the form of UF_6 (uranium hexafluoride) to TENEX, later TVEL, in Russia, where this was stored in the open air in Seversk in the Krasnoyarsk region. Protests in Europe then halted these transports in 2009. TVEL is since 2007 a subsidiary of the Russian nuclear giant Rosatom. URENCO carries out enrichment for nuclear fuel production from natural uranium to low-enriched uranium for clients all over the world and has facilities in the Netherlands, Germany and the UK.

In 2019 and 2020, these transports were resumed from the enrichment facility of URENCO Gronau and URENCO UK in Capenhurst.

URENCO Almelo currently has a permit for export, but does not use it. Its DU is sent to France for conversion into stable U_3O_8 (depleted tri-uranium-octo-oxide or uranium oxide), which is returned to the Netherlands and handed over to the waste management organisation COVRA for interim storage in the VOG facility, awaiting final disposal after 2100.

The claim is that the DU is sent to TENEX, later TVEL, for re-enrichment to natural level and reuse of the resulting double depleted uranium (DDU). Rosatom furthermore claims[114] that DDU and DU are used industrially and that the UF_6 also delivers fluorine for reuse purposes. It furthermore, describes in detail how it wants to convert its UF_6 stockpile into uranium oxide for waste treatment before 2057.

Our conclusion is that this form of TENORM (technically enhanced naturally occurring radioactive material) should be considered in principle as a waste material, for which full transparency should be assured over its complete chain of management, also when a limited amount of the material may be used as resource. Research on optimisation of the management pathways should be part of EURAD.

Our central observations are:

- The involved DU is in Russia not a resource in the sense of sustainable recycling – that is, it is not 100%, nor for a majority of it, recycled and reused.
- The ownership structure of this export of DU to Russia hides this fact. Rosatom / TVEL has taken ownership of the material after export and with that, the material is out of sight of URENCO, its hosting EU Member State (MS) Germany, and of EURATOM. It is today impossible for EURATOM, Germany or URENCO to confirm whether the material is indeed reused in any form or not.
- Resulting radioactive waste from any management operation should be returned to the country of origin (as happens in the case of reprocessing of spent nuclear fuel). This does not happen in this case.

[112] We use the term TENORM (Technically Enhanced Naturally Occurring Materials) here, though in some countries, like France, depleted uranium and reprocessed uranium (as parts of the fuel chain) are not put under that category. For us, TENORM stands for all leftovers from natural occurring materials that have been in one form or another enhanced through industrial or laboratory processes, including those in the fuel chain.

[113] In dedication to Rashid Alimov († 2020), who delivered vital input for this chapter, but succumbed to COVID-19.

[114] See: Nikitin, Alexander, Oleg Muratov and Ksenia Vakhrusheva, Depleted Uranium Hexafluoride (current situation, safe handling and prospects), St. Petersburg (2020) Bellona Foundation: https://network.bellona.org/content/uploads/sites/3/2020/08/Depleted-Uranium-Hexafluoride.pdf – Although this publication was published under the name of Bellona, the content was provided and overseen by Rosatom

- Material that is not reused or recycled within a reasonable timeframe constitutes waste and has to be treated as such from the start. It falls under radioactive waste as defined in 2011/70/Euratom and the treatment of DU – whether within or outside the Union – should be considered as waste management.
- This implies that there should be a clear description of incurred streams of all treatment pathways in line with 2011/70/Euratom – and decisions on these treatment pathways should all be based on 2011/70/Euratom and complete knowledge of these pathways, irrespective of whether this treatment takes place within the Union or outside.

4.3.2. Issues of law and transparency

There is no transparency about the pathways of management of the DU exported by URENCO to Russia. There are claims of reuse on the Russian side,[115] but there are no clear descriptions of streams and involved amounts.

The Euratom radioactive waste directive defines radioactive waste as: *"radioactive material in gaseous, liquid or solid form for which no further use is foreseen or considered by the Member State or by a legal or natural person whose decision is accepted by the Member State, and which is regulated as radioactive waste by a competent regulatory authority under the legislative and regulatory framework of the Member State;"* (art. 3(7) 2011/70/EURATOM).

Article 4(2) of the directive states: *"Where radioactive waste or spent fuel is shipped for processing or reprocessing to a Member State or a third country, the ultimate responsibility for the safe and responsible disposal of those materials, including any waste as a by-product, shall remain with the Member State or third country from which the radioactive material was shipped".*

Article 4(4) of the directive explains in more detail: "*Radioactive waste shall be disposed of in the Member State in which it was generated, unless at the time of shipment an agreement, taking into account the criteria established by the Commission in accordance with Article 16(2) of Directive 2006/117/Euratom, has entered into force between the Member State concerned and another Member State or a third country to use a disposal facility in one of them.*
Prior to a shipment to a third country, the exporting Member State shall inform the Commission of the content of any such agreement and take reasonable measures to be assured that:
(a) the country of destination has concluded an agreement with the Community covering spent fuel and radioactive waste management or is a party to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management ('the Joint Convention');
(b) the country of destination has radioactive waste management and disposal programmes with objectives representing a high level of safety equivalent to those established by this Directive; and

(c) the disposal facility in the country of destination is authorised for the radioactive waste to be shipped, is operating prior to the shipment, and is managed in accordance with the requirements set down in the radioactive waste management and disposal programme of that country of destination."

Furthermore, the EURATOM directive obliges in art. 10 transparency concerning radioactive waste.

In Russian law, the definition of radioactive waste is "*materials and substances not subject to further use, and equipment, articles (including spent ionizing radiation sources), in which the content of radionuclides exceeds the levels established in accordance with the criteria defined by the Government of the Russian Federation*" (clause 8, article 3).[116] This is a much shadier definition, whereby the issue

[115] Nikitin, Alexander, Oleg Muratov and Ksenia Vakhrusheva, Depleted Uranium Hexafluoride (current situation, safe handling and prospects), St. Petersburg (2020) Bellona Foundation; https://network.bellona.org/content/uploads/sites/3/2020/08/Depleted-Uranium-Hexafluoride.pdf

[116] From Nikitin (2020), page 17 – this refers to Federal Law of November 21, 1995 No. 170-FZ on use of nuclear energy.

of responsibilities for waste material and waste as by-product are not defined. It may therefore well be that where there is responsibility for exported DU for the state of origin under 2011/70/Euratom, there is none under Russian law.

4.3.3. Transfer of ownership and responsibility for waste and waste streams

In the current set-up, ownership of this TENORM is transferred from URENCO to TVEL / Rosatom. Nevertheless, 2011/70/EURATOM stipulates that "*the ultimate responsibility for the safe and responsible disposal of those materials, including any waste as a by-product, shall remain with the Member State or third country from which the radioactive material was shipped".* Logically, because URENCO Gronau does not reuse this material, for URENCO Gronau and Germany, this depleted uranium in the form of UF_6 is a waste material for which it has ultimate responsibility – also when others claim (but not prove in the form of accountable and accounted for pathways) use as resource. After all, 'ultimate responsibility' when the material is (partially) not reused in any way but ends *de facto* as waste, can never be shed. This has several consequences:

- The transfer of ownership does not release the Member State from which the material was shipped (e.g., Germany) from its ultimate responsibility for the depleted uranium and waste as by-product when it is not actually reused;
- For that reason, the Member State needs to have a full, proven and accountable overview of whether the material is indeed reused or not, and what is happening with all waste fractions, including by-products;
- The Member State should provide full (public) transparency about this – including the actual chains of handling – and the Member State should be involved in reducing the risks of that handling;
- The Member State should be involved in research about the handling of this stream of TENORM, in spite of (debatable!) claims that want it to be labelled as resource.

4.3.4. Resource or waste

Russia currently holds more than 1 million tonnes of DU in the form of UF_6, around half of the world's stockpile (Nikitin, 2020). It is unclear how much DU is held in stabilised form (in Russia, mainly DU_3O_8 – depleted tri-uranium-octo-oxide). Rosatom is planning to convert its complete stockpile of UF_6 to DU_3O_8 before 2057. Re-enrichment after that date would require re-conversion into UF_6.

To determine whether the to Russia exported DU may be considered to be a resource (in that case falling out of the scope of EURAD and of the Euratom radioactive waste directive), it is important to establish how much of the material is indeed reused for other purposes, which waste by-products are produced and which part remains for how long in storage without being reused.

Besides the earlier mentioned publication from Bellona / Rosatom, there is no public information available about this, nor any publicly available formal plans from TVEL / Rosatom.

According to Nikitin (2020), under Russian law, the material is seen as a "strategic reserve for the existing nuclear power industry" because of the possibility of re-enriching the material or use in fast breeder reactors.

From different sources, the following potential uses of DU can be found:

- *Reuse of fluorine*
  Nikitin (2020) puts a large emphasis on this. This is only possible when the uranium in the UF_6 is stabilised in the form of uranium-oxides and the fluorine is extracted. The resulting (radioactive) uranium would then only be further useful in metallic form (weapons, balancing, other) and breeder reactors, but not for re-enrichment. Given the fact there is no market lack of fluorine, it is highly unlikely that UF_6 for that reason would be kept as "strategic reserve" and hence justify labelling the DU as resource. Basically: declaring UF_6 a resource because of the need for toothpaste is nonsense.

- *Re-enrichment to natural level*
  Given the limited availability of natural uranium in commercially viable extractable ores, re-enrichment of DU could squeeze out some more uranium for use in the nuclear fuel chain. Officially, re-enrichment is listed as justification for the export of DU by URENCO, and URENCO receives natural uranium back in return for the delivered DU.[117] It is unclear, however, whether this is indeed re-enriched DU or whether this is an equivalent of non-enriched natural uranium. Given the extremely energy intensive nature of enrichment, it is for cost reasons likely to be the latter.
  When typical 0,2 – 0,25% DU from the enrichment facility of URENCO is re-enriched by TVEL to a level of 0,72%, 1 ton of depleted uranium yields around 0,25 tons of enriched uranium (natural level) and 0,75 tons of double-depleted uranium.[118] This means that ¾ of the exported DU will remain in Russia in the form of double-depleted UF_6, whilst maximally ¼ can be reused again by URENCO as natural level uranium for further enrichment purposes. URENCO then, in turn, delivers from these 0.03 tons of enriched uranium (nuclear fuel level) and another 0.22 tons of DU, which could yield another 0.06 tons of natural uranium and 0.007 ton of enriched uranium, etc. After many cycles, re-enrichment of DU could yield in total around 4% of the initial DU as fuel for nuclear power. 96% remains behind as double depleted uranium.
- *Use of DU in breeder reactors*
  Rosatom has declared on several occasions that the DU is to be used as plutonium breeding resource for its breeder reactors. It is currently operating two fast breeder reactors in Beloyarsk. In its Belona paper, it states that the DU is to function as a reserve for the next millennia for its '" fast" energy industry[119]. However, Rosatom already has an enormous stockpile of DU from its own sources, sufficient for covering many centuries of use in the theoretical case it would decide to continue to expand this extremely expensive way of electricity generation. For all substances that currently would fall under the definition of waste, one can dream up some kind of reuse in millennia from now, but they remain waste. Normally spoken, when a substance cannot be used within one generation – be it either because of lack of technology to reuse it or because of abundance – it is usually considered waste. Substances like paper, aluminium or steel have a reuse cycle within several years after being discarded. For that reason, fictional reuse in millennia from now cannot be used as an argument. As soon as next generations will have to take care of the management of material with toxic, radiotoxic or otherwise problematic properties, this material should be considered waste that is handed over to those next generations. Next to that, given the fact that fast breeder technology has proven so far to be an extremely expensive and risky way to generate electricity (accident risk, proliferation risk), there is a very realistic chance that nothing or only a minute part of Rosatom's current stockpile of DU would indeed ever be used in fast breeder reactors.
- *use of DU for DU weapons*
  Rosatom (in Nikitin (2020)) does not mention this potential use of DU. It is unlikely, however, that Russia is not using DU in production of armour-piercing weaponry, similar to that used by NATO and the US during the wars in Bosnia and Iraq. It may be that Rosatom does not mention this, because potential dual use of material would make it fall under EU export restrictions to Russia.[120] Apart from this dual-use problem, it is unlikely that reuse in the weapon industry

[117] https://greenpeace.ru/wp-content/uploads/2019/10/Wirtschaftsministerium-NRW-an-GAL-Gronau-12.09.2019-UAA-Gronau.pdf
[118] https://www.wise-uranium.org/nfcue.html
[119] From Nikitin (2020), page 31.
[120] Wegener, Bernhard W., *Zur Zulässigkeit von Dual-Use-Exportgenehmigungen für abgereichertes Uran von Deutschland nach Russland gemäß der EU-Verordnung 833/2014 - Rechtsgutachten für die Bundestagsfraktion Bündnis 90/Die Grünen*, Erlangen (2020) Friedrich-Alexander-Universität Erlangen-Nürnberg; https://kotting-uhl.de/site/wp-content/uploads/2020/10/Gutachten-Endfassung-final.pdf

would amount to more than a few percent of the total stockpile of DU currently available in Russia. DU from the EU would for that reason continue to expand the stockpile and should not be considered to be reused this way.

- *use of DU for balancing purposes (ships, aircraft)*
  Also, this potential reuse of DU is not mentioned by Rosatom (in Nikitin (2020)). The reasons are probably comparable with the use for DU weapons: potential military dual-use and the very minute amounts necessary in comparison with the available stockpile.
- *use in radiation resistant concrete*
  Rosatom (in Nikitin (2020)) does mention 'the manufacture of special radiation-resistant concrete'. From the description it remains unclear how much DU is used for this purpose in Russia, but the description of 'casks and protective screens for storage and transportation of SNF and [...] also [...] radiation-proof ballast for the geological burial of SNF' indicate that this concerns also speculative use of small amounts, especially because Russia has currently no active deep geological disposal programme for spent nuclear fuel (which it considers "resource" into eternity and not waste).

If all potential reuse of DU from EU sources in Russia is summarised, less than 10% will be reused in any form within the coming one or two generations. Over 90% will be passed on to the third generation and (very far) beyond for management and disposal.

This management includes (temporary) storage of UF_6, which currently happens in Russia at environment temperatures in large open air storage places. This constitutes a risky situation, and research would be needed to get a full picture of the risks (chance and impact) of failure of containers in, for instance, surrounding forest fire situations, in which corroded containers could start leaking and the UF_6 would sublimate, causing a large HF cloud. Given the obligation of ultimate responsibility of the Member State of origin for this waste under the 2011/70/EURATOM, research would be needed into lowering this risk.
Then, Rosatom intends to convert this UF_6 to a more stable DU_3O_8 before 2057. Although there is already quite some experience with this conversion within the EU (e.g., in France / Orano, Cadarache), the legal responsibility for this waste would oblige the EU Member State of origin, i.e., Germany, also to research the actual conversion and following of temporary storage and potential final disposal in Russia, including potential risks and risk reduction options.
In the Netherlands, DU_3O_8 resulting from DU from the enrichment facility of URENCO in Almelo is considered waste and is stored in the VOG temporary storage at COVRA in Borssele, awaiting final disposal in a potential deep geological disposal. Because of the long half-life of U^{238}, this disposal has to be virtually permanent.

4.3.5. Conclusions and recommendations

The production of TENORM waste in the EU is still poorly researched with long-term issues. The fact that part of this TENORM is transferred outside of the EU only further complicates the situation, but should in essence not change the 'ultimate responsibility' of Euratom Member States (2011/70/EURATOM art. 4(2)) for proper handling and disposal of this radioactive material that appears as waste from industrial processes within the European Union. Especially the longevity and toxicity of the material (with a half-life of uranium-238 of 4.5 billion years) urges for research into proper disposal of this material, when it *de facto* will not be further used.

This is especially relevant for the exported depleted uranium from URENCO to Russia. There is currently no transparency about whether any fraction of this material is actually *de facto* reused, what happens with the remaining fraction in case it is reused, and which proper handling and deposition methods must be found and optimised. Also, when this material has to be considered as waste (as we argue), or certain

fractions of it, repatriation of resulting wastes after processing needs to be taken into account, as well as handling methods that should be in place.

Given the fact that this DU will, in Russia either be demobilised as uranium oxide before 2057 and stored for an unspecified multi-generational time, or for a tiny fraction reused under the production of radioactive wastes as by-product, we argue that the status of this from the EU to Russia exported DU should by default be that of waste.

We therefore recommend:

- Proper handling and disposal of DU, like this from URENCO, should be part of EURAD research. Research into the DU waste streams of URENCO, including those to Russia, could be a template for the assessment of other TENORM streams that are currently evading investigation because of claims of partial reuse.
- Within EURAD, there should be an assessment of the handling pathways of all forms of TENORM, whether or not they include partial reuse within or outside the Union. This includes clarity about long term management of untreated or treated TENORM; safety of transport; assessment of radioactive waste as by-product in processing of TENORM; immobilisation and storage of TENORM and by-products from reuse; risks of temporary storage and final deposition of these wastes.

5. Recommendation from case studies and ICS

One of the most important challenges deriving from all three presented cases is transparency in terms of Nuclear Safety Directive and Waste Directive requirements, which includes two important aspects:

- Provision of information on the nuclear safety of nuclear installations and management of spent fuel and radioactive waste to workers and the general public.
- Provisions of opportunities to participate effectively in the decision-making process regarding the licencing of nuclear installations and spent fuel and radioactive waste management in accordance with national legislation and international obligations.

The recommendations are resulted from the three cases presented in the section 4, and also discussed in the ICS workshop (Milestone n°137 report on Interaction with Civil Society (ICS), Workshop n°2 (July 2021), available on EURAD ProjectPlace).

From the NEK case study

The licensing activities for changes at nuclear installations are organised in a way that there is not much information for the general public available, nor for workers. Licensing is organised in the frame of official institutions where exchanges take place in the triangle between the licence holder, the competent ministry and NRA. Such an approach definitely shortens the procedure, but also excludes any public participation and hence narrows the evidence base and can lead to tunnel vision. Only lately the change can be observed, basically due to court appeals from NGOs to require EIA procedures for projects. It is not clear what is the major concern or drawback not to perform an EIA. But the lack of willingness for transparency around nuclear installations is in a way the weakest point and more should be done to improve this situation and to fulfil all legal requirements in national and international legislation.

Also, a general transparency, including information provision and public participation (not to mention access to justice), in developing the programmes for shared facilities is a weakness. In case decisions are taken by appointing bodies (like, Intergovernmental Committee in case of Krško NPP), available information for all other interested parties is very poor and limited. For example, on websites there is no further information on how decisions have been taken, the public is informed on press conferences about the outcomes in a very sparse way, the documentation is not publicly available, and no public discussion is organised.

Even, if some related individual projects (like the LILW repository in case of RWM in Slovenia) are going over all steps as prescribed in legislation, including an EIA process, the process itself is governed by the legal requirements. The possibilities for remarks and comments are limited to certain time, like 1 month or even less, and public hearing is many times open during holidays. It is unrealistic to imagine that even very interested public would study extensive documents and provide substantial remarks. Therefore, other more inclusive approaches should be implemented where public participation would be organised with support of the three pillars of Aarhus convention. The fact is that for some RWM disposal projects such approach is already utilised, but when it comes to NPPs, which is the main generator of RW, still some old patterns of very formal decision making can be recognised.

The EIA Directive already now requires that for strategies or plans, a strategic environmental assessment (SEA) should be performed, also including public participation for important national strategies. Following the definitions in the Aarhus Convention, the Kiev Protocol to the Espoo Convention and the SEA Directive[121], such plans or programmes (like DP for NPP Krško) has to be

[121] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32001L0042&from=EN, DIRECTIVE 2001/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment, Art 1: "…an environmental assessment is carried out of certain plans and programmes which are likely to have significant effects on the environment.", Art 2: "…(a) plans and programmes' shall mean plans and programmes, including those co-financed by the European Community, as well as any modifications to them: — which are subject to preparation and/or adoption by an authority at national, regional or local level or which are prepared by an authority for adoption, through a legislative procedure by Parliament or Government, and — which are required by legislative, regulatory or administrative

understood as a national programme which directs RW and SF management from NPP. Also, some other ways of transparency could be implemented to provide opportunities for the public (e.g., local population, interested public, NGOs) to get the relevant information about the plans and also to participate effectively in the decision-making process. The lack of public participation could be one of the reasons for local authorities and the wider public not accepting the joint solution for the RW repository. An open discussion on the shared option and a structured dialogue with interested parties from both countries would enable a more flexible approach in which disagreement could be addressed and potentially mitigated and solved.

From the Bohunice case study

In this case, the crucial issues are mainly transparency, public access to information, evidence-based decision making and effective public participation, which, among others, represent some of the key principles of the Aarhus Convention and the European Council Directive 2011/70/EURATOM.

Effective public participation in the decision-making process requires that the public and municipalities are provided with correct, complete and evidence-based information about projects, its impacts and purpose. In doing so, the public shall be actively involved from the very beginning, when all options are open. Such an approach shall be applied not only to authorisation of individual projects but also to adoption of strategic documents (e.g., the national policy and programme for management of SNF and RW). The ongoing foreign RW incineration and treatment in Slovakia, which started in 2013, has eventually become a subject of public discussion only recently. Because of this, the discussion is strongly affected by the risk of huge financial penalties in case the already signed contracts are terminated. This significantly reduces the set of options (*de facto*) available for discussion and subsequently impacts the results of public participation. The situation is also specific in that most of the treatment technologies were built when one implicitly assumed that the treatment centre served management of Slovak RW only.

The effectiveness of public participation in the decision-making process (if such opportunity exists) will always be limited by asymmetry in information, expertise (in general), personal and financial resources between the project proposer and the public. Due to these reasons, the public and municipalities are usually reliant mostly on information and justification provided by the project proposer. Consultations with independent experts appear to be a theoretical option only, not only because of short procedural deadlines and financial constraints, but also due to lack of suitable independent nuclear experts and/or insufficient free capacities of these experts. However, some improvement might be achieved if such consulting services are reimbursed by the state and a sufficient time window within the decision-making processes could be provided for consultations requested by the public. The information asymmetry can be, to some extent, reduced by effective and fast public access to information. As much information as possible shall be available online automatically and if that is not possible then via requests of information according to the Freedom of Information Act (FOIA). The situation in Slovakia is negatively affected by the fact that JAVYS, a state-owned company that *de facto* holds a monopoly position in management of RW and SNF in Slovakia, receives millions of euros from the public budget (through the National Nuclear Fund) each year, and, on top of that, is also responsible for the project of the Slovak deep geological repository, but is claimed not to be a liable entity with respect to the Slovak FOIA.

Evidence-based decision making is a highly relevant issue. The project proposer shall be required to support his claims by objective and publicly verifiable data.

provisions;", Art 3: "2. subject to paragraph 3, an environmental assessment shall be carried out for all plans and programmes, (a) which are prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use and which set the framework for future development consent of projects listed in Annexes I and II to Directive 85/337/EEC," The Annexes I and II are part of EIA directive and include NPPs, RW and SF storages and RW and SF disposals.

The challenges related specifically to the foreign RW treatment include among others (1) missing publicly available analyses of radioactivity streams and secondary RW production and corresponding data on the fraction of foreign radionuclides that remain in Slovakia and how these missing radionuclides are replaced by Slovak radionuclides; (2) non-participation of the foreign parties in the future decommissioning of the treatment facilities and in the legal responsibility in case of accidents or other indirect impacts or (3) missing publicly available detailed financial analyses including also of all indirect costs with special regards to separation of public and commercial resources. It could be worth analysing whether the Slovak taxpayers do not subsidise the foreign RW treatment in any (hidden) way.

Issues mentioned in the previous paragraph (difficulties related to the radionuclide accountability, financial issues related to decommissioning …) seem to be common for all the countries rather than specifically related to Slovakia only. As such, they represent examples of issues to be addressed and solved when a shared facility is foreseen.

From the TENORM export to Russia case study

Proper handling and disposal of uranium resulting from enrichment and reprocessing activities in the EU (e.g., from URENCO and Orano) should be part of EURAD research. Research into the DU waste streams of URENCO and Orano, including those to Russia, could be a template for the assessment of other TENORM streams that are currently evading investigation because of claims of partial reuse.

Within EURAD, there should be an assessment of the handling pathways of all forms of TENORM, whether or not they include partial reuse within or outside the Union. This includes clarity about long term management of untreated or treated TENORM; safety of transport; assessment of radioactive waste as by-product in processing of TENORM; immobilisation and storage of TENORM and by-products from reuse; risks of temporary storage and final deposition of these wastes.

6. Interactions with other ROUTES tasks

During EURAD Year 2, ROUTES Task 7 CS experts have followed the work of the other ROUTES Tasks and they kept interacting (with the Tasks leaders especially) in different ways: through email exchanges, through questions and presentations during meetings, via deliverable reviews and participating in all other activities organised by the tasks' coordinators. Below is a short summary of the interactions between ROUTES Task 7 CS experts and the other ROUTES participants in relation to the Tasks 2, 3, 4 and 5. Also some information on the interaction with activities in the task 6 are given, although this report is devoted to the shared solutions and supports other results in Task 6.

Task 2: 'Identify challenging waste to be collaboratively tackled within EURAD'

Task 7 CS experts followed the work of Task 2 through their participation in several meetings, notably in the kick-off meeting of Task 2.2 on "Understanding at the EU level of the practical issues on RWM routes for challenging waste" in March and in the short meetings that were organised between March and May that focus on a different type of waste.

The CS experts were also very careful to the development of two of Task 2's deliverables: deliverable D9.4 on the "Overview of existing work on categorization/classification of RWs in participating states" (Task 2.1), and deliverable D9.5 on "Providing a comprehensive list of challenging waste" (Task 2.2).The deliverables have been still under development at the end of year 2, and the findings will be reported in further deliverable.

Task 3: "Description and comparison of radwaste characterisation approaches"

The Task 7 experts with delegated representatives participated the Workshop 2 on Radioanalytical characterisation of radioactive waste and waste with complex/toxic properties (as part of the Task 3.1) in December 2020 and discussed the structure of the review on characterisation methods which has been used for the D9.7. The CS experts also participated at the sub-task 3.2 characterisation and segregation of legacy waste at kick-off meeting in October 2020. More activities will be developed after drafting of D9.7.

Task 4: "Identification of WAC used in EU Member-States for different disposal alternatives in order to inform development of WAC in countries without WAC/facilities"

Task 7 experts were present at all organised meetings and support discussions and provided suggestions for the Task 4 activities. In November 2020 at the kick-off meeting for T4.2 "Sharing experience on waste management with/without WAC available" members participated in the exchange and proposed the cross-cutting topic on involvement of civil society and other stakeholders in the development and application of WAC. In March 2021 participants also contributed to the more detailed planning for the workshop based on the collected information. The presentation was given in the June 2021 at the T4.2. workshop. The members of Task 7 also attended the PREDIS/ROUTES/ERDO April and May 2021 webinar where they stimulate an exchange with active contributions.

The focus of activities is now on the development of MS88 "Current use of Waste Acceptance Criteria (WAC) in European Union Member-States and some Associated Countries" (Task 4.1).

Task 5 "RWM solutions for small amounts of wastes"

Members of Task 7 participated in a Task 5 workshop (MS 91), whose aim was to discuss possible disposal options for SIMS. Relevant here is which combinations - or alternatively just one option - make sense depending on the radioactive waste of the SIMS (LLW, ILW, very small amounts of HLW) and

which do not. The workshop which was organised by task leaders and hosted by Nuclear Engineering Seibersdorf (NES) in Austria, was held December 9th - 11th 2020. It was supposed to include a technical visit to the NES facilities in Seibersdorf, but instead it was held virtually because of Covid-19 travel restrictions.

This workshop was organised as a joint workshop of Task 5 and Task 3. In order to ensure a successful finalisation of Task 5 deliverable D9.10 *"Report about knowledge for existing and potential disposal options for SIMS"*, its current version was introduced by the main contributors and also discussed with Task 3. During the workshop, the next steps of its development were agreed upon. Initially, the deliverable was due in June 2021, but has been postponed until September 2021.

Task 6: "Shared solutions in European countries"

The members of Task 7 contributed to the discussion on the D9.12 Studies and plans for developing shared solutions for radioactive waste management in Europe and provided some comments for the deliverable as part of the subtask 6.1. For the subtask 6.2 on Case studies on shared development and use of technologies and facilities the members were involved in the meetings and workshop, organised by the coordinator. The focus of the collaboration was the experience of interactions with civil society in the case of shared solutions and lessons learned from past activities.

7. Conclusion and the focus of Task 7 in year 3

The D9.16 is the result of the implementation of action plan developed after the first year of Task 7 Interaction with civil society. The core part of this deliverable is devoted to the shared solutions of radioactive waste (RW) management and discusses some key ethical and legal principles for managing radioactive waste, which are relevant to different solutions and public concerns related to the shared solutions in general where the ideas and comments were collected from participants of ROUTES and also from CS larger group. These are then illustrated with three cases of different shared solutions which exist and are interested by the Task 7 members. Based on lessons learned the more general recommendations are derived which are of value also for other shared situations.

For EURAD year 3 the focus of the investigation of Task 7 will be on the work of Task 5 on "RWM Solutions for small amounts of waste" (and partially also new Task 8) as described in point 3 of the action plan in section 1.1. The Task 7 team will focus on the public participation in case of national RWM developments based on the existing international legal frameworks (like Aarhus and ESPOO conventions). This will also be an opportunity to review existing action plans and to address the ongoing development in other ROUTES tasks.

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[13.] Patricia Birnie and Alan Boyle: International Law and the Environment, Second Edition, Oxford: University Press, 2002.

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[15.] EIA Directive - Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment.

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9. Appendixes

9.1 IAEA's and NEA's Ethical Principles for RWM

The following ethical principles for RWM have been established by the International Atomic Energy Agency (IAEA) and the Nuclear Energy Agency (1995):

Principle 1: *Protection of human health*. Radioactive waste shall be managed in such a way as to secure an acceptable level of protection for human health.

Principle 2*: Protection of the environment*. Radioactive waste shall be managed in such a way as to provide an acceptable level of protection of the environment.

Principle 3: *Protection beyond national borders*. Radioactive waste shall be managed in such a way as to assure that possible effects on human health and the environment beyond national borders will be taken into account.

Principle 4: *Protection of future generations*. Radioactive waste shall be managed in such a way that predicted impacts on the health of future generations will not be greater than relevant levels of impact that are acceptable today.

Principle 5: *Burdens on future generations*. Radioactive waste shall be managed in such a way that will not impose undue burdens on future generations.

Principle 6: *National legal framework*. Radioactive waste shall be managed within an appropriate national legal framework.

Principle 7: *Control of radioactive waste generation*. Generation of radioactive waste shall be kept to the minimum practicable.

Principle 8: *Radioactive waste generation and management interdependencies*. Interdependencies among all steps in radioactive waste generation and management shall be appropriately taken into account.

Principle 9: *Safety of facilities*. The safety of facilities for radioactive waste management shall be appropriately assured during their lifetime.

9.2 The Bure Ethics Group on Basic Principles of RWM

In 2011, an ethics group of twelve people from Meuse, Haute-Marne, Vosges and Aube was formed to analyse the plans for a deep geological final repository for radioactive waste near the village of Bure in Northeast France. One of the leading members was Marc Stenger, bishop of Troyes, and chairman of *Pax Christi* in France. The members of the group that consisted of Christian believers, but also of non-believers, had all different backgrounds and held different views. By the end of 2012, the group published a report, in which it set out to define an ethical basis for the final disposal of radioactive waste. The starting point for this ethical foundation was, according to the group, recognition of the fact that humankind is entrusted with a special responsibility to monitor and protect the world and also to acquire the necessary means to understand this responsibility. The effort that is required does not only relate just to RWM, but also to the humanistic vision that needs to be developed. There has to be awareness of the fact that the technologies that we have inherited or created ourselves could destroy fundamental humanistic values and even human and all other life on earth. Thus, the debate on radioactive waste must take place in the light of among others the following principles[122]:

The responsibility principle: The safety of the population must be guaranteed by a vision of mankind and its future that is supported by the best and most appropriate types of technology. But it is not technology that determines the future of mankind. Technology is there to serve mankind, not the other way around.

The solidarity principle: Our lifestyle and consumer patterns have to be reconsidered. Our energy need is constantly increasing. The current “energy bulimia” legitimises the way that we threaten the future of our children and the irresponsible way we treat the planet.

The justice principle. To be just means exploring things at a level above just one set of national interests and at another level than those who make the financial decisions. Everybody should have a say, because everybody runs a risk.

The precautionary principle. When there is a suspicion about a negative impact that could seriously harm the environment, even if scientific knowledge is uncertain, the authorities should use the precautionary principle to initiate a procedure to assess risks and implement intermediate and proportional measures to prevent this harm.

The human dignity principle: This is the most important universal value, which should determine any choice with political, economic and social implications.

The truth principle: The decision-makers in RWM have an obligation to tell the truth.

Responsibility for future generations: The choices we make today have consequences for future generations who will have to manage our waste and find solutions to the problems created by us.

[122] Groupe de réflexion sur l’éthique de la gestion de déchets nucléaires, Gestions des déchets nucléaires, Réflexions et questions sur les enjeux éthiques, 2012, Mise en page 1 (villesurterre.eu)

9.3 Questionnaire to ROUTES participants

EURAD - ROUTES Task 7 - D9.16 questionnaire

In the frame of EURAD, the Civil Society (CS) experts involved in ROUTES Task 7 dedicated to the Interaction with Civil Society (ICS) in ROUTES have elaborated a questionnaire to collect the opinions of ROUTES participants from the 3 colleges (Technical Support Organisations, Waste Management Organisations, Research Entities), plus the views of the CS members involved in EURAD.

The subject of the questionnaire is shared solutions/facilities for radioactive waste management, which is the main topic of ROUTES Task 6 and also the focus of ROUTES Task 7 for EURAD Year 2. The results of the questionnaire will be gathered and analysed before being compiled in ROUTES Task 7 deliverable D9.16 entitled "Implementation of ROUTES action plan first phase"

General information

*Name/Surname

*Type of actor: WMO, TSO, RE, Civil Society

*Name of your organisation

*In which ROUTES Task are you involved?

*Email address

Questions

Q1/ What is, in your opinion, particularly challenging when we speak about shared solutions for RWM and why? Such challenges could e.g., be lack of public acceptance, transparency and a clear definition of the responsibilities and obligations of the stakeholders. Does a certain deliberative process of decision-making have to be in place and if so, which one?

Q2/ Which shared solutions for RWM would you see as an added value? Why?

Q3/ Which shared solutions would you never agree with? Why?

Q4/ If you do not agree with some shared solutions in the form they are proposed/operating at the moment, would you reconsider your opinion if some conditions are met? What conditions?

Q5/ Which conditions/criteria for shared solutions should be fulfilled? By whom?

Q6/ Is a level playing field relevant in a cooperation on shared solutions and particularly shared facilities in order to avoid environmental and social dumping among the co-operators, and if so, how should it be defined and what should it include? Do you agree with the following definition of a level playing field for shared facilities: “Any bilateral, multilateral, European and international cooperation on planning, constructing, operating and closing of shared nuclear facilities, must involve partners that follow the same technical, legal and ethical standards in their home countries. If they do not have the same standards, they should follow the highest standards in all the relevant categories among the parties that are involved in the cooperation. The standards must apply to all the phases of the development and functioning of the shared facilities, including policy, framework and program establishment, site evaluation, selection and characterisation, and facility construction, operation, closure and post-closure.”

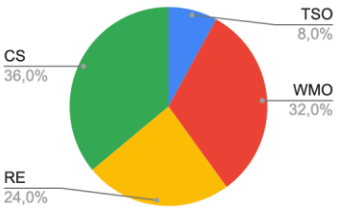
Q7/ How would the governance of shared solutions need to be structured?

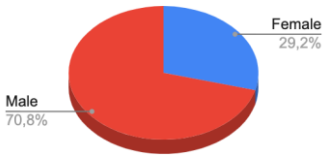
Q8/ Should the public (e.g., at the national, regional or municipal level) have the right to veto the shared solution/facility, especially if it has a very large scale? At what stage of the decision-making process?

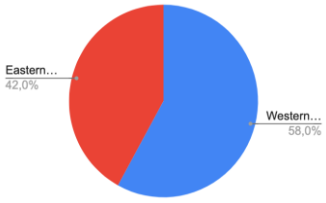
*Any comments?

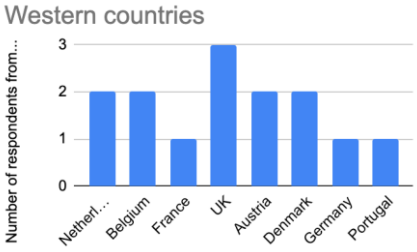
Respondents to the questionnaire - Statistics & Graphs

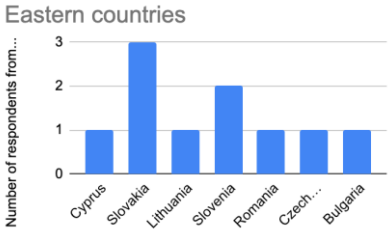
ROUTES Task 7 Questionnaire (D9.16) June 2021			
	Number	% of R	% of I
Respondents (R)	24	100%	34%
Invited people (I)	71	N/A	100%
Type of actor			
TSO	2	8%	
WMO	8	33%	
RE	6	25%	
CS	9	38%	
Gender			
Female	7	29%	
Male	17	71%	
Country			
Western countries	14	58%	
Netherlands	2		
Belgium	2		
France	1		
UK	3		
Austria	2		
Denmark	2		
Germany	1		
Portugal	1		
Eastern countries	10	42%	
Cyprus	1		
Slovakia	3		
Lithuania	1		





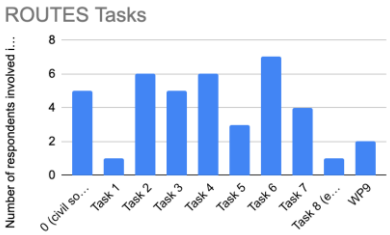






Slovenia	2		
Romania	1		
Czech Republic	1		
Bulgaria	1		

Task.s where involved		
0 (civil society)	5	21%
Task 1	1	4%
Task 2	6	25%
Task 3	5	21%
Task 4	6	25%
Task 5	3	13%
Task 6	7	29%
Task 7	4	17%
Task 8 (extension)	1	4%
WP9	2	8%



9.4 Case study on Krško NPP - long version

Shared responsibility between Republic of Slovenia and Republic of Croatia for RW and SF from Krško NPP

Nadja Železnik, May 2021

Table of Content

List of acronyms and abbreviations

ARAO	Agency for Radwaste Management
ARSO	Environmental Agency of the Republic of Slovenia
d.o.o.	limited liability company (in Slovenian: družba z omejeno odgovornostjo)
EIA	Environmental Impact Assessment
Fond	Fund for financing the decommissioning of the Krško NPP
IA	Intergovernmental Agreement
IAEA	International Atomic Energy Agency
kWh	kilowatt-hours
kV	kilovolt
LP	Local partnership
LTE	lifetime extension
MESP	Ministry of the Environment and Spatial Planning
MW	megawatts
NEK	Nuklearna Elektrarna Krško
NPP	Nuclear Power Plant
NRC	Nuclear Regulatory Commission
PWR	Pressurized Water Reactor
RC	Republic of Croatia
RS	Republic of Slovenia
RW	Radioactive Waste
SF	Spent Fuel
SFRY	Socialist Federal Republic of Yugoslavia
SNSA	Slovenian Nuclear Safety Administration
SRPA	Slovenian Radiation Protection Administration

TSO Technical Support Organisation
WMO Waste Management Organisation

Introduction

The Nuclear Power Plant Krško d. o. o. – NEK d.o.o. (hereafter NEK, Figure 1) was constructed as a joint venture between the Republic of Slovenia and the Republic of Croatia during the period 1974 – 1981. First field investigations on the Krško plain started already in the late 1960-ies with the aim to evaluate the potential of the site to construct a NPP as a larger SFRY programme on the use of nuclear energy. In 1970 the agreement on collaboration in joint venture to construct NEK at the Krško site was adopted in the parliaments of both republics Slovenia and Croatia and the investors were identified: Savske elektrarne Ljubljana and Elektroprivreda Zagreb, both public power companies within the two republics.

Based on the bidding process, two proposals for a NPP were obtained: one from Siemens (Germany) and one from Westinghouse Electric Cooperation (USA) for a single nuclear power station of a practical size. Westinghouse won the competition in 1974 to supply a plant based upon a design already existing in Brazil and South Korea. NEK was designed as a two loop PWR with an initial electric power of 632 MW. The foundation stone for NEK was laid in 1974 by the president of SFRY Josip Broz -Tito and the work started with mostly domestic companies. The NPP management in 1975 consisted of personnel from both the Slovenian and Croatian power companies and a representative from the central government in Belgrade. Trial operation was granted in 1981, in 1983 commercial operation started and a license for normal operation was obtained in 1984 according to the SFRY and Slovene legislation.

The licensing was performed by the Republic Committee for Energy, Industry and Construction as the responsible authority in the Republic Slovenia for matters relating to the safety of nuclear facilities and for inspections of the implementation of laws, other regulations and general acts of national jurisdiction governing the safety of nuclear facilities. All other authorities were coordinated by this Committee, including the Expert Committee on Nuclear Safety with its Technical Support Organisations. A safety report with safety analyses has been developed in iterative steps, mainly based on the provisions from the USA NRC legal framework as the NPP was USA design. The responsible authorities of SFRY also signed with the USA government and the IAEA a special project and supply agreement in which they agreed that the IAEA safety standards would be followed, and IAEA missions would be performed. However, no public consultations took place, and no environmental impact assessment was prepared, according to the requirements of the legislation valid at that time. Unofficial discussions with the municipality of Krško were performed to present mainly the project and economic benefits of the investment, however the municipality authorities were not involved in the decision making.

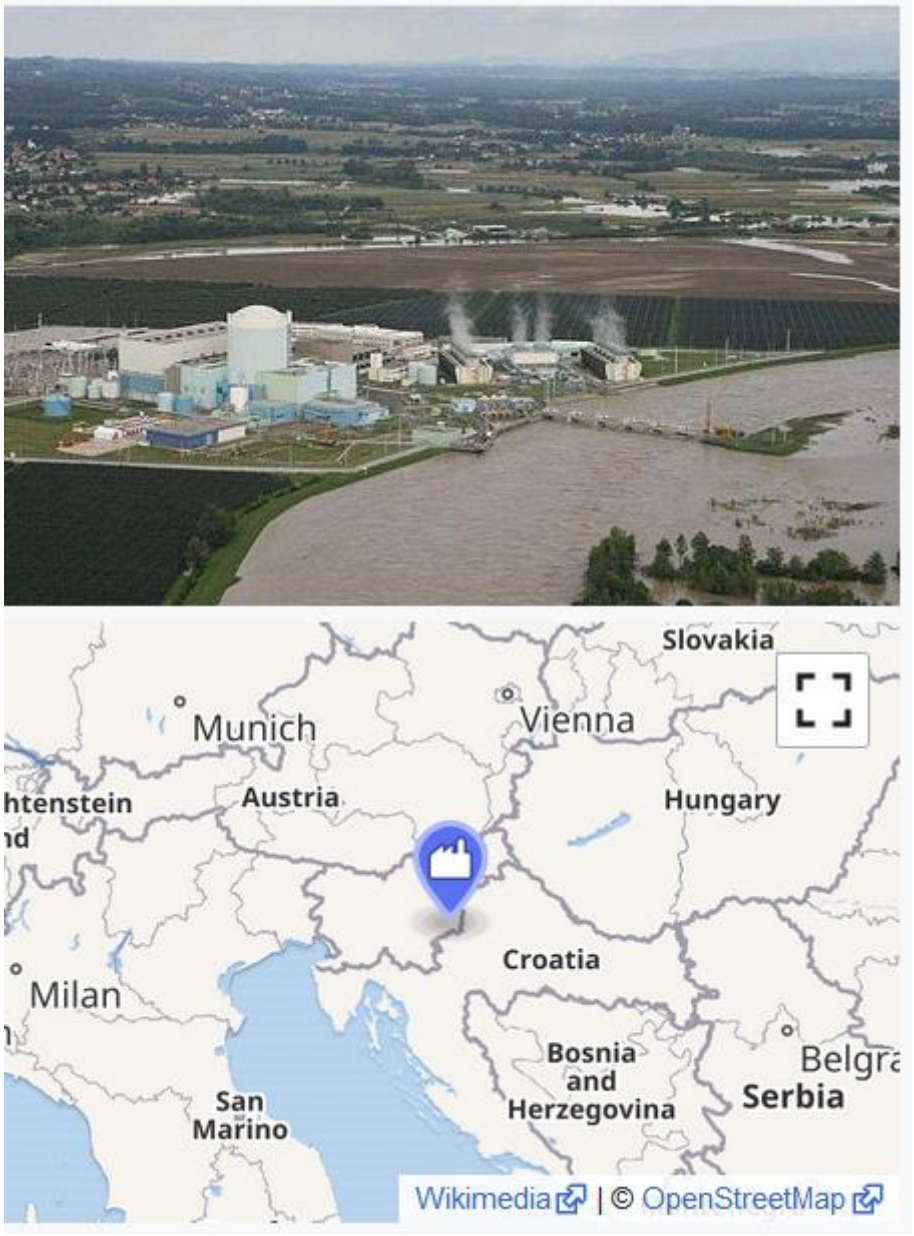


Figure 1: NEK, Slovenia, layout and situation on map

The reason why the plant is co-owned by two countries was that these then-constituent republics of SFRY planned to build two plants, one in each republic, according to the original 1970 agreement and its revised version from 1982. However, that plan was abandoned in 1987 by the Republic of Slovenia due to a referendum held in 1986, following the Chernobyl accident. From that point on, there arose an issue with radioactive waste and spent fuel generated during NEK operation.

Context of the shared facility

Overall information

NEK d.o.o. is organised as a limited liability company in 100 % state ownership from entities of two republics: 50 % is owned by GEN energija d.o.o from Slovenia and 50 % by HEP d.d. from Croatia, both in 100 % ownerships by their states and the successors of the initial investors. It is situated on the left bank of the River Sava in the south-eastern part of Slovenia. The plant is a 2-loop Westinghouse PWR, with a rated thermal capacity of 1,994 thermal megawatts (MWt) and 696 megawatts-electric (MWe). The reactor uses enriched uranium (up to 5 weight-percent of 235-U), with a fuel mass of 48.7 tones

and with 121 fuel elements, demineralized water as moderator, and 36 bundles of 20 control rods each made of silver, indium and cadmium alloys to regulate power. The original refuelling was every year with 1/3 fuel elements replacement. In 2004 NEK started operating with 18-month fuel cycles in which half of the core is removed (on average 56 fuel elements). NEK generates over five billion (10^9) kWh (5 TWh) of electrical energy per year and is connected to the 400 kV grid supplying power to consumer centres in Slovenia and Croatia. During NEK construction, all supporting facilities for normal operation have been established, however due to safety reasons (nuclear safety upgrades after the Fukushima accident) and non-availability of national RW and SF disposal facilities, some constructions have been carried out successively on site.

Nuclear safety and radiation protection

The owners of NEK are equally responsible for ensuring all material and other conditions for safe and reliable operation of NPP, whereas the regulation and supervision of nuclear and radiation safety for NEK is the sole responsibility of the Republic of Slovenia. Radiation and nuclear safety are regulated according to the Slovenian legal system which consists of a comprehensive set of regulations and decrees based on Ionizing Radiation Protection and the Nuclear Safety Act, and is regularly updated in line with international developments. The Act, lately adopted in 2017 and amended in 2019, provides a complete regulatory framework for protection against ionizing radiation in order to minimize damage to human health due to exposure to ionizing radiation and radioactive contamination of the living environment, while enabling the development, production and use of radiation sources and the performance of radiation activities. The Act is aligned with adopted EU EURATOM directives and transposed all related requirements.

The Slovenian Nuclear Safety Authority (SNSA) within the ministry responsible for environment and the Slovenian Radiation Protection Administration (SRPA) within ministry responsible for health are the principal regulators together with other authorities according to the legal framework in the Republic of Slovenia as given in Figure 2. The SNSA is responsible for the supervision of nuclear safety, nuclear and radiation facilities and sources of ionizing radiation in the country, with the exception of sources in health care and veterinary medicine, which are the responsibility of the SRPA. The effective independence of both regulatory bodies is regulated by the overall effect of various provisions of different laws and by-laws that generally define, inter alia, the following: the position of administrative bodies such as the SNSA and the SRPA within the structure of the ministries, the structure of the state budget, the reporting scheme within the governmental framework and the decision-making hierarchy in appeal processes within administrative procedures.

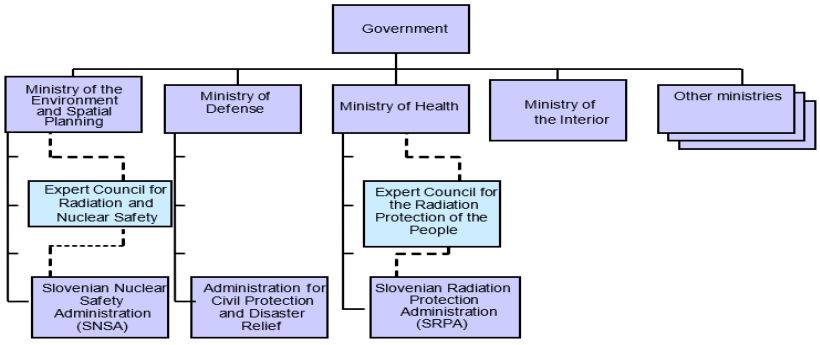


Figure 2: Regulatory framework for nuclear safety and radiation protection

The licensing system for a nuclear facility can be divided into three steps after the preliminary conditions (the planning of the location of the nuclear facility in the national site development plan) are fulfilled:

- the application for a license to construct a facility – based on the integral procedure including approval of the environmental impact assessment – the competent body is the Ministry of the Environment and Spatial Planning, with the approval of the SNSA;
- the application for a license for trial operation – the competent body is the Ministry of the Environment and Spatial Planning, with the approval of the SNSA;
- the application for operation and decommissioning (or closure in the case of a repository for radioactive waste) – the competent body is the SNSA.

According to the nuclear Act, the procedure of approval of changes to the safety analysis report is defined and the methodology for the assessment and classification of modifications is given in a subordinate regulation. The procedure outlines three classes of changes according to safety relevance:

- changes for which it is necessary to notify the SNSA,
- changes for which the intention of their implementation shall be reported to the SNSA, and
- changes of significance for radiation or nuclear safety and for the implementation of which a license from the SNSA shall be obtained.

Institutional control and regulatory inspection with respect to the safe management and operation of nuclear facility rest with the SNSA. The enforcement of applicable regulations and of the terms of licenses is implemented by the application of penal provisions, inspection, and provisions relating to the issuance, renewal, amendment, withdrawal and expiration of licenses.

Intergovernmental Agreement

After the breakup of the SFRY in 1991, NEK continued to operate under the legal framework of the Republic of Slovenia, although co-ownership with the Republic of Croatia was recognized and never argued, but was not well defined under the new legal systems of both countries. In 1997, the Slovenian side with NEK decided to increase the operational and decommissioning costs billed to both ELES GEN (predecessor of GEN energija) and HEP, but the latter (HEP) refused to pay. In 1998, the Government of Slovenia decided to stop supplying power from Krško to HEP and sued HEP for the unpaid bills. In 1999, HEP counter-sued for damages because of lack of supply. Due to these disagreements, both governments agreed to define mutual relations regarding the status of NEK in more details, including its exploitation and decommissioning, proceeding from the basic agreements in 1970-ies, and adopted in 2001 the Agreement between the Government of the RS and the Government of the RC on the Regulation of the Status and Other Legal Relations Regarding the Investment, Exploitation and Decommissioning of the Krško NPP (Intergovernmental Agreement – IA)[123], ratified by both parliaments in 2003. The adopted Intergovernmental Agreement defined several important issues in connection to NEK, among others legal successors of the investors and the company organisation with basic capital. NEK decision making bodies according to the IA has been established and are also presented in the Figure 3:

- **The Intergovernmental (Bilateral) Commission (IC)** was formed by the contracting parties (Governments, including the responsible ministers from both countries) in order to monitor the implementation of the IA and commence other businesses in accordance with the IA, and is composed of 4 members from each side with responsible ministers as chairs;
- **The Supervisory Board and Assembly** was established with representatives of the owners to perform direct supervision of NEK management: The chairperson from Croatia, the deputy from Slovenia,

[123] Agreement between the governments of Slovenia and Croatia on the status and other legal issues related to investment, exploitation, and decommissioning of the nuclear power plant Krško (Official Gazette RC, International Agreements 9/2002; Official Gazette RS 23/2003)

- **The Management Board** responsible for management of NEK: the president is proposed from the Slovenian owners (deciding vote), a deputy from the Croatian side with the following rules:
    - decisive votes shall be used exceptionally, in cases where a disagreement could endanger the safety of operations, or cause significant damage to the company;
    - in such cases, the Chairman of the Supervisory Board convenes a meeting of the Supervisory Board at which the justification for the use of such vote is discussed and appropriate decisions are taken;
    - In the event of a deciding vote being used, the members of the Management Board who voted against the decision shall not be liable for any damage.

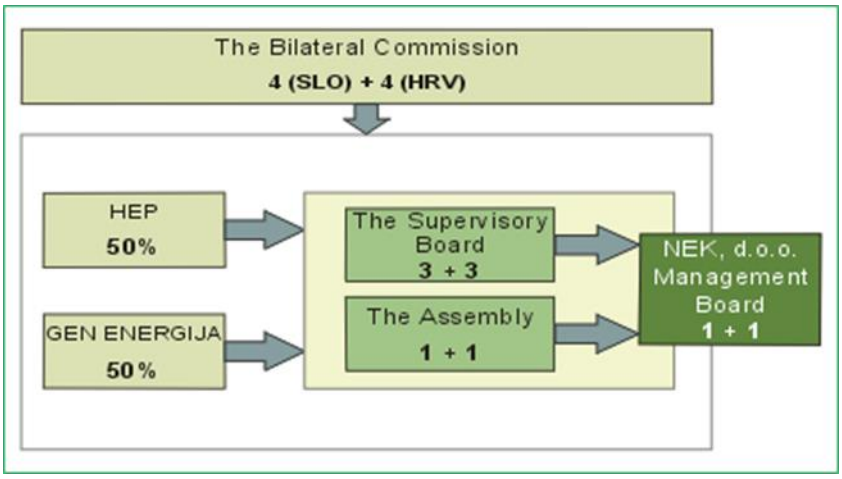


Figure 3: NEK decision making structure

Other provisions on the management of NEK were also set in the IA, like that for NEK the Slovenian regulations on co-management of workers relating to the worker director will not apply; issues which cannot be decided by the company bodies due to their parity structure shall be settled by business arbitration, the decision of which will be final and binding on the company; and that NEK is established for a limited period of time until the end of the nuclear power plant decommissioning process. Also, the Republic of Slovenia (or its authorized legal entity) shall have a pre-emptive right in the event of the sale of real estate.

Several articles of the IA are related to production of electricity, transmission and costs where:

- the company will supply the available power and the produced electricity to the members, each half, until the end lifetime,
- the supply of electricity shall be carried out at the border of the plant in accordance with European standards, under the same conditions for the partners,
- the transmission system operator from Slovenia shall provide the Croatian partner with the transmission of power and electricity by the shortest transmission route,
- available power and the electricity produced, supplied and transferred shall be free from customs duties and other duties,
- all costs for NEK operation, maintenance and depreciation (investments) shall be covered,
- if NEK does not operate for any reason (force majeure or coincidence), the partners will pay half of the costs incurred.

In case of extraordinary expenses, both parties will take appropriate measures to ensure equal proportions of the funds necessary for the payment of such expenses as well as for new investments in NEK.

A set of several provisions in the IA relates to recruitment, education, contractors and to support equal opportunities for workers from both parties, if applicable. NEK shall adhere to the principle of parity for

the members of the Management Board and for other workers with special powers laid down in the social contract when recruiting. NEK shall designate those professional positions for which vacancy is guaranteed, taking into account the principle of safety, optimal operation of the nuclear power plant and adequate representation of professional staff from both parties. The Republic of Slovenia undertakes to enable the persons having the status of foreigner to be free to employ[124]. Education, scholarship and vocational training in NEK shall respect the principle of equal rights regardless of nationality. Parties agree that NEK ensures the cooperation of companies and institutions that qualify as qualified contractors for NPPs for regular operation and in emergency situations. NEK ensures the cooperation of suppliers and contractors from both parties.

A very important part of the IA is devoted to NEK decommissioning and RW and SF management (article 10) where several provisions are agreed:

- Decommissioning of NEK, the disposal of all generated RW and SF, as specified in the IAEA Joint Convention on safety of RW management and safety of SF management, is a joint obligation of the parties.
- Parties agree to provide an effective joint solution for the decommissioning and disposal of RW and SF from an economic and environmental point of view.
- Two programmes are determined:
    - Programme of RW and SF disposal: developed in accordance with international standards with the participation of NEK by the responsible organisations (ARAO as WMO in Slovenia and the Fund for Financing the Decommissioning of the Krško NPP in Croatia). The programme includes proposal for the possible division and takeover of RW and SF, acceptance criteria for the disposal and assessment of the necessary financial resources, and deadlines for implementation, revised at least every five years.
    - Decommissioning programme: includes the management of all radioactive and other wastes generated during the decommissioning, until their removal from the NEK site, an estimate of the necessary financial resources and the deadline for its implementation, revised at least every five years.
- The location of NEK may be used for the temporary storage of RW and SF for the rest of its lifetime.
- If parties do not agree on a common solution for the disposal of RW and SF by the end of its regular lifetime (that is until 2023), they shall undertake removal of RW and SF from the NEK site no later than two years thereafter (until 2025), each half. Further removal of RW and SF will take place in accordance with the RW and SF disposal programme and the decommissioning programme, at least every five years, unless otherwise specified by the approved programmes.
- If NEK is prematurely closed due to acts of the authorities of the Republic of Slovenia that are not the result of force majeure, the Republic of Croatia will participate in decommissioning and disposal of RW and SF in proportion to the electricity taken by the Croatian partner, with regard to the electricity that NEK would produce under normal circumstances from the beginning of operation to the end of its service life.

Decommissioning and disposal financing is covered in the article 11 of the IA:

- Parties shall provide, in equal parts, the financing of the costs of the preparation of the decommissioning programme, the costs of its implementation, as well as the costs for the RW and SF disposal programme.
- If parties agree on a common solution for RW and SF disposal, these costs shall also be financed in equal parts. If no such agreement is reached, parties will individually cover the costs of all their activities in the implementation of programmes which are not of a common nature.

[124] The provision was important before the RC and RS became EU members.

- Parties shall adopt appropriate regulations to provide for the financing of the costs referred above: each party shall ensure the regular payment of the amount provided for in approved programmes to specially established funds.
- Parties will keep each other regularly informed of the amount of funds raised in their special funds.

Further provisions in the IA are more of a legal nature and define the protection of investments, protection against expropriation, repatriation of investments and incomes, subrogation, past financial questions and disputes resolutions.

On site RW and SF management and NEK LTE

NEK is the major producer of radioactive waste in the Republic of Slovenia. All operational radioactive waste and spent nuclear fuel are stored within the area of the plant and are owned by both owners (the Republic of Slovenia and the Republic of Croatia in 50:50 shares). Due to the fact there are no available repositories (for RW not for SF), some related projects have been implemented on site.

Spent nuclear fuel is currently stored under water in the *Spent Fuel Pool* with 1323 fuel assemblies at the end of 2019. In order to improve the safety of spent fuel storage as one of the actions following the Fukushima accident, it was decided to construct a *Dry Storage Facility* for spent fuel with a design lifetime of 100 years. According to current plans, it should be operational at the end of the year 2022, and the licensing process for on-site dry spent fuel storage just finished with issuance of the construction license in December 2020[125]. In the frame of this integral licensing process, also an EIA was implemented, resulting in an environmental impact report. The construction license was issued by the Ministry of Environment and Spatial Planning, Directorate for Space, Construction and Apartments, and supported by opinions of the Slovenian Nuclear Safety Administration (SNSA) and the Environmental Agency of the Republic of Slovenia (ARSO). The construction license shows, that in the process, beside official bodies and administrations, also national NGOs[126] as well as the residents from the municipality of Krško were involved in the EIA process with several questions and comments. The received suggestions and comments from a public hearing were responded to by officials (MESP, Municipality Krško, NEK and project developers) and are reported in a separate report[127]. The environmental impact assessment report concludes that the planned construction does not have significant adverse environmental impacts. NEK must, in order to prevent, reduce or eliminate adverse effects on the environment, during construction and operation of the facility, take into account also certain measures and conditions like carrying out zero monitoring before facility construction, protection of soil and water, and establishing emergency preparedness. The Republic of Austria took part in the transboundary environmental assessment procedure according to the ESPOO convention and EU EIA Directive, and developed several recommendations, some of which were included in the conditions for the construction license.

All solid radioactive waste in NEK is treated and packed into steel drums, which are then stored in the *Solid Radwaste Storage Facility*. At the end of 2019 there was 2274 m^3 of low and intermediate waste stored, mostly short lived. Some larger parts of the generated radioactive waste (i.e., replaced steam generators) are stored in the Decontamination Building. In 2018, the construction of the new Waste Manipulation Building was completed which provided new premises for the storage of drums in the process of manipulation and preparation for transport, collection, and sorting of radioactive waste. The licensing procedure for the construction of the Waste Manipulation Building followed the requirements of the Ionizing Radiation Protection and Nuclear Safety Act and the Construction Act, in which the

[125] https://www.gov.si/assets/ministrstva/MOP/Dokumenti/Graditev/gradbena_dovoljenja/suho_skladiscenje_goriva_NEK.pdf
[126] https://zeg.si/novice/111/pripomba_zeg_na_dokumentacijo_pvo_suho_skladisce_nek_krsko/
[127] https://www.krsko.si/files/other/news/71/235725Potrjena%20stali%C5%A1ca%20do%20pripomb%20javnosti.pdf

Ministry of the Environment and Spatial Planning issued a construction license with the consent of the Slovenian Nuclear Safety Administration. The municipality of Krško was involved in the procedure[128], after the presentation of the project by the investor NEK, they decided not to be included in further steps. In addition, SNSA provided some responses to questions raised in the municipality of Krško council[129]. There was no EIA procedure implemented for this facility, and therefore no public hearing and related environmental impact procedure. The request of municipality council members for an extraordinary council meeting[130] with also the question on the EIA for the building was raised. In the explanation by NEK, as response to the request, it is stated that: "In the process of obtaining a building permit, ARSO found that the procedure of obtaining an environmental permit is not necessary. As part of obtaining consent from the SNSA, all safety assessments prescribed in the procedure were performed."[131]

The original lifetime of 40 years from 1983 was in the licensing process extended until 2043 based on a decision of the SNSA[132], pending the successful conclusion of Periodic Safety Reviews in 2023 and 2033. This decision, in principle, will impact RW and SF generation in NEK and also related disposal options. In the process of a pre-litigation procedure, ARSO assessed that for the NEK lifetime extension (LTE) no environmental impact assessment was needed[133] based on the opinions of responsible official bodies, including SNSA. Due to an appeal of NGOs with the status of third party according to the Environmental Protection Act, the Ministry of the Environment and Spatial Planning, as a second-instance body, decided[134] that assessment of the environmental impact of NEK is required in order to extend the service life from 40 to 60 years, i.e., to 2043 and that environmental consent is needed. The decision was later appealed by NEK, but the responsible administrative court ruled[135] in the beginning of 2020 that an EIA process is obligatory for LTE. Therefore, in October 2020, ARSO[136] re-decided that for the intended NEK LTE until 2043 it is necessary to carry out an environmental impact assessment process with an environmental impact report, and obtain environmental consent. The process will take several years with an environmental impact assessment and report, public hearings and participation opportunities. In this procedure, public participation is ensured by providing the public with insight into the application for LTE and documentation related to the subject, including an environmental impact report. For opinions and comments, a period of 30 days is given from the day of public announcement on the e-government website.

Intergovernmental Agreement implementation

Immediately after the Intergovernmental Agreement came into power in 2003, the Intergovernmental Commission met and decided that instead of two programmes required by the Intergovernmental Agreement a single document encompassing both NEK decommissioning and NEK RW and SF management should be prepared with the title Programme of NPP Krško Decommissioning and SF & Low and Intermediate Level Waste (LILW) Disposal (hereafter DP, Rev.1). The main purpose of DP Rev1. was to estimate decommissioning and RW and SF disposal costs for NEK, in order to establish a decommissioning fund in Croatia and correct annual instalments for the then existing decommissioning

[128] https://www.krsko.si/files/other/news/71/80964Odgovor%20Ob%C4%8Dinske%20uprave%20Ob%C4%8Dine%20Kr%C5%A1ko..pdf
[129] https://www.krsko.si/files/other/news/71/80965Odgovor%20Uprave%20RS%20za%20jedrsko%20varnost..pdf
[130] https://www.krsko.si/files/other/news/71/80966Zahteva%20za%20obravnavo%20to%C4%8Dke%20oz.%20sklic%20izredne%20seje..pdf
[131] https://www.krsko.si/DownloadFile?id=80963
[132] 3570-6/2009/32, SNSA, License amendment dated 20. 06. 2012
[133] http://www.arso.gov.si/novice/datoteke/037066-Sklep.pdf
[134] https://a9g3u8k4.stackpathcdn.com/wp-content/uploads/2017/07/Odloc%CC%8Cba-Podaljs%CC%8Canje-obratovalne-dobe-NEK.pdf
[135] https://a9g3u8k4.stackpathcdn.com/wp-content/uploads/2020/02/sodba-o-NEK-feb2020.pdf
[136] https://www.arso.gov.si/novice/datoteke/043411-NEK.pdf

fund in Slovenia. DP Rev.1 was completed in the first half of 2004 and peer reviewed by Electricite de France (EDF). Following approval of the document by the Intergovernmental Commission, the Slovenian government in autumn 2004 took note of the document. The Croatian government also approved the document and then additionally DP Rev.1 was confirmed in the Croatian parliament at the end of 2004. NEK's decommissioning, RW and SF disposal discounted costs were estimated to be approximately 350 million € (in 2002 prices) based on the proposed scenario of one joint LILW repository and one joint SF disposal (in both cases either in Croatia or in Slovenia without the location mentioned). The corresponding 19 equal instalments deposited from 2004 through 2022 (by the end of expected lifetime) in one joint fund, assumed empty at the beginning of 2004, were estimated to be 28,5 million € annually. Taking into account the recalculation for each national fund, GEN energija paid 3€/MWh from 2004 on in the Slovenian Fund[137], and HEP each year 14,25 million € in the Croatian Fund[138].

As requested in the Intergovernmental Agreement, the next revision of the DP started in 2008 with the adoption of Terms of Reference (ToR) for the DP Rev.2 by the Intergovernmental Commission. A search for common solutions for RW and SF management in DP Rev.2 was governed and bounded by the national RW and SF management strategies and a separate LILW repository project that Slovenia started in 2004. Respecting potentially different interests of the two parties to the Intergovernmental Agreement, 5 different decommissioning and RW and SF disposal scenarios for NEK were considered within a framework defined by the boundary conditions given in the ToR. The DP rev. 2 was drafted in 2011, integrating all comments from different supervision bodies, but has never been adopted. The Intergovernmental Commission only in 2015 accepted the report on the progress of DP Rev.2, but not the Revision 2 itself and, having in mind new circumstances, decided to halt all the activities on DP Rev.2. Also, the Intergovernmental Commission decided that dry SF storage should be established on the site of NEK and would not be part of the DP (so only three projects were still addressed: NEK decommissioning, LILW disposal and SF disposal). Building and operation of dry storage should be part of NEK's operational costs and paid as well by both owners. The Intergovernmental Commission appointed the Slovenian waste management organisation ARAO and the Croatian Fund for Financing the Decommissioning of the Krško Nuclear Power Plant and the Disposal of Krško NPP Radioactive Waste and Spent Nuclear Fuel (that was in a meantime by Croatian law appointed as national WMO for RW and SF management, hereafter Fund), to prepare a ToR for DP Rev.3.

In July 2015, the Intergovernmental Commission confirmed the decision of the NPP owners to extend the operation of the plant until 2043, in line with international practices and recommendations and with the goal of ensuring sustainable nuclear safety. This decision by the owners was in principle, because the real licensing will be the subject of the Slovenian responsible authorities. At the same session in 2015, the Republic of Slovenia presented the project of the Vrbina LILW repository, which was developed in between and invited the Republic of Croatia to study its interest in joining the project.

In 2016, a new revision of the Krško NPP Decommissioning Programme and the Krško NPP Radioactive Waste and Spent Fuel Disposal Programme started. The Intergovernmental Commission in 2017 accepted the ToR for the Third Revision of the Krško NPP Radioactive Waste and Spent Fuel Disposal Programme (DP Rev.3) and appointed ARAO and the Fund to prepare the document on the RW and SF disposal. The NEK Decommissioning Programme was entrusted to NEK itself, following the requirements from the Intergovernmental Agreement. The IC also appointed a project Implementation Coordination Committee (ICC) with four members from each side to monitor preparation of both Programmes and to negotiate a proposal for possible a joint LILW repository solution. On the same session, the Croatian side informed the Slovenian side that the offer to participate in the establishment of the Slovenian Vrbina LILW repository, as presented by Slovenia during the previous IC session based

[137] https://www.sklad-nek.si/
[138] http://www.fond-nek.hr/en

on a study on an Investment Programme for LILW Repository on the Vrbina site, Rev C, was not acceptable.

The ToR for DP Rev 3. lists several general objectives of this revision:

- review of the DP Rev.1 and DP. Rev.2 and inclusion of new RW and SF quantities estimated in the Third Revision of the Krško NPP Decommissioning Programme; new estimates of the operational RW inventory; new circumstances that developed since the last revision, such as: new national RW and SF disposal strategies and programmes, extension of Krško NPP's lifetime until 2043, agreement between the co-owners regarding an on-site SF dry storage at Krško NPP and a possible division of RW in accordance with Article 10 of the Intergovernmental Agreement.
- creation of possible RW and SF management/disposal scenarios based on the conducted review and within the technical-technological framework of best known practices defining: which storage and disposal facilities are needed to dispose RW and SF efficiently (facility types, capacities and locations); when they need to be put into operation; how long they have to remain in operation for the management/disposal to be safe and economically efficient; and management of these facilities, including the number and type of employees.
- estimates of nominal costs (in euro (€) 2018 prices) for the developed Krško NPP RW and SF management/disposal scenarios. Nominal costs should be also discounted separately for Croatia and Slovenia.

Before final versions of the programmes were defined, the Implementation Coordinating Committee proposed in January 2019 four principles for a joint LILW repository to the IC, namely:

1. A joint LILW repository must be safe for the population and the environment, now and in the future.
2. With a joint LILW repository, both countries will solve the problem of disposal of all their LILW. In addition to LILW from the Krško NPP, also all RW from small producers in Slovenia and in Croatia.
3. The cost of a joint solution shall be advantageous to the cost of a separate solution for each of the countries.
4. Slovenian and Croatian organisations must participate equally in the construction and operation of the repository.

The Municipal Council of the Municipality of Krško discussed the four principles at a session in February 2019[139] and adopted the decision that it does not support any of the principles[140] proposed by the ICC. The Municipal Council of the Municipality of Krško also demanded from the Slovenian part of the IC and the ICC that all further negotiations with the Croatian side lead into the direction of already adopted decisions at the local and national level regarding the construction of the LILW repository at Vrbina in Krško. It is not published how the ICC principles, presented at the IG session in January 2019, were distributed to the Municipality of Krško, however, the mayor of Krško is also a member of the IC. Therefore, the Intergovernmental Commission at the meeting in September 2019 concluded that a joint solution to the disposal of LILW was not possible, which means that each country must take care of its share of LILW radioactive waste. Regarding the disposal of HLW and SF after the cessation of the operation of the Krško NPP, a joint solution is still foreseen between the two states.

In September 2019, the third Revision of the Krško NPP Decommissioning Programme and the third revision of the Krško NPP Radioactive Waste and Spent Fuel Disposal Programme[141] were completed,

[139] https://www.krsko.si/objava/176551
[140] https://www.krsko.si/DownloadFile?id=168298
[141] https://mingor.gov.hr/UserDocsImages/UPRAVA%20ZA%20ENERGETIKU/Ostali%20dokumenti/Treca_revizija%20Progra

including all requirements as defined in the ToR and in 2020 they were approved by the Intergovernmental Commission[142]. The foreseen lifetime of the Krško NPP is in the third revisions extended until 2043, although the official license procedure is now only just starting. Extended operation would defer the production of decommissioning wastes and would extend the period available to set aside funds to cover the cost of decommissioning. The years of additional electricity production would also reduce the costs of waste management and decommissioning per unit of electricity generated.

According to the ToR and for the purpose of costs analysis, SF and HLW generated by decommissioning is managed and disposed jointly, first in dry storage on NEK site and later disposed in a joint repository. Based on the existing Slovenian-Croatian Intergovernmental Agreement and conclusions from the Intergovernmental Commission, the spent fuel dry storage (SFDS) facility can only be operated at the NEK site until the end of NPP operation (the year 2043, for the storage of the Slovenian and Croatian parts of spent fuel). Further operation of the SFDS at the NPP Krško site is subject to additional negotiations and a potential further agreement between the Slovenian and Croatian governments. All SF and HLW generated at the NPP is to be disposed of in a deep geological repository.

LILW generated by operation and decommissioning of Krško NPP is managed and disposed separately. LILW is divided and taken over by both sides and then it is managed and disposed of in national repositories. The exception is radioactive waste from decommissioning of the SF dry storage that will occur after shutdown of the national LILW repositories and will be disposed of in a common HLW disposal facility. Division of the existing operational LILW in the NEK storage and its takeover, including removal from location of the Krško NPP, starts in 2023 as defined in Article 10 of the Intergovernmental Agreement. The procedure for RW division is included in the third revision of the document.

The third revision programmes calculate annuities for each country, and are presented with respect to the internal rate of return and taking into account different LILW management steps in both countries and different current financial situations with respect to the collected funds. By a decision of the Slovenian Government, the Slovenian electrical power company GEN energija should continue to contribute into the Slovenian fund for financing one half of the decommissioning, half of the joined SF repository and the Slovenian LILW disposal, with payments increased from the previous rate of 3 €/MWh to 4,8 €/MWh starting with August 2020 until the next revisions of the programmes are approved. The calculations for the Croatian HEP are still pending, but it looks like that the annual contribution could be lower than the current annual instalments of €14,25M.

In accordance with Slovenian regulations, the Government of the Republic of Slovenia adopted the decision of the IC and thus fulfilled the legal formal conditions for the approval of the third revision of both programmes. The revisions of documents were also approved by the Croatian Parliament. During the implementation of the Intergovernmental Agreement, no public participation is foreseen and all decision making is entrusted to the Intergovernmental Commission and its advisory committees.

Separate RWM in Slovenia and in Croatia

Disposal of Krško NPP LILW in Slovenia

The Slovenian national strategy on RW and SF management for the period of 2016-2025[143] defines construction of a LILW repository for the Krško NPP LILW and the disposal of the Slovenian LILW inventory in the repository as ‘as soon as possible’. The site selection for a repository started officially

ma_odlaganja_radio%20aktivnog%20goriva_i_istro%C5%A1enog%20nuklearnog%20goriva%20NEK-EN.pdf

[142] https://www.energetika-portal.si/nc/novica/n/slovenija-in-hrvaska-potrdili-revizijo-programa-odlaganja-radioaktivnih-odpadkov-4386/

[143] http://www.pisrs.si/Pis.web/pregledPredpisa?id=RESO106

in 2004 with the adoption of a programme for drawing up a national location plan for a low- and medium-level radioactive waste disposal site[144] and finished in 2010 with the adoption of the Governmental Decree on a Detailed Plan of National Importance for a low and intermediate level radioactive waste repository on the location Vrbina, municipality Krško[145].

All documentation developed for the LILW repository in this entire period included two scenarios: a baseline scenario allowing for disposal of only half of the waste generated at the Krško NPP and the entire Slovenian LILW not originating from the Krško NPP (like LILW from small producers and from the Triga Research Reactor), and an extended scenario in which an agreement is reached between Slovenia and Croatia on a joint LILW disposal in accordance with the Intergovernmental Agreement on the Krško NPP. The extended scenario provides for the disposal of all LILW waste from the Krško NPP and the entire Slovenian LILW not originating from the Krško NPP.

Disposal is foreseen in 2 phases: in the first phase from 2023 to 2028[146] presently stored operational LILW will be disposed of with other sources. In the second phase from 2050 to 2061 the rest of operational LILW together with decommissioning LILW will be disposed of, followed by final closure of the LILW repository from other sources (LILW that meets the waste acceptance criteria for disposal but originates from the Central Storage Facility for Radioactive Waste (CSF) in Brinje and its decommissioning and from TRIGA Research Reactor decommissioning). From 2028 to 2050, the repository will be in temporary standby mode. The repository is to be constructed in 3 years followed by a maximum of 2 years of trial operation. The repository will be closed down in 2062, and long-term monitoring and maintenance will begin. It was planned that in case of the extended scenario, that before the second phase an additional disposal unit would be constructed.

The choice for a silo LILW repository type was confirmed with the adoption of the Decree on the Detailed Plan of National Importance for a LILW Repository in Vrbina in the Municipality of Krško. The area included in the plan is 18 ha. The planned LILW repository includes all structures, systems and components required for its operation as an independent nuclear facility. The central area of the repository is intended for administrative and service activities, the acceptance of waste, the disposal of waste, and the security of the repository. The size of this area is approximately 6 ha, with the following structures, also given in Figure 4:

- the Administrative and Service Building,
- the Technological Building,
- the Disposal Silo with a hall above the silo, and
- the Control Pool.

[144] http://pisrs.si/Pis.web/pregledPredpisa?id=DRUG2157&d-49681-o=2&d-49681-p=1&d-49681-s=3
[145] http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED5417
[146] Modified due to delays from original period 2020 to 2025 in the Third Revision of the Krško NPP Radioactive Waste and Spent Fuel Disposal programme Text version 1.3.

Figure 4: LILW repository facilities and silo cross section

The repository is a silo structure, designed as a reinforced concrete cylindrical construction with an internal diameter of 27.3 m and an active height of 34 m. In the silo, the disposal of the first level of containers is arranged at a depth of 49.2 m, in total 99 containers at each level on 10 levels. Inside the silo, there is a vertical communication tract in the form of a shaft. The central part of the communication tract consists of stairs and an elevator, and the side parts are intended for the installation lines. The hall above the silo covers the entire floor area of the silo, including the handling area. The hall protects the silo and gantry cranes for the disposal of containers from weather conditions. The Control Pool is designed to collect water from the silos, from the hall above the silo and from the Technological Building resulting from cleaning of the floor, and the decontamination of tools and equipment. The construction of the Control Pool is in line with the technological requirements.

The construction and operation of the repository will be financed from the Slovenian Fund for Financing the Decommissioning of the Krško Nuclear Power Plant and the Disposal of Radioactive Waste from the Krško NPP (Sklad NEK) and proportionally from the state budget for radioactive waste not originating from Krško NPP (for Slovenian LILW). In the price, also includes compensations to the local communities as foreseen Decree on the Criteria for Determining the Compensation Rate due to the Restricted Use of Areas and Intervention Measures in Nuclear Facility Areas[147] as well as VAT. The total cost for LILW repository is €340.30M, out of which the compensation to local communities' accounts for €164.47M.

Public participation in disposal establishment

Based on the lessons learned in the past failed site selection process for a LILW repository in Slovenia that took place between 1986 and 1993, the competent WMO ARAO adopted together with the other responsible authorities (especially the Ministry of Environment and Spatial Planning) a much broader public participation process was already adopted in the Programme for drawing up a national location plan for low and medium-level radioactive waste disposal site in 2004 (link in the footnote 19). Local partnerships were established in the local communities in the Posavje region – e.g., in the municipalities Krško and Brežice – which were selected from 8 volunteered local communities in the siting process. The local partnerships served as an organising frame for all activities during site characterisation and confirmation of potential sites and also established a platform for cooperation and to some extent also for decision making of local stakeholders. The local partnerships (LPs) were designed and proposed by ARAO to the local municipalities as an agreement signed by the director of ARAO and mayors to

[147] http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED6353, several times already modified, based on the first decree from 2003 devoted to the compensation to local communities due to nuclear facilities. This decree was adopted in RS in December 2003 without the discussion with the representatives of RH, although the Intergovernmental Agreement ratified as law in March 2003 in RS foreseen possible joint solution for NEK RWM.

establish a kind of coordinating body for information dissemination, communication and involvement of local citizens in the site selection process with the aim to find a locally acceptable site for LILW repository. The name and the idea for LPs was taken from the Belgian approach, but the structures, the status, the organisation and the mode of operation consider the characteristics and expectations of the individual local communities. Therefore, in two local municipalities two different LPs were established, providing the basis for public information and participation as well as a mode for consultations and verification, additional independent studies and other activities defined within these structures. Although the local partnerships were formally working according to agreements between ARAO and each of the communities, they provide a framework for participation and cooperation of all people - citizens in the site selection process.

The general scheme, given in the Figure 5, foresees the establishment of local partnerships through a steering committee, which has the role to coordinate and to facilitate the participation and involvement of citizens. To involve as many people as possible, different tools can be chosen such as organising different committees, working groups, presentations, round tables, workshops or any other appropriate way to involve locals. During the establishment of the local partnership, a clear programme, defining the purpose of the local partnership, principles, goals, participants, functioning, information accessibility, decision making, funding and time frames, has to be prepared and accepted by all partners. Funds were allocated to each of the LPs, for their functioning (administration and committees functioning), information to the public, site visits and any other activities that are organised by decision of the steering committee (app. €96,000/year). Additionally, there were also funds for independent expert opinions and studies that would be requested by partners (app. €42.000/year).

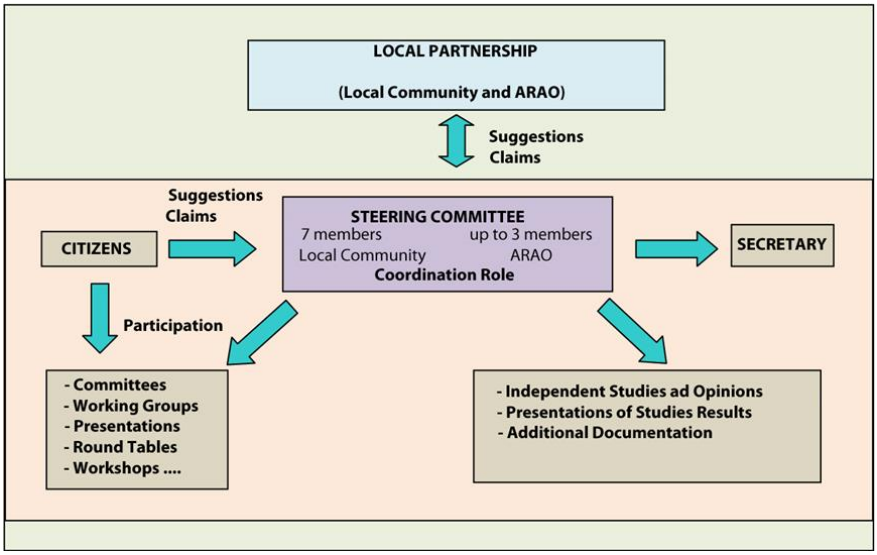


Figure 5: General scheme of local partnership in Slovenia

The functioning of local partnerships was formalised in the administrative procedures like preparation of the national spatial plan for LILW repository, the environmental assessment process, etc., where public participation is prescribed according to the Slovene legislation. In other issues related to site selection, the LP functioned in an informal way, where participants discussed about field investigations, design solutions for LILW repository, safety aspects of nuclear facility, environmental impacts, development possibilities due to compensation for the limited land use, societal and health issues and all other aspects that were relevant or interesting for the specific local community. The LP was also obliged to organise broader discussions and form working groups, inform the public, hold round tables in communities, and involve independent expert opinions for some issues. The work of local partnerships

was public, and therefore the minutes, invitations and documents were published on the web page or in the locally usual way.

Although the LPs were involved in many processes and invited to participate in the coordination meetings at the responsible ministry for site selection, it must be mentioned that the decision-making power stayed with the local municipality council and other bodies of local autonomy, while the LPs have an advisory role.

The formal duration of the LPs was determined by the duration of the siting process – they ended with the confirmation of the location for the LILW repository (Feb 2006 - March 2010) – a fact that local and NGO members of LPs were not satisfied with. Also, in Krško the LP the working programme stated that the duration of the LP is not limited to site selection phase and that its functioning would continue afterwards.

After the adoption of the Governmental Decree on the Detailed Plan of National Importance for the Low and Intermediate Level Radioactive Waste Repository on the Location Vrbina, municipality Krško[148], ARAO continued with the development of project documentation, including the draft safety report. This work progressed very slowly and the EIA process for a LILW repository at Vrbina in the municipality of Krško started officially in March 2018 only when the first documents were published at the ARSO website[149]. Within the EIA process, the documents including the EIA report have been open to the public and submitted to a public hearing to prepare environmental consent. The latter will be the entrance point for the construction licence issued by the Ministry of the Environment and Spatial planning. The public hearing was performed in summer 2020 and received suggestions and comments that were responded to in October 2020. Several NGOs with a special status participated with comments and also the nearest local communes in the Krško Municipality, Spodnji Stari Grad. They expect that in the body that will supervise the LILW repository establishment also three members appointed by Spodnji Stari Grad will participate with the right to control all documentation, measurements and operations. In parallel, also a transboundary environmental impact assessment process according to the ESPOO convention started in which the Republics of Austria and Croatia are participating; Hungary and Italy decided that they do not raise any questions. Some questions and comments from the Republic of Croatia are still open and will be further discussed. The environmental consent is not yet issued, as in May 2021.

Management of the Krško NPP LILW in Croatia

The strategy for the Management of Radioactive waste, Disused Sources and Spent Nuclear Fuel[150] (the Strategy) was adopted by the Croatian Parliament in 2014. The Strategy defines basic objectives and guidelines for the management of institutional radioactive waste (IRW) produced in RC, disused sources (DS), LILW and SF from the Krško NPP as well as for the remediation of locations with naturally occurring radioactive material (NORM). The objectives set out in the Strategy include the establishment of a long-term storage and then repository for IRW, DS and LILW from the Krško NPP. In order to fulfil those objectives, the Strategy sets up general guidelines regarding the legislative framework, responsibilities, funding, human resources and public participation. Also, the Strategy offers regarding RW management an official interpretation of the key LILW and SF Disposal Articles in the Intergovernmental Agreement. After adoption of the Strategy, Croatian Government adopted in 2018 the National Programme for the Implementation of the Strategy for the period up to 2025 with a view to

148 http://www.pisrs.si/Pis.web/pregledPredpisa?id=URED5417

149 http://www.arso.gov.si/varstvo%20okolja/presoja%20vplivov%20na%20okolje/okoljevarstveno%20soglasje/Vloge%20v%20re%C5%A1evanju/

150 https://narodne-novine.nn.hr/clanci/sluzbeni/2014_10_125_2382.html

2060[151]. The National Programme sets out dates for two objectives stated in the Strategy for the period up to year 2025: the establishment of the Central National Storage Facility (CNSF) for IRW and DS and the construction with commissioning of a long-term storage facility for LILW from the Krško NPP. The planned duration of long-term storage for LILW from Krško NPP is 40 years, the establishment of a repository for LILW is not required before 2051. Therefore, activities regarding the site selection, site characterisation and confirmation for the repository are not planned to start in the next 10 years, within the span of this National Programme. The Strategy anticipates the establishment of a special Radioactive Waste Management Centre (RWM Centre). The preferred location for the RWM Centre is Čerkezovac, the location of a military logistic complex without perspective for future use by the army. Čerkezovac is located in the Dvor Municipality on the southern slopes of the Trgovska gora massif, on the border with Bosnia and Herzegovina.

After being taken over from storage in the Krško NPP, LILW will be treated and conditioned into a form suitable for subsequent operations. Treatment and conditioning procedures will be carried out in a dedicated waste management facility in a third country. The Croatian half of LILW will be conditioned by packaging into concrete containers. These containers will be stored in long term storage (operational in 2023) and later disposed of in the appropriate LILW repository to be established in Croatia (operational in 2051). Establishing the LILW repository for the Croatian half of the Krško NPP will start in 2038 with site investigation and the launch of the different procedures to obtain the necessary permits in accordance with regulations, starting with the location permit. The location permit would be issued by 2044 and by the end of 2046 a building permit would be issued. The LILW repository will be of the near surface type, utilizing reinforced concrete cassettes for the placement of LILW.

Although there are many different views, and also strong opposition with regards to the potential location in neighbouring Bosnia and Herzegovina, Croatia continues its commitment to confirm the Čerkezovac site proposed by the National Radioactive Waste Management Programme. In 2020, seismographs and accelerographs were set up to monitor seismic disturbances. Studies that have yet to be done, like radiological monitoring, field investigations and other monitoring will be performed to confirm whether the location is adequate or not.

Challenges of the shared responsibility for RW and SF from NEK

Until the adoption of the IA in 2003, the management of different issues of NEK were already bringing disagreements between the co-owners. One of the major ones was the issue of costs for NEK operation and also for the related decommissioning, RW and SF management, to be set in the dedicated fund. The dispute ended with lawsuits of both owners to each other and a final decision of the International Centre for Settlement of Investment Disputes (ICSID) in 2015 that Slovenia had to pay a total of around €40M due to the non-supply of electricity to Croatia in 2002 and 2003.

After the adoption of the IA in 2003, all relations have become much more defined with procedures on how to approach in case of divergences. For on-site RW and SF management, a basic decision-making process is in place that supports adoption of agreed decisions, and no disagreements are reported publicly (e.g., in media). Such decisions include the cases of RW and SF buildings on site (like the Waste Manipulation Building, the Dry SF Storage) which were agreed in the scope of the IA and adopted by the IC and their supporting bodies. However, the Waste Manipulation Building has not gone in an EIA process by decision of ARSO, and therefore no public participation took place. It is not known how that decision was adopted, but also NGOs with the status of third party did not appeal. For the DSFS, the EIA process was taken place basically due to the demands from NGOs[152] in 2016, when initial plans of NEK claimed that the DSFS is only a safety upgrade for which no EIA is needed, supported by the

[151] https://radioaktivniotpad.org/wp-content/uploads/2015/01/Nacionalni-programme.pdf

[152] https://www.zens.si/sites/zens.si/files/zeg-_zahteva_za_oceno_vplivov_na_okolje_pri_podaljsanju_nek2016.d.pdf

opinion of the SNSA. Also, the NEK LTE has gone to an EIA, but only after an appeal of NGOs, an administrative court judgment and a new decision of ARSO in 2020.

With regards to the long-term decisions for RW and SF management from NEK operation in the future and decommissioning, the issues are more open ended and complex. The main decision-making body defined in the IA is the Intergovernmental Commission. The basic documents that define the future decommissioning and disposal activities are RW and SF Disposal and Decommissioning Programme, which should be developed every five years. The mechanisms for development of those programmes are also in place: two responsible organisations - ARAO and the Fund – with sufficient knowledge and resources for development of work, based on a ToR adopted by the IC and further confirmed by the Slovenian Government and the Croatian Parliament. However, the process of regular adoption of new revisions every five years was not successful. After the DP, Rev. 1, adopted in 2004, the Revision 2 of the DP was scheduled to be adopted in 2009. Although it started on time, it was never formally adopted. The reasons for non-adoption of the final document were never given in writing. Several points can be mentioned:

- The five developed scenarios addressed all open options at that time: a NEK shut down in 2023, or LTE until 2043, with joint or separate RW disposal. The final proposal was to adopt the S5 scenario with NEK operation until 2043 and start of LILW repository in the late 2030's.
- Such scenarios lead to increase of costs, and only one scenario with prolonged NEK operation and later start of joint LILW repository (S5) enlarged the cost only slightly.
- However, even this small increase of costs has not been well accepted by the IC and its consulting bodies.
- The Slovenian side has carried on with its LILW repository project under its boundary conditions (including very high compensation to the local communities in value of approximately €6M per year, which impact final costs) adopted only in Slovenia, which finished with a repository site license in 2010 with modular option for several silos. The modular option provided for a joint repository, but such a decision was never publicly accepted.
- There was political disagreement as the DP Rev. 2 adoption coincided with a dispute between the countries to define the border on the sea.

Only in 2020, the Revision 3 of the DP was adopted, but no joint solution for LILW management was agreed and two separate LILW repositories are currently planned for. The reasons for rejection of the establishment of a joint LILW repository were never put in writing, but the basic principles as proposed by the advisory body to the IC (on the safety of the solution, disposal of all RW in RS and RH, optimization of costs and equal participation of entities from both countries) were already rejected at the level of the Krško municipality and were just taken over by the IC.

According to the IA, the decision making is limited to the official representatives of both countries, i.e., the members of the IC and its advisory body (this time called Implementation Coordinating Committee), basically represented by appointed high ranking politicians or heads of responsible organisations. There is no other decision making foreseen, as programmes are a kind of strategic document. However, there is a question whether such documents should also be open for public participation (in terms of any kind of environmental assessment or other unofficial discussions) and would such broadening of transparency increase the acceptability of projects.

Findings and conclusions

The experience with co-ownership of NEK is, especially after the adoption of the Intergovernmental Agreement, in general very good. The performance of NEK is rated very high according to performance indicators, and safe and stable operations are kept while respecting high standards. The production price of the power generated is competitive and in accordance with the business plan. As reported by the responsible nuclear authorities, all regulatory and environmental requirements are met. In the past,

after the Fukushima accident, there have been intensive actions for safety upgrades implemented and only some are still underway. By the end of 2019, around 92% of the safety upgrades was implemented, and the rest is scheduled to be implemented by the end of 2021[153].

The issue which is in a way typical for NEK activities is transparency in terms of Nuclear Safety and Waste Directive requirements[154]: the approach used is to go for construction licenses to the MESP, where the SNSA provides consent for the nuclear safety and radiation protection part. Such an approach definitely shortens the procedure, but also excludes any public participation. Only lately can we see a change, basically due to successful juridical appeals from NGOs to require an EIA for projects. Typical cases were the on-site construction of the DSFS and NEK LTE, the latter also decided by the Administrative Court judgment referring to the European Court of Justice decision in the case of LTE of the NPP Doel[155]. Only after that, NEK started to perform an EIA for each of the activities. It is not clear what the major concern or drawback is not to perform an EIA. But the lack of willingness for transparency by NEK is in a way its weak point and more should be done by the owners and government (as NEK is publicly owned) to improve transparency and to fulfil legal obligations in national and international legislation.

In relation to the development of long term RW and SF management solutions for NEK, the implementation of the IA is not so effective and successful. The mechanisms for development of related programmes (including the decommissioning programme) are in place, also the responsible organisations to prepare the programmes are defined, but the functioning of the Intergovernmental Commission is somehow limited. The fact is that the members of the IC are changing with the governments: the lead from each country is the responsible minister with a state secretary in the ministry and some other state officials. Therefore, the composition changes whenever new governments are elected. In the case of Slovenia, instead of every four years this is now happening on average every two years, as the governments are very unstable. According to the IA, the DP should be adopted every 5 years, but in 18 years from the IA adoption, only two DPs were confirmed. Therefore, it is important to stabilise the foreseen functioning of the IC and perhaps to think about professionalisation of the body. If the members would not change every two years, continuity would be better assured, they would be much more knowledgeable in the area, and also much more independent in decisions. Currently, the IC is perceived as a political body and also the broader context of the relationship between the countries impacts its functioning.

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[153] http://www.ensreg.eu/sites/default/files/attachments/stress_test_nacp_slovenia_2019.pdf

[154] Directive 2009/71/EURATOM establishing a Community framework for the nuclear safety of nuclear installations and its amendment, Directive 2014/87/Euratom: Article 8: 2. Information shall be made available to the public in accordance with relevant legislation and international instruments, provided that this does not jeopardise other overriding interests, such as security, which are recognised in relevant legislation or international instruments. 4. Member States shall ensure that the general public is given the appropriate opportunities to participate effectively in the decision-making process relating to the licensing of nuclear installations, in accordance with relevant legislation and international instruments.
Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste: Article 10: Transparency: 1. Member States shall ensure that necessary information on the management of spent fuel and radioactive waste be made available to workers and the general public. This obligation includes ensuring that the competent regulatory authority informs the public in the fields of its competence. Information shall be made available to the public in accordance with national legislation and international obligations, provided that this does not jeopardise other interests such as, inter alia, security, recognised in national legislation or international obligations. 2. Member States shall ensure that the public be given the necessary opportunities to participate effectively in the decision-making process regarding spent fuel and radioactive waste management in accordance with national legislation and international obligations.

[155] https://www.politico.eu/wp-content/uploads/2019/07/CP190100EN.pdf

Transparency, including information provision and public participation (not to mention access to justice) of the developed programmes decided by the IC is really a weakness. The decisions are taken by the IC, on websites there is no further information on how decisions have been taken, the public is informed on press conferences about outcomes. The programmes are published only after they are adopted and there is no public participation. However, the individual projects (like the LILW repository) are, in implementation, going over all steps as prescribed in legislation, including an EIA process. The Law on Environmental Protection already now requires that for strategies or plans, a SEA should be performed for important national strategies, also including public participation. The DP can be understood as a national programme which directs RW and SF management from NEK. Also, some other ways of transparency could be implemented to provide opportunities for the public (e.g., the local population, interested public, NGOs) to get information about the plans and also to participate effectively in the decision-making process. A good example was the case of site selection for the LILW repository in Slovenia, which for a limited time implemented local partnerships to enable very active communication with citizens. The cessation of the local partnership after site selection in 2010 was, however, strongly criticised, because later activities of the LILW repository establishment have not been shared and discussed with the local population. Lack of public participation was one of the reasons for not accepting the joint solution for the LILW repository. An open discussion on the shared option and structured dialogue with interested parties from both countries would enable a more flexible approach in which disagreements could be mitigated and solved. Another reason for the rejection of a joint solution was most probably also the costs, including the cost of compensation to the local municipality, which is according to Slovenian rules very high. In case a joint solution would be planned between the two countries, decisions on conditions should be developed together, as the costs are finally shared.

9.5 Case study on the Bohunice Centre - long version

Foreign radioactive waste treatment in Jaslovské Bohunice, Slovakia

Michal Daniška, June 2021 (partial revision in November 2021)

[The author actively opposes the foreign RW treatment in Slovakia]

List of acronyms and abbreviations

JAVYS	Jadrová a vyraďovacia spoločnosť (literally translated: Nuclear and decommissioning company)
JESS	Jadrová energetická spoločnosť Slovenska (literally translated: Nuclear energetic company of Slovakia)
NRA SR	Nuclear regulatory authority of the Slovak republic
BRWTC	Bohunice RW Treatment Centre
RW TCT	RW Treatment and Conditioning Technologies in J. Bohunice
EIS	Environmental impact statement
EIA	Environmental impact analysis
SNF	Spent nuclear fuel
RW	Radioactive waste
LLW, VLLW	(Very) low-level waste
ALARA	As low as reasonably achievable (radiation protection principle)
CSSR	Czecho-Slovak socialist republic
NC SR	National Council of the Slovak republic (i.e., the parliament of the Slovak republic)
NPP	Nuclear power plant
MP	Member of parliament
OĽaNO	a political party in Slovakia
NNF	National Nuclear Fund
CTU SR	The Confederation of trade unions of the Slovak republic
PHA SR	Public Health Authority of the Slovak republic

Introduction

Since 2013 (at the latest) foreign LLW and VLLW has been treated at RW Treatment and Conditioning Technologies in Jaslovské Bohunice (RW TCT), Slovakia, mainly through incineration. Hundreds of tons of RW from the Czech republic, Italy and Germany have been incinerated or contracted for incineration at RW TCT (see the sec. "*Foreign RW treatment history*" for details). The transformation of RW TCT from the exclusively national facility to an international RW treatment provider was done without prior consultation with and approval by the public and municipalities which, according to, e.g., one of the

mayors[156], might have found out about it only in 2018 (i.e., after approx. 5 years). Foreign RW share at incineration varied between approx. 35-45% during 2015-2019 and exceeded 50% for the first time in 2020. Foreign RW treatment, especially by means of incineration, was originally categorically rejected by the vast majority of the affected municipalities. However, multiple municipalities later turned their position by 180 degrees on the condition, among others, that they received economic and non-economic incentives. Unusually strong refusal arose also among the public, e.g., approx. 3000 citizens signed a petition against capacity increase of RW TCT and demanding prohibition of foreign RW treatment in Slovakia. Meanwhile, the operator applied for an increase of the RW TCT treatment limits from 8343 to 12663 t/year in total (including an increase from 240 to 480 t/y by incineration) and a second incineration plant has been constructed. There is some evidence supporting an opinion that Slovakia itself does not need such an increase of treatment (or at least incineration) capacities and a suspicion that the second incineration plant might be purpose-built to better fit the specific RW from the Caorso NPP, Italy. The Slovak Atomic Act allows import, treatment and conditioning of foreign RW on the condition that the radioactivity level of the imported RW equals the radioactivity level of the reexported (after treatment and conditioning) RW. Since the change of government in March 2020 the new Minister of Environment has been trying to ban foreign RW incineration by law. On 6 October 2021, the Slovak Parliament approved a bill which aims at banning future contracts for incineration of foreign RW on the Slovak territory[157]. The already signed contracts for incineration of foreign RW from Italy (617 m^3 and 865 tons) and Germany (21.7 t) will not be affected by the bill in order to avoid penalties and sanctions related to contract cancellation.

Historical context

RW TCT are a part of a larger nuclear site near Jaslovské Bohunice, Slovakia, that includes also NPP A1 and V1 (both being decommissioned), NPP V2 (in operation), interim SNF storage and other nuclear installations. In addition, a new nuclear reactor is planned in this locality (EIA process completed in 2016). NPP A1, commissioned in 1972, was the first NPP in the former Czechoslovakia. Being operated only for 5 years, NPP A1 was permanently shut down after two serious accidents in 1976 and 1977. Shortly after the process of decommissioning had slowly begun, continuing to these days. The core of the RW TCT was designed to ensure the process of treatment of RW produced during the decommissioning of NPP A1. As a result of gradual development, the RW TCT in its current state consists of:

1. Bohunice RW Treatment Centre (BRWTC);
2. fixed RW pre-conditioning line;
3. metallic RW remelting facility;
4. decontamination and fragmentation workplaces;
5. line for the treatment of contaminated cables and other RW management equipment;
6. bituminisation lines;
7. active waste water cleaning station;
8. RW storage facilities and structures.

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156 "*We found out about it* [foreign RW treatment] *in either 2018 or 2019, I am not sure.*" A statement made by Mr. Gilbert Liška, the mayor of the municipality Veľké Kostoľany in the investigative videoreportage broadcasted on 15.06.2020 (part of "Reportéri RTVS" series) available at: https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu (time 03:55-04:03)

157 http://www.nuclear-transparency-watch.eu/activities/radioactive-waste-management/slovak-parliament-approved-a-bill-to-ban-future-contracts-for-incineration-of-foreign-radioactive-waste-according-to-the-slovak-ntw-members-some-concerns-still-remain.html

The Bohunice RW Treatment Centre (BRWTC) was constructed between 1993-1999 and has been in operation since 2000[158]. BRWTC includes[159]:

1. equipment for the concentration of liquid RW;
2. equipment for solid RW sorting;
3. two incineration plants for solid, liquid RW and saturated sorbents;
4. equipment for supercompaction of solid RW;
5. cementation plant for final grouting of treated RW by cement mixture in fibre-concrete containers or alternative packaging sets.

The first of the two incinerators is a shaft furnace type (as in Seibersdorf, Austria), was built between 1993-1999 and has been operated since 2000. The second incinerator has a rotary kiln, its project dates back to February 2017 at the latest, has been constructed between 2019-2021 and is going to be commissioned soon.

RW TCT is owned and operated by JAVYS (**Ja**drová a **vy**raďovacia **s**poločnosť = Nuclear and decommissioning company), a state-owned stock company (the Ministry of Economy of the Slovak republic holds 100% of the company stocks). Originally, before JAVYS was founded in 2005, RW TCT belonged to Slovenské elektrárne (i.e., "Slovak power plants") company. Prior to its privatisation in 2006 Slovenské elektrárne had been a state-owned company which operated all the power plants in Slovakia including the nuclear ones and the related infrastructure (e.g., RW and SNF management facilities). JAVYS was founded on 6th July 2005 by separating it from the Slovenské elektrárne[160], as one of the crucial steps before privatisation of the Slovenské elektrárne. JAVYS was not a subject of privatisation and, as a result, has remained completely state-owned. Originally, the name of the new company was GovCo, but it soon changed to JAVYS on 5th August 2006[161]. At the time of its founding JAVYS consisted of selected nuclear assets in which the Italian ENEL company, the winner of the business competition for privatisation of the Slovenské elektrárne, was not interested. These assets included the nuclear power plant V1 in Jaslovské Bohunice (being decommissioned since its shut down in 2006 (1st reactor block) and 2008 (2nd reactor block) as a condition of accession of Slovakia into the European Union in 2004) and the detached plant SE-VYZ which focused on decommissioning of the NPP A-1 in J. Bohunice and management of Slovak RW and SNF at RW TCT, Interim SNF interim storage facility (both in J. Bohunice) and National repository for LLW and VLLW in Mochovce. The portfolio of activities of JAVYS expanded during the following years. At the moment, JAVYS is also responsible for the project of the deep geological repository, holds the *de facto* monopoly position in interim storage of Slovak SNF, decommissioning and management of RW from decommissioning (§3 sec. 10 of the Atomic Act[162]) and owns 51% share of the JESS company (Jadrová energetická spoločnosť Slovenska = Nuclear energetic company of Slovakia) the objective of which is the construction of a new nuclear power plant in Jaslovské Bohunice. The installation called "Final treatment of liquid RW" in Mochovce is also operated by JAVYS. Although JAVYS is state-owned, carries out a public service and receives millions of euros from public budget (through the National Nuclear Fund) each year, it claims not to be a liable entity according to the Slovak Freedom of Information Act and therefore not obliged to reply to public requests of information[163].

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158 https://www.javys.sk/sk/jadrove-zariadenia/technologie-spracovania-a-upravy-rao/bohunicke-spracovatelske-centrum-rao (in Slovak)

159 EIA report "*Optimisation of treatment capacities of RW treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*", page 12. Available at https://www.enviroportal.sk/eia/dokument/295761

160 https://orsr.sk/vypis.asp?ID=141624&SID=2&P=1

161 https://www.javys.sk/en/about-the-company/company-profile/history

162 https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2004/541/#paragraf-3.odsek-11

163 A JAVYS employee responsible for the EIA report within the process "*Optimisation of treatment capacities of RW treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" incorrectly claimed after the public hearing on 26.08.2019: "*Of course, it is possible to contact JAVYS to provide information under the Freedom of Information Act.*" See

The already existing and operated RW TCT were assessed for the first time on the basis of modern EIA legislation during the EIA process "*RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location*" (December 2012 – November 2014). The Environmental Impact Statement (EIS) from this EIA process (issued in November 2014, with minor changes valid until today) explicitly states that **RW TCT serves the treatment and conditioning of VLLW, LLW and ILW from (1) decommissioning of the Slovak NPPs A1 and V1; (2) operation of Slovak nuclear installations; or (3) institutional RW (IRW) and captured RW (CRW)**. The list of purposes does not explicitly mention treatment (incineration) of foreign RW. In March 2021 the Slovak Ministry of Environment stated[164] that "*the ongoing foreign RW treatment (incineration) is inconsistent*" with the EIS mentioned above. However, the treatment of foreign RW at RW TCT continues.

This EIA process set the legal limits for annual volume of RW treated by the individual technologies, e. g. 240t of RW per year by incineration, which still apply today. Taking into account all RW TCT technologies together, the total limit reaches 8343 tons per year. In March 2018 JAVYS applied for increase of RW limits by 4320 tons of RW per year (from 8343 to 12663 tons per year) including an increase of the incineration limit from 240 to 480 tons per year (corresponding to the real incinerated volume increase from approx. 130t/y, the technical limit of the first incinerator, to approx. 420-460t/y if both incinerators are in operation). Currently, the corresponding EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" is in its final stage. The Ministry of Environment of the Slovak republic issued the EIS no. 417/2021-1.7/zg from this EIA proces on 24.03.2021 which has not entered into force yet due to appeals lodged. This EIS approved the proposed capacity increase and set no restrictions on foreign RW treatment. The Ministry of Environment argued that 1.) it cannot interfere with or restrict business activities if significantly negative impact on the environment had not been demonstrated and 2.) there is a constitutional right to engage in business and other gainful activity[165]. Meanwhile, another individual EIA process for the second incinerator only was held, thus accelerating the authorization process of the second incinerator. This EIA process resulted in a condition that foreign RW must not be treated at the second incinerator. Once the EIS from the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" comes into effect, the EIS from EIA process "*RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location*" and the ruling from the individual EIA process for the second incinerator expire. Therefore, the restriction prohibiting incineration of foreign RW at the second incinerator will expire as well, unless the EIS no. 417/2021-1.7/zg is amended as a result of the appellate procedure and such restriction is added to the EIS.

According to the National policy for management of SNF and RW in the Slovak republic from 2015[166] the current (unincreased) capacity of RW treatment lines (state without the second incineration plant) is sufficient (with reserves) for treatment of RW from both operation and decommissioning of the Slovak nuclear installations.

Foreign radioactive waste (RW) treatment history

Volumes of RW incinerated at RW TCT from 2007 to 2020

At RW TCT the foreign RW is treated mainly by incineration[167]. The incineration of foreign RW dates back to 2013 when 8.8 tons of Czech RW were incinerated. It was not until the beginning of 2018 that information on the treatment (incineration) of foreign RW resonated for the first time among

http://vegatv.sk/index.php?mact=CGBlog%2Ccntnt01%2Cdetail%2C0&cntnt01articleid=2085 at time 4:44.

164 See p. 90 of the English version of the EIS available at https://www.enviroportal.sk/eia/dokument/326075 or p. 86 of the Slovak version available at https://www.enviroportal.sk/eia/dokument/323308

165 See p. 76 of the English version of the EIS available at https://www.enviroportal.sk/eia/dokument/326075

166 see sec. "*Current treatment capacities vs. Slovak needs*"

167 some foreign RW was treated by supercompaction as well

municipalities and a part of the public. There were two main sources – (1) the press conference of then opposition MPs Mr. Igor Matovič and Mr. Marek Krajčí about incineration of RW from the Italian NPP Caorso and their failed attempt to ban incineration of foreign RW by law (February 2018) followed by (2) publishing the EIA plan "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" (March 2018) where foreign RW treatment was mentioned among the purposes of RW TCT. However, the treatment and especially incineration of foreign RW gained more significant and repeated media attention only in the middle of 2020, after the February 2020 elections and the consequent change of government (Mr. Matovič and Mr. Krajčí became the Prime Minister and the Minister of Health, respectively).

Historical records of volumes of RW incinerated at RW TCT from 2007 to 2019 provided by the Nuclear Regulatory Authority of the Slovak republic (NRA SR)[168] are shown in Fig. 1 and Table 1, where conversion rule $1m^3 = 1t$ is assumed in order to combine volumes of liquid RW (LRW, in m^3) and solid RW (SRW, in t)[169].

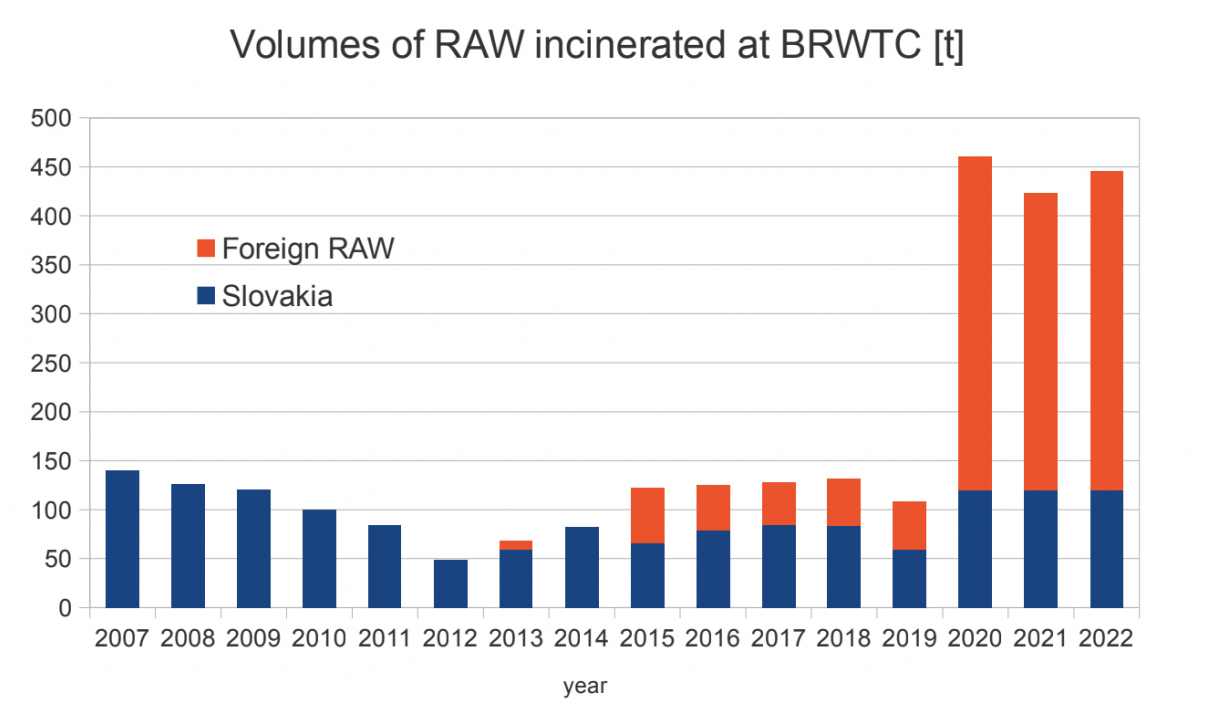

Fig. 1.: Volumes of RW incinerated at RW TCT (assuming conversion rule $1m^3 = 1t$ in order to combine volumes of liquid RW (in m^3) and solid RW (in t)):

1. 2007 - 2019*: historical records provided by NRA SR;*
2. 2020 - 2022: *predictions (in case the RW TCT capacity increase is approved) based on the total volume estimate provided by JAVYS (source: expert judgment on the EIA report within the EIA process "Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice") and conservative estimate of volume of the Slovak RW (120 t/y) based on historical records.*

[168] a response to the request on information, letter no. 3921/2020 dated 19.05.2020

[169] According to 2020 annual report of JAVYS, additional 84.785t + 41.618m^3 (=approx. 126,403 t) of RW was incinerated in 2020 in total. Volume of incinerated Slovak RW was not published.

In 2012 the annual volume of the incinerated Slovak RW reached its historical minimum after it had decreased from approximately 140t/y to 50t/y between 2007-2012. The following year, in 2013, incineration of foreign RW at RW TCT started. Approx. 300 t of foreign RW were incinerated during 2013 – 2020 in total. In the period 2015-2019 approx. 110-130t of RW in total were incinerated annually, out of which the Slovak RW represented 60-85t, the share of foreign RW at incineration oscillated between 34-46% (43-56 tons annually) and exceeded 50% for the first time in 2020. The incineration has taken place exclusively at the first incinerator, as the second one had not been commissioned yet (but was completed in the end of 2020 and is expected to be commissioned soon).

Although the current legal limit for RW incineration is 240 t/year, it is, according to JAVYS, not technically feasible to incinerate more than 130-150 t/year of RW at the first incineration plant in practice[170] (compare to approx. 120-140 t/y and 110-130 t/y incinerated during 2007-2009 and 2015-2019, respectively). In case the capacity increase (in case of incineration from 240 t/year to 480 t/year[171]) is approved and the second incineration plant becomes operational, the volume of incinerated RW in practice may increase to approx. 420-460 t/year[172] (i.e., approx. 3,5-fold increase if compared to the current state and 7-8 times more than the current annual volume of incinerated Slovak RW (approx. 60t/y)). Even when the volume of incinerated Slovak RW is highly overestimated to be 120 t/year in 2020-2022 (compare to maximum 85 t/year during 2011-2019 and a decrease to approx. 60 t/year in 2019), the share of foreign RW at incineration may reach more than 70%.

Due to unfulfilled assumptions (RW TCT limits increase and commissioning of the second incinerator not yet operational) the original prediction of the total volume of RW incinerated in 2020, i.e. approx. 460 tons, provided by JAVYS in August 2019 (the EIA report release date) differs from the reality significantly. According to the 2020 annual report of JAVYS approx. 126 tons of RW[173] in total were incinerated in 2020[174], the volume of foreign RW was not specified in the annual report. According to the quarterly RW inventory data provided by the NRA SR[175] in July 2021, treatment and conditioning of RW through incineration at RW TCT totalled approx. 71 tons of foreign RW (34.37 t of solid RW and 37 m^3 of liquid RW) and 50.40 tons of solid Slovak RW. NRA SR stated that the inventory data and the RW volume presented in the 2020 annual report are not and cannot be technically comparable since the two documents differentiate the data for different purposes. However, based on the data provided by the NRA SR, we deduce that the foreign RW share exceeded 50% in 2020. Due to the same reasons a similar situation is expected to repeat in 2021. According to the data provided on monthly basis to the mayors of 9 affected municipalities 94.78 tons of foreign RW and 37.81 tons of Slovak RW have been incinerated between January and October 2021, resulting in the foreign RW ratio at incineration 71.48%.

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170 Ruling of the Ministry of Environment of the Slovak republic no. 2764/2019-1.7/zg-R dated 19.02.2019

171 The theoretical capacities of both incineration plants are 240 t/y each (the second incinerator should be able to meet its theoretical capacity 240 t/y), JAVYS therefore proposes to increase the approved incineration capacities (legal limit) from 240 t/y (theoretical capacity of the old incineration plant) to 480 t/y (sum of theoretical capacities of both the incineration plants).

172 See the treatment plan for variant No. 1 in 2019-2023 on p. 52 in the expert judgment on the EIA report within the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" – a corrected version of Table A.II.10/05 from the EIA report within the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*"

173 84,785 tons of solid RW and 41,618 m^3 of liquid RW

174 Available online at https://www.javys.sk/data/web/dokumenty/vyrocne-spravy/vs-en-javys-2020-fin.pdf, see p. 20

175 An e-mail dated 7 July 2021 where NRA SR responded to the author's previous request of information

year	RAW from Slovakia	RAW from foreign countries	All RAW	Foreign RAW Share
Historical records of amounts of incinerated RAW. [Source: NRA SR]				
2007	140.4	0	140.4	0.00%
2008	125.9	0	125.9	0.00%
2009	121.1	0	121.1	0.00%
2010	100.5	0	100.5	0.00%
2011	84.7	0	84.7	0.00%
2012	49	0	49	0.00%
2013	59.1	8.8	67.9	12.96%
2014	82.1	0	82.1	0.00%
2015	65.7	56.1	121.8	46.06%
2016	79.6	45.8	125.3	36.55%
2017	84.7	43.6	128.2	34.01%
2018	83.7	47.8	131.5	36.35%
2019	58.9	49.1	108	45.46%
Predictions of amounts of incinerated RAW in the near future (in case variant 1 is approved)				
	Conservative estimate based on Historical records	Difference between predictions for All RAW and Slovak RAW	Source: Expert judgement on the EIA report	
2020	120	340.9	460.9	73.96%
2021	120	303.1	423.1	71.64%
2022	120	326	446	73.09%

Table 1.: Volumes of RW incinerated at RW TCT (assuming conversion rule 1m³ = 1t in order to combine volumes of liquid RW (in m³) and solid RW (in t)):

1. *2007 - 2019: historical records provided by NRA SR;*
2. *2020 - 2022: predictions (in case the RW TCT capacity increase is approved) based on the total volume estimate provided by JAVYS (source: expert judgment on the EIA report) and conservative estimate of volume of the Slovak RW (120 t/y) based on historical records.*

Since summer 2019 JAVYS has been providing some data about incineration on monthly basis to the mayors of 9 affected municipalities. Only the data from the previous month are displayed at any time (i. e. access to the archive is not possible). Table 2 shows data from March 2020 – October 2021 only, since data from earlier months are currently not available to the author. The foreign RW share in the period March 2020 October 2021 was 57.6%. Foreign RW is said to be treated (incinerated) if there are free treatment capacities after treatment (incineration) of Slovak RW.

RAW incinerated at BRWTC from 2020/03 to 2021/10										
month	JAVYS, a.s.		SE, a.s.		Foreign RAW		All RAW		Ash	
	Volume [t]	Activity [MBq]	Volume [t]	Activity [MBq]	Volume [t]	Activity [MBq]	Volume [t]	Activity [MBq]	Volume [t]	Activity [MBq]
2020/03	0	0	2.4756	515	7.5524	1130	10.028	1645.0	0.44	186
2020/04	0.261	0.00039	6.5714	2440	0	0	6.8324	2440.0	0.523	156
2020/05	0.03	0	1.324	374	5.4531	1940	6.8071	2314.0	0.265	2310
2020/06	0.6108	275	0	0	5.6424	9840	6.2532	10115.0	0.091	4330
2020/07	11.308	28300	4.44	4538	0	0	15.748	32838.0	0.905	21400
2020/08	7.5482	1378	0.7429	106.9	0	0	8.2911	1484.9	0.979	1300
2020/09	6.4649	25803	8.2598	3205	1.4234	3280	16.1481	32288.0	0.5	34100
2020/10	0	0	0	0	8.6562	13600	8.6562	13600.0	0.292	4550
2020/11	0	0	0	0	5.6211	19700	5.6211	19700.0	0.208	4540
2020/12	6.4246	30.8	0.8063	931	0	0	7.2309	961.8	0.788	787
2021/01	0.9653	136	1.6099	365	23.6327	7560	26.2079	8061.0	0.445	976
2021/02	0	0	0	0	18.2971	3790	18.2971	3790.0	0.36	511
2021/03	0	0	0	0	15.4188	10100	15.4188	10100.0	0.631	3370
2021/04	0	0	6.4975	2225	5.2153	7763.5	11.7128	9988.5	0.518	4680
2021/05	0	0	0	0	6.5191	12500	6.5191	12500.0	0.276	3610
2021/06	0	0	0	0	10.3254	70100	10.3254	70100.0	1.163	61600
2021/07	6.2304	782	0	0	4.3688	32600	10.5992	33382.0	1.198	12600
2021/08	10.7596	1086.1	6.0145	1019.3	0	0	16.7741	2105.4	1.037	2100
2021/09	0.2415	2.1	5.489	368.6	5.2808	14700	11.0113	15070.7	1.189	3950
2021/10	0	0	0	0	5.7245	20900	5.7245	20900.0	0.356	6880
Total	50.8443	57793	44.231	16088	129.131	229504	224.2063	303384.3	12.164	173936

Table 2.: *Volumes and activities of RW incinerated at RW TCT and of the resulting ash each month during March 2020 – October 2021. Slovak RW sources:*

1. *JAVYS, a.s.: NPP A-1, V-1 in Bohunice (being decommissioned) & other*
2. *SE, a.s. (Slovenské elektrárne, a.s. = Slovak powerplants, Inc.): NPP V-2 (in operation) in Bohunice and blocks 1 & 2 of the Mochovce NPP (in operation)*

Contracts for incineration of foreign RW at RW TCT

The permits gradually issued by NRA SR to import and incinerate foreign RW are listed in the table 3. Taking into account the natural time delay between signing the contract and the NRA SR permit issue date, we cannot rule out with certainty (although it is not expected) there might be additional contracts we are unaware of if the corresponding NRA SR permits were not issued yet[176]. According to §21 sec. 12b of the Atomic Act[177] NRA SR can authorize import of foreign RW "*for the purpose of its treatment or conditioning in the territory of the Slovak Republic, if the export of material with aliquot activity is contractually secured and authorized by NRA SR*", i.e., the radioactivity level of the imported RW must equal the radioactivity level of the reexported RW (after treatment and conditioning).

[176] In some cases, this delay can be as long as 3 years. For example the Caorso contract was signed in June 2015 (see e.g. the 2015 annual report of JAVYS, p. 24: https://www.javys.sk/data/web/dokumenty/vyrocne-spravy/vs-javys-2015-eng.pdf and the redacted version of the Caorso contract (in Slovak and Italian) published by JAVYS in November 2020: https://www.javys.sk/sk/cinnosti-spolocnosti/komercne-aktivity/spracovanie-sorbentov-z-je-caorso) and the NRA SR permit had not been issued until June 2018.

[177] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2004/541/20191001#paragraf-21.odsek-12.pismeno-b

	NRA SR permissions – foreign RAW incineration in Bohunice							
	Permission no.	Permission issue date	Company	Country	Imported volume		Expiration date	RAW type
					SRAW	LRAW		
Completed	920/2013	31.10.2013	ČEZ, a.s.	Czech rep.	39.64 t	0	31.10.2016	SRAW and ion-exchange resins (NPP Temelín + Dukovany)
Completed	524/2015	03.09.2015	Nucleco S.p.A.	Italy	7 t	16 m3	31.08.2018	Institutional RAW
Completed	681/2015	27.11.2015	ČEZ, a.s.	Czech rep.	145.2 t	0	30.11.2018	SRAW + LRAW and ion-exchange resins (NPP Temelín + Dukovany)
Ongoing	128/2018	04.06.2018	SOGIN S.p.A.	Italy	865 t	0		ion-exchange resins in ureaformaldehyde [800t] and sludge [65t] (NPP Caorso)
Ongoing	20/2019	22.01.2019	Eckert & Ziegler Nuclitec GmbH	Germany	18.7 t	3 t		Institutional RAW
Ongoing	30/2019	25.01.2019	Nucleco S.p.A.	Italy	383 m3	234 m3		Institutional RAW

Table 3.: Permits issued by NRA SR to import and incinerate foreign RW at RW TCT.

As one can see from table 3, incineration of approx. 1600 tons of foreign RW (Czech rep., Italy, Germany) was contracted by JAVYS in total, out of which approx. 250 tons have already been incinerated between 2013 – 2019 (see data in the previous section). In comparison, approx. 1100 tons of Slovak RW were incinerated between 2007-2019. Three contracts (39.64t + 145.2t RW from NPP Temelín and Dukovany, Czech Republic and 7t +16m institutional RW from Italy) had already been completed. JAVYS currently has active contracts for incinerating of approx. 1500 t of foreign RW (865t of RW from Caorso NPP, Italy; 617m^3 of institutional RW from Italy and 21,7 t of institutional RW from Germany). It is worth pointing out that, due to pre-conditioning, the volume of incinerated RW might be lower than the contracted volume[178].

While only the first incineration plant is operational, only approx. 50-80 t/year of foreign RW (residual capacity after incinerating the Slovak RW) can be incinerated. Also, the RW TCT capacity increase has not been approved yet. Taking into account these limitations, the large volume of contracted but not yet incinerated foreign RW[179] and the assumption that permits are issued with respect to the treatment capacity available by the permit issue date, one can raise the question whether issuance of the permits 128/2018, 20/2019 and 30/2019 was in accordance with the article 27 (1) (iii) of the Joint Convention on the Safety of SNF Management and on the Safety of RW Management: "*a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the SNF or the RW in a manner consistent with this Convention*".

According to NRA SR[180] issuance of the permit 128/2018 for incineration of RW from Caorso in this situation is not inconsistent with the article 27 (1) (iii) of the Joint Convention on the Safety of SNF Management and on the Safety of RW Management, since the permit (and 20/2019 and 30/2019 as well) has no expiration date and thus does not restrict the duration of incineration of the RW from Caorso.

178 The volume of incinerated RW (data in tables 1, 2) is measured at the inlet of the incinerator (statement of JAVYS made during the oral proceedings as part of the authorization procedure for the early commissioning of the second incinerator on 07.05.2021). However, pre-conditioning may significantly reduce the original volume of the imported RW before it is moved to the incinerator. For example, during the half-a-year-long hot tests of the Caorso RW incineration in 2019, only approx. 1/3 of the input RW mass remained after the preconditioning phase (15.552 out of 43.031 tons), see sec. "*The Caorso contract – 865 tons of radioactive ion exchange resins in ureaformaldehyde and sludges*" for details.

179 According to our expectations the volume of contracted but not yet incinerated foreign RW might equal 1000-1300 tons as of June 2021, depending on the volume reduction due to pre-conditioning.

180 Statement made during the oral proceedings as part of the authorization procedure for the early commissioning of the second incinerator on 07.05.2021.

By early October 2020 only 103 tons from the Caorso contract had already been imported and preconditioned, of which 79 tons were incinerated and exported back to Italy as well[181]. Assuming the total volume of the Caorso contract (865 ton) and also other contracts (e. g. 617m^3 of institutional RW from Italy) we find it questionable whether the Caorso contract deadline at the end of 2023 can be met if only the first incinerator is used.

The Caorso contract – 865 tons of radioactive ion exchange resins in ureaformaldehyde and sludges

The Caorso contract holds an exceptional position among the 6 contracts for foreign RW incineration at RW TCT. The main reason is the allegedly challenging nature of this RW that is said to lead to difficulties during incineration in the shaft furnace of the first incinerator and a suspicion that the second incinerator with the rotary kiln might be purpose-built to better fit the RW from Caorso and thus overcome these difficulties.

According to Sogin, the Italian state-owned company responsible for the decommissioning of Italian nuclear plants (including the Caorso NPP) and the management of radioactive waste, *"the Caorso contract involves 5,900 tanks, containing 800 tonnes of ion exchange spent resins and 60 tonnes of radioactive sludges"*[182]. The permission (ruling No. 128/2018 from 04.06.2018) issued by NRA SR informs about 865 tons and 5881 barrels[183]. The Caorso NPP was shut down shortly after the Chernobyl accident (24/10/1986)[184] as a direct reaction to the accident. The contracted 865t of RW originate from operation, not from decommissioning[185] of the Caorso NPP, the RW is therefore more than 30 years old. A report[186] from 1997 mentions about 5800 barrels of resin and 300 barrels of sludges stored in Caorso. Decommissioning license for the Caorso NPP was granted in February 2014 on condition that "*A project for the re-conditioning of resins and sludge that have been treated in the past with ureaformaldehyde has to be performed in the near future in a defined timeframe as established by the licensing conditions."*[187] According to *World nuclear news*[188] "*The plant's decommissioning licence, obtained in 2014, includes the treatment and conditioning of around **860 tonnes** of radioactive ion exchange resins and sludges, still contained in two on-site temporary storage buildings. This waste represents more than **90% of the contamination inventory** at Caorso. The aim of the project is to transform this waste into final packages, with a volume reduction factor of 10, whilst emptying the two storage buildings in order to refurbish them."* It looks like the decommissioning license condition covers exactly the 860 t of RW contracted by JAVYS. In that case the term *near future* and *a defined timeframe* (for re-conditioning of the resins and sludges) might be related to the official timeframe for incineration and conditioning at RW TCT - the shipment of the last contracted barrel from Caorso NPP to RW TCT should be concluded by

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181 See the statement of the spokeswoman of JAVYS in the news article "*Spaľovať cudzí rádioaktívny odpad? Kollár a Sulík sú za, zvyšok koalície proti*" dated 08.10.2020, available online (in Slovak) at: https://e.dennikn.sk/2078275/spalovat-cudzi-radioaktivny-odpad-kollar-a-sulik-su-za-zvysok-koalicie-proti/

182 See https://www.sogin.it/en/closureoftheitaliannuclearcycle/italian-nuclear-sites/caorsonuclearpowerplant/decommissioningprojects/resins-treatment.html

183 Available at (in Slovak): https://www.ujd.gov.sk/amis/dbrozhod.nsf/0/292441615CE0C443C12582A3002FA4EE/$FILE/128.pdf

184 See e.g., annex 1 in the 8th Italian National report for the Convention on nuclear safety (2019), available online at: https://www.isinucleare.it/sites/default/files/contenuto_redazione_isin/cns_8th_review_italy_national_report_2019.pdf

185 see the NRA SR permit no. 128/2018

186 See p. 60 in Davies, M. W. et all: *A review of the situation of decommissioning of nuclear installations in Europe*, report, 1997 (available at https://op.europa.eu/en/publication-detail/-/publication/549586d4-0751-40c1-8658-a3e486ddc34f): "*There are 1248 fuel elements remaining in the pool. Stored elsewhere are about 1000 barrels of paper, rags gloves (0.5% w/o), **about 5800 barrels of resin (82% w/o), about 300 barrels of sludges (3% w/o)** and about 500 barrels (15% w/o) of other wastes.*"

187 See Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, 4th National Italian National Report (October 2014), p. 159. Available at https://www.isinucleare.it/en/publications

188 See https://world-nuclear-news.org/Articles/Ansaldo-Nuclear-provides-robot-for-Caorso-decommis

2022 and the incineration and conditioning at RW TCT should be completed by 2023[189]. One might expect that treatment (incineration) and conditioning of the radioactive resins and sludges from the Caorso NPP should be a priority of Sogin, since the decommissioning license explicitly requires completion of the re-conditioning by a specified date in the near future.

The Italian national reports on *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*[190] from 2008, 2011 and 2014 state (the part in the square brackets can be found in the 2008 report only):

"At present in the Caorso NPP the radioactive waste is stored in the three storage facilities of the NPP site. 1250 m³ of operational radioactive waste (resins and sludge) have been treated in the past with ureaformaldehyde but, due to the presence of significant amount of free (corrosive) liquids[191] *[and due to a compressive strength significantly lower than the required limit of 5 Mpa,] a new conditioning campaign has to be performed, as requested by the Regulatory Authority. An international tender for the supply of a system for the thermal treatment and conditioning of operational radioactive waste is under way.*"

Only in the 2017 report the paragraph ending changes to: "*The Caorso NPP obtained the decommissioning licence on February 2014. At present in the Caorso NPP the radioactive waste is stored in the three storage facilities of the NPP site (see Figure 4). 1250 m³ of operational radioactive waste (resins and sludge) have been treated in the past with urea-formaldehyde but, due to the presence of significant amount of free (corrosive) liquids, the treatment process was not satisfactory. A new conditioning campaign is in progress. As result of an international tender, the thermal treatment and conditioning of operational radioactive waste has been assigned to a qualified Slovak operator.*"

One can conclude that the international tender for incineration of the Caorso RW took at least 6 years (from 2008 to 2014). As already mentioned above, since re-conditioning of the resins and sludges represents one of the conditions of the Caorso NPP decommissioning license, this RW might be considered a priority issue. One might ask why the search for a contractual partner took at least 6 years, why the RW had been waiting for incineration for more than 30 years and whether it might be related to the alleged "challenging" nature of this RW, as some sources state (see below). Significant difficulties were experienced when the ion-exchange resins in ureaformaldehyde from Caorso had been incinerated on commercial basis in Seibersdorf, Austria in the 1990s (see the section "*Incineration of ion-exchange resins from Caorso in Sweden and Austria*" for details).

According to JAVYS two other companies participated in the international tender - Studsvik from Sweden and Socodei from France[192]. The contract between Sogin and JAVYS was signed in June 2015 and states (in the article 4 "*duration of the service*") that "*the contract shall be valid for 1437* [i.e., approx. 4 years] *consecutive calendar days from its conclusion*"[193]. On the very same webpage JAVYS states that the RW treatment and return of the products of this treatment to the country of origin is expected to be completed by 2023, i.e., 7,5 years since the contact was signed. The statements of JAVYS in news articles also set the deadline at the end of 2023[194].

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189 According to https://www.sogin.it/en/closureoftheitaliannuclearcycle/italian-nuclear-sites/caorsonuclearpowerplant/decommissioningprojects/resins-treatment.html: "*Therefore, Sogin launched, on January 29th 2020, the second and final phase of the transfer program (with 33 transports) of the remaining drums, approximately 5,600, to the Slovakian plant, whose conclusion is expected in 2022.*" and "*Treatment of 5.600 drums and shipment operations are expected to conclude by 4 years (2020-2023).*"

190 Available at https://www.isinucleare.it/en/publications

191 According to a statement made by a NRA SR inspector during the oral proceedings as part of the authorization procedure for the early commissioning of the second incinerator on 07.05.2021 the free liquids are removed from the RW at a preconditioning line in Caorso before shipment of the RW to Slovakia

192 https://www.javys.sk/sk/cinnosti-spolocnosti/komercne-aktivity/spracovanie-sorbentov-z-je-caorso

193 See the redacted version of the Caorso contract (in Slovak and Italian) published by JAVYS in November 2020: https://www.javys.sk/sk/cinnosti-spolocnosti/komercne-aktivity/spracovanie-sorbentov-z-je-caorso

194 See e.g., https://e.dennikn.sk/2078275/spalovat-cudzi-radioaktivny-odpad-kollar-a-sulik-su-za-zvysok-koalicie-proti/

Neither JAVYS nor a supervising institution (e.g., the NRA SR) have confirmed a direct relation between the second incinerator and the Caorso contract. However, according to some sources[195] JAVYS allegedly has experienced some difficulties while incinerating the radioactive resins and sludges from Caorso at the first incineration plant (with a shaft furnace) and there is suspicion the second incinerator with the rotary kiln might allegedly be purpose-built to better fit the RW from Caorso and thus overcome these difficulties. These doubts may be supported by the following:

1. The original contract for construction of the second incinerator dated 22.06.2017 states that the incinerator must "*with special regards*" be capable of incineration of ion-exchange spent resins in ureaformaldehyde which shall be proven by successful hot tests with 100 tons of ion-exchange resins in ureaformaldehyde (the hot tests include only 20 tons of other RW)[196]. Also, the EIA project for the second incineration plant[197] and the corresponding ruling of the Ministry of Environment of the Slovak republic no. 2764/2019-1.7/zg-R dated 19.02.2019 explicitly declare that the second incineration plant will be able to incinerate ion-exchange resins fixed in urea-formaldehyde matrix. According to available sources no Slovak RW belongs to this category, but the RW from Caorso NPP meets this definition. In May 2021 the NRA SR explicitly confirmed that "*exactly the urea-formaldehyde resin represents the foreign RW*"[198].;
2. The Caorso contract was signed in June 2015, but hot tests of incineration of the RW from Caorso at the first incinerator (not to be mistaken with the hot tests of the second incinerator, mentioned in the previous paragraph) started only in January 2019, after a brand-new pre-conditioning line at RW TCT was commissioned in December 2018[199].
3. The hot tests of incineration of the RW from Caorso at the first incinerator took almost half a year (21.01.2019 – 02.07.2019) and large volumes (43.031 tons reduced by preconditioning to 15.552 tons) were incinerated[200]. One may expect that only a few tons of RW should be sufficient for hot testing in standard situation. According to *World nuclear news* "*In November 2017, the first resin tanks were sent to Bohunice to carry out cold tests of the pre-treatment system and the incinerator's power supply. The first phase of the actual transport programme involved the shipment in June 2018 of 336 drums to perform the hot testing with the production of the first final products.*"[201]. Since the 865 tons of the Caorso contract are stored in 5881 drums, one can estimated that 336 drums correspond to approx. 50 tons of RW (compare to 43.031 tons before pre-conditioning);
4. Almost a threefold reduction of RW mass through pre-conditioning (43.031 tons reduced to 15.552 tons);
5. The public procurement order for construction of the second incinerator was published on 26.01.2017[202], i.e., 1,5 years after the Caorso contract was signed (June 2015);

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195 E.g., (1) news article dated 12.08.2020 available at https://www.aktuality.sk/clanok/813522/stali-sa-zo-slovakov-pokusne-mysi-olano-prudko-otocilo/ (translated from Slovak): "*Sceptics are convinced that JAVYS needs the new incineration plant, because the sludges from Italy cannot be incinerated at the old one*. *Even people who have been employed in the nuclear energy sector for years have no doubts about it.*"; (2) statement of the mayor of Veľké Kostoľany (one of the 9 affected municipalities) in the investigative videoreportage broadcasted on 15.06.2020 (part of "*Reportéri RTVS*" series) available at https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu (time 04:27-04:46): "*We suppose that the new incineration plant is being purpose-built, since the RW imported from Italy cannot be incinerated at the old one*"; (3) official statement of the town Piešťany dated 28.04.2020 mentioned directly in the main text.

196 The contract is available at https://www.uvo.gov.sk/vyhladavanie-dokumentov/detail/838123, see p. 19 and 25. The public procurement order was published on 26.01.2017.

197 The EIA process "*Optimisation of incineration capacities of the nuclear installation RW Treatment and Conditioning Technologies*"

198 see NRA SR ruling no. 164/2021 P dated 24 May 2021, p. 20

199 The pre-conditioning line was commissioned by the NRA SR ruling no. 361/2018 dated 19.12.2018, available online at: https://www.ujd.gov.sk/amis/dbrozhod.nsf/0/E9F050D8E7F6F6EAC125836900456C07/$FILE/361.pdf

200 The report from the hot tests, p. 6 and 8

201 See https://www.world-nuclear-news.org/Articles/Second-phase-of-shipments-of-Italian-waste-to-Slov

202 https://www.uvo.gov.sk/vyhladavanie-zakaziek/detail/405486

6. On 12-13 February 2018 tests of the rotary kiln technology were conducted at the ordinary waste incineration plant in Prešov, Slovakia. The main objective was to verify the correctness of the rotary kiln technology for incineration of the ion-exchange resins in ureaformaldehyde[203];
7. JAVYS in 2018 accepted the condition prohibiting foreign RW treatment at the second incinerator. However, this restriction will be de facto applied only after the second incinerator is commissioned and will expire once the EIS from the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" comes into effect, unless the EIS is amended as a result of the appellate procedure and prohibition of foreign RW incineration is added to the EIS (see sec. *EIA process I.2 "Optimisation of incineration capacities of the nuclear installation RW Treatment and Conditioning Technologies"* for details);
8. The residual capacity (i.e., after incineration of the Slovak RW) of the first incinerator only is approx. 50-80 t of foreign RW per year, which does not seem to be sufficient to meet the Caorso contract deadline in 2023 (assuming the contract volume 865 ton and also volume of other contracts);
9. unlike the first incinerator the incineration at the second incinerator would not result in alpha cross-contamination of the (foreign RW) ashes[204];
10. The town Piešťany mentions the following in its EIA process[205] statement dated 28.04.2020:
    - *"The RW from Caorso NPP should be very heterogenous - from solid to liquid/sludge phase."*[206].
    - *"At the time of signing the contract, the qualitative and radiologic analysis of this RW only on the general level was available and the Italian side was not able to guarantee composition of this RW"*
    - *"At the time of signing the contract, it became apparent that treatment of this type of RW at the old incineration plant would be very difficult."*
11. Significant difficulties were experienced when the ion-exchange resins in ureaformaldehyde from Caorso had been incinerated at the "twin" of the first incinerator from RW TCT in Seibersdorf, Austria (see the section "Incineration of ion-exchange resins from Caorso in Sweden and Austria" for details)

The report from the hot tests of incineration of the RW from Caorso at the first incinerator explicitly confirms that the preconditioning line was constructed mainly for the purpose of treatment of the RW from Caorso by stating "*In accordance with the concluded contract and on the basis of the results of tests with the simulate of this waste, which were carried out in 2016 and 2017, mainly for the needs of the implementation of the project of treatment of radioactive saturated sorbents and sludge from the Caorso NPP corresponding technological equipment was built within IPR I00TSVD20006 "PS 35 Line for preconditioning of fixed RW" and IPR I00TSVD20004 Unit for bulk RW dosing into the* [first] *incinerator PS 06BSC*"[207]. Also, the 2019 annual report of JAVYS confirms direct relation between the

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203 See the technical report from the tests dated 27.02.2018, p. 4

204 The first incinerator is alpha-contaminated due to incineration of alpha-contaminated RW from the A1 NPP

205 The EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*"

206 Note that the presence of free (corrosive liquids) is mentioned also in the Italian national reports (see above). During the oral proceedings as part of the authorization procedure for the early commissioning of the second incinerator on 07.05.2021 the NRA SR stated that the free liquids are removed from the RW in Italy before shipment to Slovakia. The NRA SR permit no. 128/2018 also mentions sorbents without free liquids. The bound liquids are (or can be) extracted through the new pre-conditioning line at RW TCT.

207 In Slovak: *"V súlade s uzatvorenou zmluvou a na základe výsledkov skúšok so simulátom tohto odpadu, ktoré boli realizované v roku 2016 a 2017, boli predovšetkým pre potreby realizácie projektu spracovania vysýtených ra-sorbentov a ra-kalov z JE Caorso vybudované súvisiace technologické zariadenia v rámci IPR I00TSVD20006 "PS 35 Linka na predúpravu fixovaných RAO" a IPR I00TSVD20004 Uzol dávkovania sypkých RAO do spaľovne PS 06BSC""*

preconditioning line and the Caorso contract: "*A significant progress was made within the project covering the processing of saturated sorbents and sludges from the Italian Caorso NPP. Following active complex tests, the line providing the preconditioning of solidified sorbents prior to their incineration was commissioned. 49 tons of RW were imported for that purpose. Subsequently, more than 40 tons of saturated sorbents and sludges were processed. The project is implemented within a consortium with the Italian company Ansaldo New Clear.*"[208] By October 2020 JAVYS had already spent €20M on new installations which should also enable the treatment of the foreign waste[209]. The contracted construction costs of the second incinerator are €8,496,400 VAT excl.[210], we failed to obtain information on the construction costs of the preconditioning line.

The total value of the Caorso contract is €37M, of which JAVYS is to receive €26M with the balance going to another company from Italy[211]. According to JAVYS, if the contract were cancelled, the penalties could be as high as €10M[212]. Any efforts to terminate the Caorso contract, e.g., as part of the ongoing initiative to ban the foreign RW treatment, therefore face a significant obstacle represented by the corresponding huge financial penalties (see sec. "Legal framework and efforts to outlaw import and treatment of foreign RW in Slovakia" for further details). The details about the financial sanctions are, however, not publicly available (the relevant data is redacted in the version of the Caorso contract which was made public in November 2020).

Incineration of ion-exchange resins from Caorso in Sweden and Austria

Test volumes of ion-exchange resins in ureaformaldehyde from Caorso NPP were incinerated at Studsvik, Sweden, already in 1985-1986[213] (when Caorso NPP was still in operation). Even though Studsvik had experience with incineration of this RW, we were not able to find any records about further incineration of the ion-exchange resins in ureaformaldehyde from Caorso at Studsvik. In the meantime, other types of RW from Caorso NPP were treated at Studsvik, e.g., "*about 350 tons of low-level waste (oil, charcoal, polymer, carbon steel, technological waste)*" in the years 2011-2013[214];

In 1990s some RW (ion-exchange resins mixed with urea-formaldehyde) from Caorso NPP was incinerated at the Forschungszentrum Seibersdorf, Austria, where a similar incineration plant (from NUKEM) to the first incinerator in Jaslovské Bohunice has been in operation since 1980s[215]. We were not able to verify if the ion-exchange resins in ureaformaldehyde incinerated in Seibersdorf were identical to the ion-exchange resins in ureaformaldehyde contracted by JAVYS. According to [1]

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208 https://www.javys.sk/data/web/dokumenty/vyrocne-spravy/vs-javys-2019-eng.pdf, p. 37

209 https://e.dennikn.sk/2099264/ak-nespalime-taliansky-radioaktivny-odpad-hrozi-10-milionova-pokuta/

210 https://www.uvo.gov.sk/vyhladavanie-dokumentov/detail/838123

211 https://e.dennikn.sk/2099264/ak-nespalime-taliansky-radioaktivny-odpad-hrozi-10-milionova-pokuta/, https://www.world-nuclear-news.org/Articles/Second-phase-of-shipments-of-Italian-waste-to-Slov

212 https://e.dennikn.sk/2099264/ak-nespalime-taliansky-radioaktivny-odpad-hrozi-10-milionova-pokuta/

213 According to table I in A. Donato, A. Pace, G. Ricci: *Optimization and characterization of cement products incorporating ashes from radwaste incineration*, Feb 1989, the following volumes of RW from Caorso NPP were incinerated at Studsvik in 1985-1986:
1985: ion-exchange resins in urea-formaldehyde (3.088 t); ion-exchange resins in urea-formaldehyde (3.064 t) mixed with ordinary solid waste (0.681 t)
1986: ion-exchange resins (26.7 t); ion-exchange resins (3.2 t) mixed with ordinary solid waste (6.1 t)

214 See Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, 4th National Italian National Report (October 2014), p. 159: "*In the years 2011-2013 about 350 tons of low-level waste (oil, charcoal, polymer, carbon steel, technological waste) were treated by Studsvik in Sweden, producing 208 drums of final packages.*"

215 See Neubauer, J., "Incineration of ion exchange resins: Operational experience", In: Incineration and Thermal Treatment Technologies (Proc. Int. Conf. Irvine, CA, 1996), University of California, Irvine, CA (1996) and Neubauer, J. "Treatment and Conditioning of Low-and Intermediate Level Radioactive Waste at the Austrian Research Centres Seibersdorf (ARCS)". In: International Conference on Radioactive Waste Management and Environmental Remediation. American Society of Mechanical Engineers, 2001. p. 863-867. (https://asmedigitalcollection.asme.org/ICEM/proceedings-abstract/ICEM2001/80173/863/1083035)

development of the treatment procedure at Seibersdorf started in 1990, but first operational experience was reported only in 1994 (4 years delay). Many details of the procedure were improved during the following years. High sulphur content[216] of the resins (1 – 4.5 % in the dry sample) resulted in a very short time of operation of the HEPA-filters. The filters had to be changed after 2-4 days of operation (compared to 2-4 weeks of operational time during incineration of hospital waste) which significantly increased the quantity of secondary waste. This problem had not been solved by the time the report [1] was published (1996). By 1996 about 800 tons of ion-exchange resins had been incinerated, the total volume reached approx. 1600 m^3 [2]. After the Austrian public found out about this project (in 1997 at the latest)[217] and expressed fundamental refusal of it, Austrian government intervened and the incineration of the RW from Caorso was discontinued.

Current treatment capacities vs. Slovak needs

According to the (Slovak*) National Nuclear Fund for Decommissioning of Nuclear Installations and for the Management of Spent Nuclear fuel and Radioactive Waste* (NNF) the current capacity of RW treatment lines (state without the second incineration plant) is sufficient (with reserves) for treatment of RW from both operation and decommissioning of Slovak nuclear installations (see exact formulations below).

The *National policy for management of spent nuclear fuel and RW in the Slovak republic* and the National programme for the implementation of the National policy[218], which are supervised by NNF, state, for example:

1. *"At the beginning of 90s management of state corporation Slovenské elektrárne a. s.* (*Slovak powerplants Inc.) decided about building of Bohunice processing centre. In this time this centre, in which full pressure compactor, combustion chamber and cementing line is located becomes a part of RW TCT owned and operated by JAVYS. There is also a facility „Final processing of liquid radioactive wastes "in operation in Mochovce. Both facilities mentioned above have available capacity reserves; their capacity is not limiting factor in system approaches for handling of RW from operation and decommissioning of nuclear installations."*
2. *"The Strategy does not envisage using of other technologies of processing and conditioning of RW and other packing form than it is applicable in present. As long as new technologies for processing and conditioning or radioactive wastes will be introduced, reason would not be capacity but improving effectivity and safety of whole system for handling. An example is implemented technology improvement of Bohunice processing centre."*
3. *"Curved line of integrated dependency for need to dispose of packing forms of wastes in National disposal site of LLRW in Mochovce on time (from decommissioning of nuclear installations) shows the steepest increase from 2014 till 2026 (see Fig. No. 4). In this time expectations call for conditioning and subsequently depositing up to 460 packing forms of conditioned wastes per year. Comparison of this number with current production of packing*

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216 Sulphates in ashes produced by incineration of ion-exchange resins mixed with formaldehyde are mentioned also in A. Donato, A. Pace, G. Ricci: *Optimization and characterization of cement products incorporating ashes from radwaste incineration*, Feb 1989: "*In fact in the case of Nust 1, taking into account the origin of the ash,* ***the main salt anion is the sulphate****, coming from both the powdex resins and the catalyst used for the urea-formaldehyde polymerisation, while in the Nust 2 the sulphate concentration is strongly reduced by the presence of ash coming from the ordinary power plant solid wastes.*"

217 WirtschaftsBlatt, 26.08.1997, Nr. 452, S. A4 with the title *Atommüll: Regierung verzichtet auf 300 Mio. Das Verbrennen von Caorso-Abfall brächte Einnahmen für Seibersdorf* (in German)

218 The Slovak version is available at http://www.njf.sk/wp-content/uploads/2020/01/N%C3%A1vrh-Vn%C3%BAtro%C5%A1t%C3%A1tnej-politiky-a-Vn%C3%BAtro%C5%A1t%C3%A1tneho-programu-nakladania-s-VJP-a-RAO-v-SR.pdf

forms of wastes and with rate of their disposal, it may be stated that in system for handling of RW, technologies for handling before their disposal will take place have adequate capacity reserves."

The most recent annual report on implementation of the *National programme for management of SNF and RW* for 2019 (available only in Slovak) states:

"*Treatment of RW using technologies at RW TCT and Facility for final treatment of liquid RW in Mochovce in 2019 was carried out in accordance with the RW flows schedule. Capacity of the treatment lines was sufficient, ...*"[219]

Possible effects on the national radioactive inventory due to foreign RW treatment

The ratio of radioactivity retained in ash after incineration compared to radioactivity of the input RW shows significant monthly variations (between 6.39% - 105.61%, see Table 2 prepared on the basis of the monthly reports sent by JAVYS to the mayors of the 9 affected municipalities located near RW TCT) and its average value is approx. 60%, i.e., significantly below 100%. One may expect radioactive nuclides representing the residual radioactivity might be captured in the filtration system of the first incinerator (wet scrubbers followed by HEPA filters), on the inner surface of the incinerator or the chimney, during the pre-conditioning phase (take into account the approx. threefold mass reduction through pre-conditioning during the hot tests of incineration of the RW from Caorso) and so on. As a result, one may expect that a fraction of the foreign nuclides might remain in Slovakia and their absence is compensated by addition of Slovak RW[220] in order to balance the radioactivity level of the incoming foreign RW and the reexported products after treatment and conditioning (ashes) as required by §21 sec. 12b of the Atomic Act[221]. For example, based on the data from the similar ("twin") incinerator in Seibersdorf, Austria, we expect that the wastewater from wet filtration of flue gases from RW incineration can contain significant share of foreign radionuclides.

According to the 7th national report of Austria on the implementation of the obligations of the Joint convention on the safety of spent fuel and on the safety of radioactive waste Management[222] the wastewater from wet filtration of flue gases at the incinerator in Seibersdorf e.g., contains 20% of ^{137}Cs and ^{241}Am:

"*It was found that ^{137}Cs and ^{241}Am are contained in the ashes to 80 %, and 20 % are carried to the wastewater, where they are removed by the routinely run treatment process (co-precipitation and filtration). Radioisotopes of Iodine are removed to nearly 100 % in the scrubber. None of these nuclides are detected in the off gases.*

Tritium is found to 80 % in the wastewater, the rest in the off gases. ^{14}C is emitted with the off gases."

At the same time the wastewater (that might contain significant share of foreign radionuclides) ends up permanently in the national RW repository in Mochovce[223]. According to NRA SR[224] "*radioactivity*

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[219] Original Slovak version: "*Spracovávanie RAO na technológiách TSÚ RAO a FS KRAO sa realizovalo v roku 2019 podľa plánu tokov RAO. Kapacity spracovateľských liniek boli dostatočné, ...*"

[220] The Minister of Economy R. Sulík stated during a joint press conference with the Director General of JAVYS on 12.02.2021 (available at https://www.ta3.com/clanok/193834/tb-ministra-hospodarstva-r-sulika-o-spalovani-jadroveho-odpadu) that "*not a single gram of foreign radioactivity remains in Slovakia*".

[221] See https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2004/541/20191001#paragraf-21.odsek-12.pismeno-b

[222] https://www.bmk.gv.at/dam/jcr:f9e7a291-d810-4000-8558-967aa8b18114/Austria_7th_National_Report.pdf

[223] In the response to the request of information NRA SR confirmed in the letter no. 7622/2020 dated 05.11.2020 that "*the waste water from wet flue gas scrubbing is used for cement grout of the fibre-concrete containers*" [in the national RW repository in Mochovce]

[224] Response to the request of information, the letter no. 7622/2020 dated 05.11.2020

contained in the wet scrubbing water is subject to balancing of imported and exported radioactivity". However, we failed to obtain further details about how this radioactivity balance is maintained.

Tracking down where all foreign radionuclides might end up could be highly relevant. In order to analyse the fraction of foreign radionuclides that remain in Slovakia and how these missing radionuclides are replaced by Slovak radionuclides we requested, mostly unsuccessfully, data about radioactivity streams during RW preconditioning, incineration and post-treatment (e.g., how much radioactivity is carried to the wastewater) and the production of secondary RW. These data are crucial in order to analyse the impact of the foreign RW treatment, especially by incineration. However, when requested, the NRA SR could not provide (did not have) detailed data about activity streams in the treatment process. The data cannot be obtained from JAVYS either, since it claims not to be a liable entity according to the Slovak Freedom of Information Act.

Guarantee that the radioactive nuclide composition of the input RW is identical to that of the re-exported ash is therefore missing. Another effect on the Slovak radioactive inventory which is worth pointing out is the RW produced by decommissioning of the RW treatment technologies in the (far) future. Management of this RW will be the sole responsibility of the Slovak republic, not foreign countries which participated or are expected to participate in the use of these facilities. According to the National policy and programme for management of SNF and RW from 2015 the existing treatment facilities (without the preconditioning line and the second incinerator at that time) offer sufficient capacities (with reserves) for management of RW originating from Slovakia (see sec "*Current treatment capacities vs. Slovak needs*" for details). Thus, one might assume that the RW from decommissioning of the second incineration plant and the preconditioning line might have been eliminated completely if foreign RW is not incinerated in Slovakia and the second incineration plant is not put into operation.

Legal framework and efforts to outlaw import and treatment of foreign RW in Slovakia

According to §21 sec. 12b of the Atomic Act[225] NRA SR can authorize import of foreign RW "*for the purpose of its treatment or conditioning in the territory of the Slovak Republic, if the export of material with aliquot activity is contractually secured and authorized by NRA SR*", i.e., the radioactivity level of the imported RW must equal the radioactivity level of the reexported products after treatment and conditioning.

During recent years there have been efforts to ban incineration/treatment of foreign RW. Chronologically these activities may be divided into two phases which took place from 2017 to February 2018 and from February 2021 to October 2021, respectively.

Phase I (2017- February 2018)

In 2017-2018 the Radiation Protection Act was being amended (transposition of the Council Directive 2013/59/Euratom to the Slovak legislation)[226]. According to the Public Health Authority of the Slovak republic, Section of radiation protection (PHA SR), during the intra-departmental commenting procedure (within the Ministry of Health of the Slovak republic[227]) PHA SR proposed to ban incineration of foreign RW in the Radiation Protection Act and justified this proposal by the ALARA principle ("*to ensure the primary optimization of radiation protection, without the use of secondary technical or organizational measures so that the amount and activity of RW is kept as low as reasonably achievable*"). The regulation is said to have been omitted from the final draft of the Radiation Protection Act due to a conflict

[225] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2004/541/20191001#paragraf-21.odsek-12.pismeno-b

[226] https://www.slov-lex.sk/legislativne-procesy/-/SK/LP/2017/564

[227] At that time (in 2017-2018) the Minister of Health was Mr. Tomáš Drucker who served as the chairman of the supervisory board of JAVYS between 2010-2012.

with competence (given by the Atomic Act) of the NRA SR to issue permits to import, treat and condition foreign RW[228].

During the inter-departmental commenting procedure in August 2017 the Confederation of trade unions of the Slovak republic (CTU SR) also proposed prohibition of foreign RW incineration through an additional section no. 7 of §34 "Prohibited activities"[229]:

"(7) Radioactive waste, which was not produced in the Slovak republic, is prohibited to

a) be incinerated

b) be treated or conditioned by a procedure that could result in increased radiation burden of residents or environment

Reasoning:

By adding sec. 7 of §34 we want to achieve that large amount of RW is not imported into Slovakia and obtaining a permit for import of such waste is not easy. Within the act no. 541/2004 on the Peaceful use of nuclear energy (Atomic Act) the permission for import of RW focuses more on meeting the time limits, providing application requirements – the administrative point of view, but what are the terms and conditions specified for protection? We are exposed to risk that other EU member states will change Slovakia to their waste plant. In this case protection of the environment of the Slovak republic and the health of our residents must be prioritized before economic interests. We cannot let Italians, Germans, French, … and other states protect their territory at the expense of Slovaks and Slovakia ..."

After the attempts of both PHA SR and CTU SR failed, Mr. Marek Krajčí (then an opposition member of parliament (representing the party OĽaNO) who had served as Minister of Health of the Slovak republic from March 2020 to March 2021) once again proposed to amend a formulation identical to that of CTU SR during the law adoption process in the Slovak parliament on 06.02.2018. Almost all MPs from the parties OĽaNO, Sme Rodina and SaS (then in opposition, now in the government) voted for this proposal[230], but once again, it was rejected by the coalition of government (in 2018) parties Smer-SD, SNS and Most-Híd and the Radiation Protection Act was adopted in a form that allows incineration and treatment of foreign RW.

The reasoning of Mr. Marek Krajčí's proposal was the following[231]:

"The objective of the proposal is the protection of environment and health of residents against potential contamination of Slovakia by radioactive waste.

Although the import of RW or its transportation through the territory of Slovakia is regulated by the Atomic act; management, treatment and further conditioning of this waste should be regulated by the Radiation Protection Act. Therefore, it must be guaranteed that the act regulates not only the administrative procedure but also RW management conditions for protection of environment and health of residents similarly to other EU member states. In this case economic interests must be put aside.

Also, it is stated in the preamble of the Council directive 2013/59/EURATOM which sets the elementary safety standards for protection against ionizing radiation risks … and which is the reason for adoption of the new Radiation Protection Act that:

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228 a written statement of PHA SR sent to the journalists investigating the foreign RW treatment at RW TCT in June 2020. The resulting videoreportage was broadcasted on 15.06.2020 (part of "Reportéri RTVS" series) and is available at https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu

229 See https://www.slov-lex.sk/legislativne-procesy/-/SK/LP/2017/564/pripomienky/COO-2145-1000-3-2110863

230 See https://www.nrsr.sk/web/Default.aspx?sid=schodze/hlasovanie/hlasklub&ID=39780 and https://www.nrsr.sk/web/Default.aspx?sid=schodze/hlasovanie/hlasklub&ID=39781

231 See https://www.nrsr.sk/web/Dynamic/DocumentPreview.aspx?DocID=448553 and https://www.nrsr.sk/web/Dynamic/DocumentPreview.aspx?DocID=448554

"As this Directive provides for minimum rules, Member States should be free to adopt or maintain more stringent measures in the subject-matter covered by this Directive, without prejudice to the free movement of goods and services in the internal market ..."

The regulation proposed in this proposal represents a more stringent measure allowed by the Council directive. "

Prohibition of foreign RW treatment is in force in other EU member states, e. g. Lithuania and Bulgaria.[232]

On 07.02.2018 Mr. Igor Matovič (then an opposition member of parliament (OĽaNO) who had served as Prime Minister from March 2020 to March 2021) and Mr. Marek Krajčí held a press conference[233] about their failed attempt to ban incineration of foreign RW by law and about incineration of RW from the Italian NPP Caorso, which drew some, but limited, public attention. A related online article was published on the same day[234]. The headline of the article is self-explanatory - translation into English: "*It seems like Slovakia has ambitions to become the incineration plant for RW from all over Europe*". The article text contains (among others) the following statements:

"*According to the Atomic Act, permissions to transport RW are issued by NRA SR and PHA SR. Since the JAVYS company did not obtain permissions from these regulatory authorities, it applied for the permission at the Ministry of Transportation and Construction of the Slovak republic, and, therefore, implemented also a competence for this ministry within this (Radiation Protection) act by a suggestion and by Minister Drucker. It is a rarity, at least in Europe, that a Ministry of Transportation and Construction issues permissions of this kind. Radiation protection within the RW framework shall be regulated by PHA SR*".

"*Fourteen European countries exploit nuclear energy, but only four of them have their own incineration plants, which they, nevertheless, use to incinerate their own waste only. Only Sweden was willing to treat Czech RW. Now this waste has been treated by us for 3 years. It seems like Slovakia has ambitions to become the incineration plant for RW from all over Europe.*"

Shortly after the press conference (in 2018) more than 3000 Slovak citizens expressed their position against import and treatment of foreign RW in Slovakia by signing a petition[235].

The possibility of RW TCT step-by-step becoming an international treatment centre for RW from all over Europe may be also supported by the official statement of JAVYS from 12.12.2019[236]:

"*The concept of regional treatment (i.e., treatment of RW need not be done in the country of origin) has already become a standard on the European level. We repeat once again, that the stabilized form of the RW after treatment and conditioning must be returned to the country of origin.*

This trend is supported by the fact, that there are 15 countries in Europe which have NPP (Belgium, Czech Republic, Finland, France, Germany, Hungary, The Netherlands, Romania, Slovenia, Slovakia, Spain, Sweden and UK), but only 5 countries have RW treatment centres.

No new treatment centres will be built in the EU."

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232 https://www.eca.europa.eu/Lists/ECADocuments/SR16_22/SR_NUCLEAR_DECOMMISSIONING_SK.pdf, p. 33

233 Video of the press conference is available at https://www.youtube.com/watch?v=jLZ8rsPuxbE (Longer version, 9:17 min) and https://www.youtube.com/watch?v=scYwq6sX_OA (Shorter version 2:22 min).

234 http://www.obycajniludia.sk/aktualita/marek-krajci-zda-sa-ze-slovensko-ma-ambicie-stat-sa-spalovnou-radioaktivneho-odpadu-europy/

235 www.stopjadrovemuodpadu.sk

236 original Slovak version is available at: https://www.topky.sk/cl/10/1845529/Obce-pri-bohunickej-atomke-su-proti-ukladaniu-zahranicneho-radioaktivneho-odpadu

Phase II (February 2021 – present)

The elections in February 2020 significantly changed the political situation in Slovakia. The party OĽaNO won the elections, the former opposition parties took power and Mr. Matovič and Mr. Krajčí became the Prime Minister and the Minister of Health, respectively. Also, in comparison to the past, the treatment and especially incineration of foreign RW has gained more significant and repeated media attention since the middle of 2020[237]. The initiative to ban incineration of foreign RW renewed, this time institutionally covered mainly by the new leading figures of the Ministry of Environment. The original ambition of the new Minister of Environment Mr. Ján Budaj, presented in February 2021, was to ban foreign RW incineration by a constitutional law[238]. In comparison to an ordinary law the constitutional form would represent a much stronger guarantee that the measure remains in force long-term[239]. Two government parties SaS[240] and Sme rodina supported the prohibition of foreign RW incineration in February 2018 (see the previous section) but changed their position in the meantime. These parties therefore explicitly rejected the constitutional form and agreed only to the ban via ordinary law on condition that the restriction would not apply to the already signed contracts arguing among others by huge financial penalties in case the Caorso contract is terminated and that the constitutional ban would be "*against the interests of Slovakia, expertise and technological capacities*"[241].

A corresponding compromise legislative bill reflecting these demands has been submitted in the Slovak parliament on 28 May 2021[242].The original wording of the bill was formally proposed by four MPs from all the four different political parties of the current Slovak government coalition. The MPs used their legal right to directly propose amendment of laws, in this case amendments of the Act no. 17/1992 Coll. on the Environment and the Act no. 87/2018 Coll. on Radiation Protection. The key part of the bill was, in its original wording, aimed at prohibition of import of RW and/or spent nuclear fuel that was not produced on the Slovak territory as well as the prohibition of its storage, treatment, conditioning, disposal, manipulation and other ways of management in a way that could lead to an increase in the radiation exposure of the population or the environment.

However, on 24 September 2021, two from the MPs proposed a significant amendment of their own original wording of this bill proposal, which changed its tenor significantly. The original proposal was, at an advanced stage of law approval procedure in the Parliament, amended only to prohibition of (future contracts to) "*import RW that was not produced on Slovak territory for the purpose of incineration*", i.e. very significantly limited. Subsequently, on 6 October 2021, the Slovak Parliament approved the bill in

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237 See e.g., https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu
https://e.dennikn.sk/2354816/spalovanie-odpadu-z-cudzich-jadroviek-ziskalo-suhlas-no-budaj-ho-chce-zakazat-zakonom/
https://e.dennikn.sk/2245425/sulik-a-kollar-ustupili-budajovi-cudzi-radioaktivny-odpad-sa-spalovat-nebude/
https://e.dennikn.sk/2099264/ak-nespalime-taliansky-radioaktivny-odpad-hrozi-10-milionova-pokuta/
https://e.dennikn.sk/2078275/spalovat-cudzi-radioaktivny-odpad-kollar-a-sulik-su-za-zvysok-koalicie-proti/
https://e.dennikn.sk/2066628/slovensko-spaluje-cudzi-radioaktivny-odpad-nikto-nevie-vysvetlit-preco-a-vlada-to-nechava-tak/
https://www.aktuality.sk/clanok/832250/sulik-kryje-biznis-s-podobnou-pointou-aku-ma-matovicov-nakup-testov/
https://www.aktuality.sk/clanok/828860/sulik-nechal-nominanta-smeru-na-mieste-kde-ludia-zarabali-viac-ako-premier-matovic-mlci/
https://www.aktuality.sk/clanok/826902/v-ktorom-okrese-zakopu-radioaktivny-odpad-aktivisti-upozornuju-na-utajovanie/
https://www.aktuality.sk/clanok/823992/budaj-sa-pustil-do-pellegriniho-za-jadro-co-bude-s-odpadom-z-talianska-nevedno/
https://www.aktuality.sk/clanok/813522/stali-sa-zo-slovakov-pokusne-mysi-olano-prudko-otocilo/
https://spectator.sme.sk/c/22604566/environment-ministry-wants-constitutional-ban-on-incineration-of-foreign-radioactive-waste.html

238 https://www.minzp.sk/faq/ako-zakazat-spalovanie-zahranicneho-radioaktivneho-odpadu.html
https://www.enviroportal.sk/clanok/mzp-spalovanie-zahranicneho-radioaktivneho-odpadu-by-sa-mohlo-v-sr-zakazat

239 https://www.minzp.sk/faq/preco-je-dolezite-ustavnym-zakonom-zakazat-spalovanie-radioaktivneho-odpadu-zo-zahranicia.html

240 The leader of the party SaS, Mr. Richard Sulík, serves as the acting Minister of Economy

241 https://www.enviroportal.sk/clanok/mzp-spalovanie-zahranicneho-radioaktivneho-odpadu-by-sa-mohlo-v-sr-zakazat
https://www.minzp.sk/spravy/stanovisko-ministerstva-zivotneho-prostredia-sr-k-tlacovej-besede-richarda-sulika-spalovani-zahranicneho-radioaktivneho-odpadu-slovensku.html

242 https://www.nrsr.sk/web/Default.aspx?sid=zakony/zakon&MasterID=8287

the significantly changed/limited form.[243] After the president of the Slovak republic signed the bill on 25 October 2021, it is coming into effect on 1 January 2022. The already signed contracts for foreign RW incineration will not be affected by the bill. This concerns 617 m^3 and 865 tons of RW from Italy and 21.7 t from Germany, i.e. amounts that significantly exceed the volumes of incinerated domestic RW (about 60 – 85 tons annually during the period 2016-2020). Thus, even if the proposed increase of treatment limits of RW TCT is approved, one might expect that, in order to complete the contracts, while taking into account also the volume of the domestic RW that is to be incinerated (see above), tens or hundreds of tons of foreign RW will still be incinerated in Slovakia annually for the next few years after the bill comes into force on 1 January 2022.

Corresponding EIA processes

In this section we provide further details about the EIA processes that have already been briefly described in the section "Historical context". The RW TCT has been a subject of multiple EIA processes, supervised by the Ministry of Environment of the Slovak republic. Those listed below seem to be the most relevant from the "foreign RW treatment" perspective[244]:

I. *"RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location"*[245].

Process duration: December 2012 – November 2014 (full EIA process including a project phase, an EIA report, a public hearing and concluded by the Environmental Impact Statement (EIS) no. 2764/2019-1.7/zg-R dated 14.11.2014)

The objective was to perform **joint** assessment of the already existing and operating set of technologies included in the RW TCT, no new technologies were added at that time.

I.1. *"Installation and operation of a facility for preconditioning of solid RW at SO 44/20"*[246]

Not an individual EIA process, but *an announcement about change of planned activity "RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location*", thus the number I.1

Process duration: October 2017 – September 2018 (reduced EIA process consisting of the project phase only, concluded by ruling no. 483/2018-1.7/hp-R dated 06.07.2018)

The objective was the installation of a facility for preconditioning of RW before its incineration.

I.2. *"Optimisation of incineration capacities of the nuclear installation RW Treatment and Conditioning Technologies"*[247].

Not an individual EIA process, but an announcement about change of planned activity "RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location", thus the number I.2

Process duration: September 2018 – May 2019 (reduced EIA process consisting of the project phase only, concluded by ruling no. 2764/2019-1.7/zg-R dated 22.02.2019)

The sole objective was the construction of the second incineration plant (PS 45).

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243 http://www.nuclear-transparency-watch.eu/activities/radioactive-waste-management/slovak-parliament-approved-a-bill-to-ban-future-contracts-for-incineration-of-foreign-radioactive-waste-according-to-the-slovak-ntw-members-some-concerns-still-remain.html

244 Documents for most of the EIA processes related to RW TCT or JAVYS (dating back to approx. 2010) are available at https://www.enviroportal.sk/sk/eia?search[ico]=35946024

245 Documents avalable at https://www.enviroportal.sk/sk/eia/detail/technologie-pre-spracovanie-upravu-radioaktivnych-odpadov-javys-v-loka

246 Documents avalable at https://www.enviroportal.sk/sk/eia/detail/instalacia-prevadzka-zariadenia-na-predupravu-pevnych-rao-v-so-44-20

247 Documents avalable at https://www.enviroportal.sk/sk/eia/detail/optimalizacia-kapacit-spalovania-jz-tsu-rao

II. *"Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice"*[248]

Process duration: ongoing process - since March 2018 (full EIA process including a project phase, an EIA report, public hearings and concluded by the EIS. The EIS was issued on 24.03.2021, but has not entered into force yet due to appeals lodged.).

The main objective is to increase the legal limits of the RW treatment at RW TCT - from 8343 to 12663 tons per year in total (incineration itself from 240 to 480 tons per year).

Please note that EIA process II. started before I.2 (for further explanation of the time sequentiality and connections between the processes II, I.1 and I.2, please see below).

EIA process I. "RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location"

This EIA process started in December 2012. The objective was to perform joint assessment of the already existing and operating set of technologies. Although there had been EIA processes for some particular treatment technologies before, this was the first time when the set of technologies (RW TCT) was assessed together (according to the EIA Act No. 24/2006 Coll as amended). No new technologies were added at that time, the assessed set of technologies had already been constructed and commissioned at the time the EIA process started[249]. According to the section "*II.2. Purpose*" of the EIA report the purpose of the proposed activity is:

"These technologies serve for the processing and treatment of low and medium activity RW produced during the decommissioning of A1 NPP, which is currently at stage II, and during the decommissioning of the V1 NPP (currently at stage I), as well as for RW produced by the NPP facilities and by various other fields of human activities, such as research, medicine, etc. (institutional radioactive waste)."[250]

The objective of the EIA process and also the origins of the RW TCT are explained in more detail in the introduction of the plan of this EIA process[251] that states:

"The technology for RW processing and treatment at the Jaslovské Bohunice location was created and completed gradually, and in some cases initially comprised experimental facilities.

Some parts of the technology were designed to ensure the process of treatment of RW produced during the decommissioning of A1 nuclear power plant (the non-renewal of operation of the crashed power plant was decided by Resolution of the Government of CSSR No. 135 of 1979), which is currently at stage II. The beginnings of the process of approval of the principal facilities date back to the period prior to the validity of Act of NC SR No. 127/1994 Coll. on Environmental Impacts Assessment, e.g., Bohunice RW Treatment Centre in 1993, fragmentation and decontamination line in 1987, etc.

Throughout their existence, the compound of operating units and parts of technology, as well as the operating units and parts of technology as such have gradually developed or have been adapted to the required purposes and demands, as a result of which many of them have gone through a series of changes and adjustments….

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248 Documents avalable at https://www.enviroportal.sk/sk/eia/detail/optimalizacia-spracovatelskych-kapacit-technologii-pre-spracovanie-upr

249 Mr. Jan Haverkamp in his statement from 22.03.2013 (prepared for Greenpeace) objected against this EIA process, reasoning that since the assessed installations had already been commissioned, the public was not provided for early participation, when all options are open and effective public participation can take place (see Article 6(4) of the Aarhus convention). Additional objections include e.g., assessment of treatment technologies independently of the subsequent RW storage; missing assessment of future decommissioning or accidents (only normal operation is described); ...

250 Available at https://www.enviroportal.sk/eia/dokument/208447

251 The plan is available at https://www.enviroportal.sk/eia/dokument/156826

In spite of the fact that some parts of the RW processing and treatment technology were assessed under the process of assessment of stage I of the A1 nuclear facility implementation and of the condition after completion of stage I, some parts of the technology and workstations did not have the current form at that time, or it was not possible to assume their precise form at that time, and hence to make a complete assessment of their environmental impacts.

Since, as has already been mentioned, the current form of the given technology compound as such is optimised and stabilised, the proponent, upon consideration and consultations with the competent and approving authorities, has initiated a joint process of assessment of the proposed activity´s environmental impacts and impacts on the population."

Based on the ESPOO convention, the neighbouring countries (Austria, Hungary, Czech Republic, Poland and Ukraine) were informed about the EIA process. Austria decided not to participate. There were 9 municipalities (villages) with the "affected" status. None of them sent negative opinion to the project. The association of the municipalities in the region of the Bohunice NPP sent approving opinion (with minor objections). No other members of the Slovak public reacted to the EIA report.

The public hearing of the EIA report was held on 3rd March 2014 at 16:00, however, only mayors of the affected municipalities (not ordinary citizens) raised questions during the discussion. Among others, the mayors asked[252]:

Mr. Martin Červenka, the mayor of Ratkovce: *"Will the RW treated on the treatment lines come only from NPP V1 and other nuclear installations from the Jaslovské Bohunice location or will it come from other locations, too?"*[253]

Mr. Miroslav Božik[254], JAVYS: "*The set of treatment lines that are included in the nuclear installation RW TCT, was constructed particularly for decommissioning of the A1 NPP. As the decommissioning process progressed, corresponding technologies, that allowed for treatment of RW from decommissioning and their processing into FCC[255], must have been constructed. The capacity was designed in such a way, so that it was possible to treat RW from operation of NPP V1, V2 and Mochovce and now also from decommissioning of nuclear installations."*[256]

Mr. Marek Hrčka, the mayor of Dolné Dubové: "*Martin Červenka has already asked an interesting question regarding the treatment and conditioning of RW also from outside the Jaslovské Bohunice location. Are you considering, for example, import of RW from Mochovce, too, and if yes, what will be the volume?"*[257]

Mr. Miroslav Božik, JAVYS: "*At the moment we treat RW from operation of the Mochovce NPP (1st and 2nd reactor block) and also from operation of the nuclear installation Liquid RW final treatment facility (LRW FTF) in Mochovce. Regarding other companies, of course, if there is a free capacity of the treatment lines, we seek to conclude contracts for services for other companies interested in treatment*

252 See pages 27-29 of the EIS (in Slovak only) available at https://www.enviroportal.sk/eia/dokument/221746

253 (Original in Slovak): *"Budú na spracovateľských linkách spracovávané odpady len z JE V1 a ďalších jadrových zariadení v lokalite Jaslovské Bohunice alebo aj iných lokalít?"*

254 A member of the Board of Directors of JAVYS and A1 Decommissioning and RW and SNF Management Division Director (since 2008)

255 Fibre-concrete container (in Slovak VBK = vlákno-betónový kontajner).

256 (Original in Slovak): *"Súbor technologických liniek, ktoré sú zahrnuté do jadrového zariadenia TSÚ RAO, bol budovaný predovšetkým pre vyraďovanie jadrovej elektrárne A1. Ako prebiehalo vyraďovanie, museli byť dobudované príslušné technológie, ktoré boli schopné spracovať odpady z vyraďovania a upravovať ich do VBK. Kapacita bola navrhnutá tak, aby bolo možné spracovávať rádioaktívne odpady z prevádzky JE V1, V2, Mochoviec a v súčasnosti aj z vyraďovania jadrových zariadení."*

257 (Original in Slovak): "*Martin Červenka už položil zaujímavú otázku, týkajúcu sa spracovania a úpravy RAO aj mimo lokality Jaslovské Bohunice. Bude sa napríklad uvažovať aj o tom, či sa bude dovážať RAO aj z Mochoviec a ak áno, v akom množstve?*"

and conditioning of RW. It would be an opportunity that would have a significantly positive effect on the operation technology from the perspective of capacity usage."[258]

Mr. Ladislav Boháčik, mayor of Pečeňady: "*For many years, there has been a controversy about commercial use and institutional waste, will this site not become an unlimited storage within the Slovak Republic? Therefore, two mayors asked questions on this issue.*"[259]

Mr. Miroslav Božik, JAVYS: "*Institutional waste that will be treated and conditioned into a form that can be stored at the National RW repository in Mochovce can only come from the territory of the Slovak Republic.*"[260]

Please note that the public hearing took place in March 2014, i.e. in a situation when JAVYS had already incinerated 8.8 tons of foreign RW in 2013 (from Czech republic, see table 1). Also, as stated in the annual report of JAVYS from 2013[261], in 2013 JAVYS concluded a contract with the Czech company ČEZ (incineration of 39,64 t of RW permitted by ruling no. 920/2013 issued on 31.10.2013 by NRA SR); started a joint project with Italian company NUCLECO S.p.A. (treatment of institutional RW), actively participated in competitive tenders for treatment of foreign RW, namely from Romania, Czech Republic, Italy and Ukraine.

Based on the public hearing recording, one might conclude the following:

1. The mayors were not aware of foreign RW treatment in March 2014;
2. Even though the mayors directly and indirectly asked about the possibility of treatment of RW from locations other than J. Bohunice, they were not informed about foreign RW treatment (e.g., incineration) that had already been carried out or that had already been contracted;
3. Although it was admitted that contracts for RW treatment and conditioning were being seeked, it was not directly mentioned that the RW should come from abroad. The already carried out or contracted foreign RW treatment was not mentioned and the statement was formulated in conditional way, as if the treatment of RW for other companies (aside from RW from Mochovce NPP) was not a reality yet.

In addition, neither the plan of the proposed activity nor the EIA report directly mentions foreign RW treatment at any point. According to Mr. Gilbert Liška, mayor of V. Kostoľany (one of the 9 affected municipalities) continuously since at least 2006 who participated in the public hearing in March 2014, too: "*we found out about it* [foreign RW treatment] *in either 2018 or 2019, I am not sure.*"[262] (see section I.2. "Optimisation of incineration capacities of the nuclear installation RW Treatment and Conditioning Technologies" for additional evidence indicating that mayors of the affected municipalities might not have been aware of the ongoing foreign RW incineration until about 2018).

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258 (Original in Slovak): "*V súčasnosti spracovávame RAO z prevádzky JE Mochovce (prvého a druhého bloku) a tiež z prevádzky JZ FS KRAO. Čo sa týka iných spoločností, samozrejme, ak máme voľnú kapacitu technologických liniek, snažíme sa získať nejaké kontrakty na služby pre iných záujemcov o spracovanie a úpravu RAO. Bola by to príležitosť, ktorá by významne pozitívne ovplyvnila technológiu prevádzky z pohľadu využitia jej kapacít*"

259 (Original in Slovak): "*Dlhé roky je tu polemika o komerčnom využití a o inštitucionálnych odpadoch, či sa v rámci Slovenskej republiky nestane z tejto lokality neobmedzené skladisko? Preto boli aj položené otázky dvoch starostov k tejto problematike.*"

260 (Original in Slovak): "*Inštitucionálne odpady, ktoré budú spracované a upravené do formy uložiteľnej na Republikovom úložisku RAO v Mochovciach môžu pochádzať len z územia Slovenskej republiky.*"

261 Available at (p. 3 and 18): https://www.javys.sk/data/web/dokumenty/vyrocne-spravy/vs-javys-2013-eng.pdf

262 statement in the investigative videoreportage broadcasted on 15.06.2020 (part of "Reportéri RTVS" series) available at https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu (time 03:55-04:03):

According to the written records, the foreign RW treatment at RW TCT was directly mentioned for the first time in the expert judgment to the EIA report[263]. The comment no. 5 of the expert[264] states[265]:

"*The purpose of the proposed activity (e.g., sec. II.2 Purpose[266], p. 11) is not completely described. In fact, it cannot be found even once in the EIA report in the correct and complete form that would reflect the reality and the precept of NRA SR no. 30/2012[267]:*

"The technologies serve the treatment and conditioning of very low, low and medium level radioactive waste (RW) *generated during the decommissioning of the NPP A1 (currently in the II. decommissioning phase), decommissioning of the NPP V1 (currently in the I. decommissioning phase), RW originating from operation of nuclear facilities in the Slovak Republic, institutional radioactive waste (IRW) and captured radioactive waste (CRW) and the treatment of radioactive waste from foreign entities with the subsequent return of processed RW."*

In this judgment and in the draft of the EIS, we use the purpose of the proposed activity defined this way."

Please compare the purpose of the proposed activity defined by the expert himself (unilaterally?) to the purpose described in the plan or the EIA report, where foreign RW treatment is not directly mentioned. One might expect that the expert was aware of the foreign RW treatment (carried out, contracted or planned). The expert judgment was elaborated in June 2014, i.e., after the public hearing took place and institutions, municipalities or public sent their opinions on the EIA report. The expert judgment is usually not sent to the EIA process participants, so the municipalities might not have even noticed the "foreign RW treatment" in the comment no. 5 before the EIS was issued in the next stage and in the EIS, too.

Finally, on 14.11.2014 the EIS was issued by the Ministry of Environment of the Slovak republic (ruling no. 2276/2014-3,4/hp). It states the following in the section "recommended variant":

"*The proposed activity represents creation of new facilities and modification of existing facilities within the collection of technologies for RW treatment and conditioning of the company JAVYS*

These technologies serve the treatment and conditioning of very low, low and medium level RW:

- *generated during decommissioning of the A1 NPP (currently in the II. decommissioning phase);*
- *generated during decommissioning of the V1 NPP (currently in the I. decommissioning phase);*
- *originating from existing operating nuclear installations in the Slovak republic;*
- *institutional RW (IRW) and captured RW (CRW)."*

This formulation strongly resembles the purpose of the planned activity from the comment no. 5 of the expert judgment, but misses any mention about foreign RW treatment. Since, according to the expert judgment, the purpose list of the proposed activity in the draft of the EIS included also the fifth bullet "*the treatment of radioactive waste from foreign entities with the subsequent return of processed RW*", one

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263 Elaborated by Ing. Igor Matejovič, Csc. in June 2014 (selected parts are included in the EIS)

264 See p. 53 of the EIS.

265 (Original in Slovak): "*Účel navrhovanej činnosti (napr. str. 11 II. Účel) nie je úplne popísaný. Prakticky ani raz sa nenachádza v správe o hodnotení v správnej a úplnej podobe, ktorá by odrážala skutočnosť a vyhlášku ÚJD SR č. 30/2012: „Technológie slúžia na spracovanie a úpravu veľmi nízko, nízko a strednoaktívnych rádioaktívnych odpadov (RAO) vznikajúcich počas vyraďovania JE A1 (v súčasnosti v II. etape vyraďovania), vyraďovania JE V1 (v súčasnosti v I. etape vyraďovania), RAO pochádzajúcich z prevádzky jadrových zariadení v Slovenskej republike, inštitucionálnych rádioaktívnych odpadov (IRAO) a zachytených rádioaktívnych odpadov (ZRAM) a spracovanie rádioaktívnych odpadov od zahraničných subjektov s následným návratom spracovaného RAO. "*
V tomto posudku a v návrhu záverečného stanoviska používame takto definovaný účel činnosti."

266 See the beginning of this section

267 The version of NRA SR precept no. 20/2013 is available (in Slovak) at https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2012/30/20120301.html
However, it is not clear to the author of this report how exactly the precept affected the formulation used in the comment no. 5 of the expert judgment.

might expect that the "*foreign RW treatment*" purpose might have been intentionally struck out from the draft, probably by the Ministry of Environment. Assuming this, the interpretation of missing "*foreign RW treatment*" in the purpose list of the proposed activity in the final EIS as "it is not explicitly forbidden by the EIS and therefore does not violate the EIS" might be considered as at least questionable. Also, foreign RW treatment is not mentioned neither in the plan, nor the EIA report and appears only once in the EIS (within list of comments of the expert judgment). Since it does not appear in the most relevant part of the EIS, it sounds plausible that the municipalities might not have been aware of the ongoing foreign RW incineration until about 2018. Also, Austria might have decided to participate in the EIA process I. if foreign RW treatment were mentioned in the plan of the proposed activity.

The legal state (e. g. the limit 240t per year of RW incineration) introduced by the EIS (no. 2276/2014-3,4/hp) from this EIA process has held to these days (up to modifications represented by the EIA processes I.1 and I.2 which, however, do not affect the list of purposes of the recommended variant). The EIS no. 2276/2014-3,4/hp will expire after the EIS from the ongoing EIA process II. "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" comes into force. Due to missing "foreign RW treatment" in the list of purposes of the EIS no. 2276/2014-3,4/hp, one therefore might ask if e.g., incineration of approx. 250 tons of foreign RW between 2015-2019 violates this EIS or not. In March 2021 the Slovak Ministry of Environment stated[268] that "*the ongoing foreign RW treatment (incineration) is inconsistent*" with this EIS.

EIA process I.1 *"Installation and operation of a facility for preconditioning of solid RW at SO 44/20"*

The announcement about change of planned activity did not explicitly mention that the preconditioning line was constructed mainly for the purpose of treatment of the RW from Caorso (as confirmed in the report from the hot tests of incineration of the RW from Caorso at the first incinerator, see sec. "*The Caorso contract – 865 tons of radioactive ion exchange resins in ureaformaldehyde and sludges*").

EIA process I.2 *"Optimisation of incineration capacities of the nuclear installation RW Treatment and Conditioning Technologies"*

Run as an announcement about change of planned activity *"RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location"* (EIA process I.). The process ended in the plan phase. The sole objective was the construction of the second incineration plant (PS 45) while the limit 240 t RW per year set by the EIS from the EIA process I. remained unchanged. The first incineration plant (PS 06) had already been operated since 2000. The theoretical capacities of both incineration plants are 240 t/y each. In practice, the first incineration plant PS 06 can incinerate only up to approx. 130-150 tons of RW a year[269], while the second one should be able to meet its theoretical capacity 240 t/y. The second incinerator PS 45 contains a rotary kiln while PS 06 is designed as a shaft furnace, with RW dosing in its upper part. The EIA plan and ruling no. 2764/2019-1.7/zg-R (that concluded the EIA process) explicitly state (among the main properties of the second incinerator) that it can incinerate ion-exchange resins mixed with ureaformaldehyde. According to available sources no Slovak RW belongs to this category, but the RW from the Caorso NPP meets this definition. In May 2021 the NRA SR explicitly confirmed that "*exactly the urea-formaldehyde resin represents the foreign RW*"[270]. There is suspicion that the second incinerator might be purpose-built to better fit the RW from Caorso (see section *"The*

[268] see p. 90 of the English version of the EIS available at https://www.enviroportal.sk/eia/dokument/326075 or p. 86 of the Slovak version available at https://www.enviroportal.sk/eia/dokument/323308

[269] see p. 10 of the ruling no. 2764/2019-1.7/zg-R available (in Slovak) at: https://www.enviroportal.sk/eia/dokument/287520

[270] see NRA SR ruling no. 164/2021 P dated 24 May 2021, p. 20

Caorso contract – 865 tons of radioactive ion exchange resins in ureaformaldehyde and sludges" for more details).

Since March 2018 the construction of an incinerator with rotary kiln (with incineration capacity 260 tons per year, later to be reduced to 240t/y) had already been covered in the plan of the EIA process II. *"Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice"*. The NRA SR could issue permission for construction of the second incinerator only after its environmental impact had been assessed. The EIA process II. must have undergone the complete EIA procedure (including the EIA report, public hearing, and expert judgment), therefore even in 2018 it was expected that the EIA process II. could hardly be completed before the end of 2019. In this situation the EIA process I.2 solely for the second incineration plant started in September 2018 (half a year after the EIA process II. started). In this case the complete EIA procedure was not obligatory, only the project phase must have been carried out, thus providing an opportunity to accelerate the authorization process of the second incinerator. After the project phase ruling no. 2764/2019-1.7/zg-R came into effect in May 2019, NRA SR issued permission for construction of the second incinerator on 12 June 2019 (ruling no. 176/2019). The construction of the second incinerator was completed at the end of 2020 (cold tests carried out in October 2020), the administrative procedures for issuing permits for early commission and hot tests of the second incinerator have been recently concluded. Once the second incinerator is commissioned, the annual volume of incinerated RW can (due to incineration at both incineration plants) increase from approx. 130 t/y (real capacity of the first incinerator) to 240 t/y (current legal limit until the capacity increase to 480t/y is approved in the EIA process II.).

The plan of the EIA process I.2 *"Optimisation of incineration capacities of the nuclear installation RW Treatment and Conditioning Technologies"* does not include description of the purpose of the second incinerator. A short notice on foreign RW treatment can be found in sec. III.5 of the plan (transboundary effects):

"When importing RW from external foreign producers for treatment by incineration, the conditions specified in the NRA SR permissions authorizing each import will be observed."[271]

The plan does not mention foreign origin of ion-exchange resins mixed with ureaformaldehyde nor, except for section III.5, foreign RW treatment.

7 of the 9 affected municipalities in a joint statement dated 15.10.2018[272] agreed to incineration of 240t/y RW (based on their *"no capacity increase"* position previously declared during the plan phase of the EIA process II. *"Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice"* in April 2018) on condition that:

1. any form of treatment of RW imported from abroad is not carried out in the Jaslovské Bohunice locality.
2. after the new incinerator is commissioned, within a given day RW is treated by one incinerator only.
3. they demand from JAVYS to present valid permits of the Nuclear Regulatory Authority of the Slovak Republic for the import of RW from external foreign producers, which have so far been processed in the Jaslovské Bohunice locality;
4. they demand from JAVYS to document from which activities and in what quantities the increased amounts of RW from decommissioned NPP A1, V1, operated NPP V2 in the locality Jaslovské Bohunice, eventually NPP Mochovce, are expected, as in the years 2013-2017 max. 130 tons of RW per year were incinerated.

[271] (Original in Slovak): "*Pri dovoze RAO od externých zahraničných producentov na spracovanie spaľovaním budú dodržiavané podmienky uvedené v rozhodnutiach ÚJD SR povoľujúcich každý dovoz.*"

[272] See p. 5-6 of the ruling no. 2764/2019-1.7/zg-R available (in Slovak) at: https://www.enviroportal.sk/eia/dokument/287520

JAVYS replied[273] in a letter dated 17.12.2018 that (shortened):

JAVYS cannot agree to no foreign RW treatment by already operated lines of RW TCT. During the public hearing held on 3rd March 2014 (part of the EIA process I. "RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location") the affected municipalities were informed that the use of free capacities was also being considered for the treatment of RW from other localities and for other interested parties[274]. *"The demand of the affected municipalities not to treat foreign RW at the new incineration plant, which was the subject of the announcement about change of proposed activity, is currently acceptable for the proposer. "*

The 2nd condition is acceptable for the proposer during the first year of operation of the new incineration plant only.

Permissions 681/2015, 524/2015 and 128/2018 for import and incineration of RW from the Czech republic and Italy were mentioned[275]. JAVYS also stated:

"The maximal assessed annual capacity of the incineration facility PS 06 has not been achieved since its commissioning due to technical, but also organizational limitations of its operation and was at the level of max. 130 tons of treated solid and liquid RW per year. Mainly for these reasons, it was decided to implement the project "Optimization of RW incineration capacities", the implementation of which, due to its technical solution, would enable the achievement of the assessed RW incineration capacity of 240 t/ y."

"In the period 2020-2023, an increase in the generation of combustible RW from the decommissioning of nuclear power plants A1 and NPP V1 is currently expected at the level of approximately 50%, … At the same time, the start of production of combustible RW from operation of NPP EMO blocks 3 and 4 is being considered from 2020 onwards. For the above reasons, it is necessary for the proposer to have in the following period an operational technological facility for solid and liquid RW incineration, which can treat RW within the assessed capacity of 240 tons of treated waste per year so that our company can primarily meet emerging requirements for RW treatment from decommissioning and also from the operation of NPPs in the Slovak Republic in a flexible way."

The demands no. 1 and 3. support the claims that most of the mayors might not have been aware of foreign RW treatment before 2018 and that these mayors strongly opposed the increase of treatment capacities (proposed as variant no. 1 in the EIA process II. *"Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice"*) and any foreign RW treatment in the Bohunice location until October 2018 at least.

JAVYS justified the second incinerator by the necessity to have an operational incinerator capacity within the limit of 240 tons/year in order to *"meet emerging requirements for RW treatment from decommissioning and also from the operation of NPPs in the Slovak Republic"* due to expected approx. 50% increase in production of domestic combustible RW in 2020-2023[276]. Based on this justification, majority of the municipalities approved the second incinerator on condition that the limit 240t/y (for both incinerators together) will be preserved and no foreign RW will be incinerated at the second incinerator. These conditions, explicitly accepted by JAVYS, were transposed into the final ruling no. 2764/2019-1.7/zg-R issued in this individual EIA process. Under these conditions, the municipalities did not obstruct

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273 See p. 9-11 of the ruling no. 2764/2019-1.7/zg-R available (in Slovak) at: https://www.enviroportal.sk/eia/dokument/287520

274 Detailed discussion about this argument can be found in the section I. "RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location" of this report

275 Compare to the list of permissions shown in the section "Contracts for incineration of foreign RW at RW TCT" – the list provided by JAVYS does not include permission no. 920/2013.

276 more precisely (according to the statement of JAVYS dated 17.12.2018): 50% increase in production of RW from NPP decommissioning combined with the start of production of combustible RW from operation of (to be commissioned) NPP Mochovce blocks 3 and 4 from 2020 onwards, i.e. 50% increase in the number of operated reactor blocks in Slovakia – from 4 to 6. However, the reactor blocks Mochovce 3 and 4 have not been commissioned yet

the authorization process and already in June 2019 the NRA SR could have issued a construction permit and the construction of the second incinerator could have begun.

The condition prohibiting incineration of foreign RW will be de facto applied only after the second incinerator is commissioned. On 24.03.2021 the Ministry of Environment of the Slovak republic issued the EIS no. 417/2021-1.7/zg from the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" which, however, has not entered into force yet due to appeals lodged. This EIS approved the proposed capacity increase and set no restrictions on foreign RW treatment. The Ministry of Environment argued that 1.) it cannot interfere with or restrict business activities if significantly negative impact on the environment had not been demonstrated and 2.) there is a constitutional right to engage in business and other gainful activity[277]. Once the EIS from the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" comes into effect, the EIS from EIA process "*RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location*" and the ruling from the individual EIA process for the second incinerator expire. Therefore, the restriction prohibiting incineration of foreign RW at the second incinerator will expire as well, unless the EIS no. 417/2021-1.7/zg is amended as a result of the appelate procedure and such restriction is added to the EIS.

It is important to point out that JAVYS agreed to no foreign RW treatment at the second incinerator in December 2018, i. e. in a situation when the EIA process II. *"Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice"* was already in progress and permits for incineration of foreign RW valid today had already been issued by NRA SR or the permits had already been requested. Also, at that time (until October 2020) the contract for construction of the second incinerator stated that successful incineration of 100 tons of ion-exchange resins in ureaformaldehyde (the type of RW from Caorso) during hot tests of the installation is required.[278]

The possibility of keeping the ban on burning foreign RW at the second incinerator was commented by the JAVYS spokesperson in October 2020 as follows: „*JAVYS is technically and technologically ready and able to carry out contractual activities, even without the new incinerator. The eventual non-authorization of incineration of the foreign RW at the new incinerator, that is being commissioned, will not stop the process, but will complicate it and, of course, will slow it down.* "[279]

In 2019 the volume of incinerated Slovak RW reached approx. 60 tons per year[280] (1/8 of the proposed increased limit 480t/y) which means approx. 25% decrease if compared to the period 2016-2018 (approx. 80-85 t/y) (compare to the statement of JAVYS from 17.12.2018 when expected approx. 50% increase in Slovak RW production in the period 2020-2023 was used as the primary reason for justification of the second incinerator.)

According to NNF, the expected volume of combustible RW produced during the:

a) 2nd phase (2015 - 2025) of the NPP V-1 decommissioning is 142.1 t (According to NRA SR, 35 tons of RW from NPP V-1 were incinerated during 2015-2019)

b) 3rd and 4th phase (2017-2025) of the NPP A-1 decommissioning is 86.1 t (According to NRA SR, 78.2 tons of RW from NPP A-1 were incinerated during 2017-2019)

According to the National policy and programme for management of SNF and RW in the Slovak republic (2015) the current capacity of RW treatment lines (state without the second incineration plant) is

[277] See p. 76 of the English version of the EIS available at https://www.enviroportal.sk/eia/dokument/326075

[278] See section "The Caorso contract – 865 tons of radioactive ion exchange resins in ureaformaldehyde and sludges" for more details

[279] https://e.dennikn.sk/2078275/spalovat-cudzi-radioaktivny-odpad-kollar-a-sulik-su-za-zvysok-koalicie-proti/(dated 08.10.2020)

[280] See sec. "Volumes of RW incinerated at RW TCT from 2007 to 2020" for more details

sufficient (with reserves) for treatment of RW from both operation and decommissioning of the Slovak nuclear installations[281]. These conclusions are consistent (at least in terms of RW incineration) with the (1) data about volumes of incinerated Slovak RW (60-85 t/y in 2015-2019) which is far below the technical capacity of the first incinerator (approx. 130t/y); (2) expected remaining volumes of combustible RW produced from decommissioning during the near future 2020-2025 and (3) historical records of volumes of combustible RW produced from operation of V-2 NPP in Bohunice and blocks 1&2 of Mochovce NPP. Some sources claim that the National policy and programme from 2015 have become obsolete. On the other hand, the project of the second incinerator dates back to January 2017 at the latest[282], i.e., less than 2 years after the National policy and programme were published.

EIA process II. *"Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice"*

It is a complete EIA process (including the project phase, an EIA report, public hearings and concluded by the EIS). This EIA process started in March 2018 and has not been completed yet. The EIA report was published in august 2019 and two public hearings followed on 26.08.2019 and 16.12.2019. The expert judgment on the EIA report was submitted in February/March 2020. On 24.03.2021 the EIS was issued which approved the capacity increase and set no restrictions on foreign RW treatment, but has not entered into force yet due to appeals lodged.

The main objective is to increase the legal limits of the RW treatment at RW TCT - from 8343 to 12663 tons per year in total (all technologies combined), incineration itself from 240 to 480 tons per year.

Two project variants are considered in the EIA process:

Variant No. 0 (current state) total processing capacity 8343 tons a year; capacities of individual technologies (e.g., incineration 240t/y; metallic RW remelting 1000t/y) can be found in Table A.II.10/02 on page 38 of the EIA report[283].

Variant No. 1 (capacity increase) total processing capacity 12663 tons a year; capacities of individual technologies (e. g. incineration 480t/y; metallic RW remelting 4500t/y) can be found in Table A.II.10/05 on page 47 of the EIA report.

According to the section "*II.2. Purpose*" of the EIA plan the purpose of the proposed activity also includes management of foreign RW (represented by the term *"external producers"*)[284]:

"The proposed technologies will be used for the treatment and conditioning of low-activity and very low-activity RW arising from the decommissioning of NPP A1, which today is at the 3rd and 4th decommissioning stage, the decommissioning of NPP V1 (at present at the 2nd stage of decommissioning), RW coming from the operation of nuclear facilities, the operation of NPPs in the SR, institutional RW from different fields of human activities such as research, medicine, etc. generated outside the operation of NPPs, Captured Radioactive Materials (CRW) and the management of RW as part of nuclear services provided for external RW producers."

The section *"II.2. Purpose"* of the EIA plan justifies the proposed capacity increase by *"requirements"* of the Slovak RW production. The foreign RW treatment is presented as activity that improves the efficiency of the treatment lines (similarly, during the public hearings foreign RW treatment was described as *"complementary"* activity that improves efficiency by utilization of the *"free capacity"* of the

281 See also section "Current treatment capacities vs. Slovak needs"

282 See section "The Caorso contract – 865 tons of radioactive ion exchange resins in ureaformaldehyde and sludges" for more details

283 The direct link to the EIA report in English is https://www.enviroportal.sk/eia/dokument/295761

284 Apart from the foreign RW treatment, the purpose complies with the definition given during the EIA process I. "*RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location*"

treatment lines[285], i.e., the difference between real capacity of the lines and the amount of Slovak RW treated by these lines):

"The subject of the Plan under review is the optimization of the processing capacities of the Nuclear Facility RW PTT with respect to the current requirements and known facts in the field of the management of RW from the decommissioning of NPPs A1 and V1 with simultaneous provision of the requirements for the management of RW from the operation of nuclear facilities, the operation of NPPs in the SR, institutional RW, CRW and the RW management as part of nuclear services provided for external RW producers in order to achieve the most efficient way of utilization of the processing and personnel capacities of the Nuclear Facility RW PTT."

JAVYS further stated in the section V.3. *Substantiation of optimal variant proposal* of the English version of the EIA report (page 191)[286]:

"The proposed optimisation of treatment capacities, modification of str. 760-II.3,4,5 with the simultaneous use of the existing operations will ensure the observance of the deadline for A1 NPP and V1 NPP decommissioning according to the approved strategic documents and obligations of the SR to the EU."[287]

An effect of the proposed capacity increase on the decommissioning process was denied by the Ministry of Environment through the statement "*The proposed activity that is the subject of these proceedings does not affect the decommissioning of A1 and V1 or is not expected to extend the decommissioning period of A1 and V1.*" in the EIS[288]. Also, the National policy and programme for management of SNF and RW state that the capacity of RW TCT "*is not limiting factor in system approaches for handling of RW from operation and decommissioning of nuclear installations.*"

The Ministry of Environment failed while attempting to obtain an additional independent expert opinion on the EIA report in autumn 2020.[289]

Officially, there are 9 affected municipalities considered within the EIA process. Until spring 2019 and September 2019, respectively, majority of the 9 affected villages and the *Association of the municipalities in the region of the Bohunice NPP*[290] kept opposing the project[291]. During the plan phase in april 2018 they demanded variant No. 0 (no capacity increase) to be selected and prohibition of treatment of foreign RW at RW TCT, reasoned their position by protection of environment and public health and expressed concern about radiation burden and emissions originating from RW incineration. They also pointed out that "*the company JAVYS was established for the purpose of treatment of RW*

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285 Minutes of the public hearings from 26.08.2019 and 16.12.2019

286 Almost identical justification was presented also in the EIA plan

287 Similar formulations might have had impact on positions of parties which took part in the EIA process. For example, the Trnava self-governing region provided the following reasoning to its approval of the RW TCT capacity increase project (dated 20.04.2018):
"*In case the proposed optimization of treatment capacities is not implemented in the area, meeting the deadline for completion of the 2nd phase of V1 NPP decommissioning and also completion of the A1 NPP decommissioning might be jeopardized.*"
[in Slovak - original]: "*V prípade, že by navrhovaná optimalizácia spracovateľských kapacít nebola v danom území realizovaná, môže byť ohrozené ukončenie 2. etapy vyraďovania V1, v stanovenom termíne, ako aj ukončenie vyraďovania JE A1*".
Also, the joint position of the municipalities of Chtelnica, Červeník and PhDr. Július Zemko to the EIA report (letter delivered on 20 September 2019) state "*In the event that the proposed optimisation of treatment capacities is not implemented in the given area, they are aware that the completion of Stage II of V1 NPP decommissioning within the set deadline, as well as the termination of NPP A1, may be endangered.*", see p. 23 of the English version of the EIS available at https://www.enviroportal.sk/eia/dokument/326075

288 See p. 88 of the English version of the EIS

289 See p. 49 of the English version of the EIS

290 Approx. 150 member municipalities, see zmo.sk

291 See e.g., statements (in Slovak) on pages 6-10 in the document available at https://www.enviroportal.sk/eia/dokument/295013

from the Jaslovské Bohunice site during the decommissioning of NPP A1 and V1. It would therefore be appropriate to focus exclusively on the treatment of waste from the site or Mochovce site" and "*The current state, which is represented by variant no. 0, has so far been accepted by the municipalities, but with the proviso that the proposer will treat RW exclusively from the Jaslovské Bohunice locality.*" Evidence about explicit categorical disapproval of treatment of RW that did not originate from the Jaslovské Bohunice locality can be found as far as in July 2014[292] when all 9 affected municipalities in their joint statement approved the metallic RW remelting facility on condition that "*exclusively metallic radioactive materials from the Jaslovské Bohunice locality were remelted in the proposed facility*. *They did not agree that radioactive material from other RW producing facilities or countries would be* transported to and treated at the future RW remelting facility".[293]

Austria decided not to participate in the EIA process according to the ESPOO convention, since Austrian experts did not *"expected remarkable transboundary impact on Austrian territory"*. The official statement of Austria can be found at the very end of the document containing statements of various institutions to the project[294].

On 12.09.2019, i.e. after the first public hearing (26.08.2019), 5 affected municipalities officially turned their position by 180 degrees[295] and approved variant No. 1 (capacity increase) on conditions that e.g. (1) the Ministry of Economy of the Slovak republic (which holds 100% of shares of JAVYS) prepares (adopts) legislative measures for economic and non-economic incentives (for the region around RW TCT); (2) JAVYS establishes a fund for support of the region development and makes annual contributions to that fund depending on the company profit; (3) (another) fund for support of the region financed by the National Nuclear Fund is established, (4) JAVYS provides information about volumes and activity of the incinerated RW to mayors of the 9 affected municipalities; (5) the share of the foreign RW is limited by 30% of the total processing capacity (i. e. approx. 3800 t/year).[296] The association of municipalities made identical turn on 28.10.2019[297], although just a 1,5 month earlier (in an official statement dated 12.09.2019) it still demanded variant No. 0 (no capacity increase), prohibition of treatment of foreign RW and reasoned its position by (protection of) sustainable healthy environment.

As of June 2021, only 1 of the 9 affected municipalities, two county towns (Hlohovec, Piešťany) together with some other municipalities keep opposing and explicitly disapprove the RW TCT capacity increase and foreign RW treatment. The 6 affected municipalities which consented to the project in September 2019 received 10000€ each from JAVYS in December 2019. On the contrary, the 3 then opposing affected villages received only 2500€ or 0€[298]. The following year in December 2020, after this fact was published in media, all 9 affected municipalities received 10000€ each from JAVYS. Some members of municipal councils of the affected municipalities are employed at JAVYS[299] which might indicate possible conflict of interests at the municipal level.

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292 I.e., 4 months after the public hearing within the EIA process I. "RW processing and treatment technology by JAVYS, a.s. at Jaslovské Bohunice location" took place in March 2014

293 See p. 24 of the EIS no. 1775/2015-3.4/h from the EIA process "*RW remelting facility in the Jaslovské Bohunice locality*" dated 26.01.2015 available at https://www.enviroportal.sk/sk/eia/detail/zariadenie-na-pretavovanie-kovovych-radioaktivnych-odpadov-v-lokalite-

294 Available at https://www.enviroportal.sk/eia/dokument/295013

295 See statement (in Slovak) available at https://www.jaslovske-bohunice.sk/evt_file.php?file=26988&original=stanovisko_obci.pdf

296 At the moment the share of the foreign RW is not limited, the only restriction in effect is the prohibition of foreign RW incineration at the second incinerator.

297 See resolutions no. 2/28.10.2019, 3/28.10.2019 and 4/28.10.2019 of the Council of the Association of the municipalities in the region of the Bohunice NPP

298 https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu at 11:22-12:50

299 https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu at 10:37-11:22 Translation to English: [journalist] "*Are they not corrupting you?*" [mayor] "*Our corruption is only secondary. The decisions are carried out by our citizens, or as the mayor here said, by local municipality councils. In my council, there are four people who are either working at the power plant or in JAVYS."* [journalist] "*And for example here in Jaslovské Bohunice, you also have in the council people who are…"* [mayor(s)] "*Four of them… She has four. We all do."* [journalist]

Unusually strong refusal arose also among the public. Aprox. 3000 citizens signed a petition against capacity increase of RW TCT and demanding prohibition of foreign RW treatment in Slovakia.[300] The public disapproval is mainly triggered by the treatment of foreign RW in the incineration plant and refers specifically to the foreign RW treatment in Slovakia, not to nuclear energy exploitation in general.

There were two public hearings during this EIA process - on 26.08.2019 and 16.12.2019. During the public hearing on 26.08.2019 JAVYS, among others, declared foreign RW treatment as "*a complementary activity*"[301] (compare to 34-46% share of foreign RW at incineration in 2015-2019 and possible expected increase over 70% in the future). During the public hearing on 16.12.2019 JAVYS, among others, claimed that foreign RW share at incineration was 12% only[302]. The spokesperson of JAVYS claimed that incinerated foreign RW consists of "*gloves and tubes*"; 865 tons of ion exchange resins in ureaformaldehyde and sludges from Caorso NPP were not mentioned. The public obtained data about volumes of incinerated RW in 2007-2019 only in the middle of 2020. There have beenattempts to obtain more detailed data about incineration of foreign RW (e.g., activity streams, production and management of the secondary RW) which, however, have led to a very limited success only.

In June 2020, outside the EIA process, the spokesperson of the Ministry of Economy even implicitly denied that foreign RW was incinerated in Slovakia by saying "*If there is a free capacity of the incinerator, it is economically advantageous for Slovakia to use it fully. And thus treat, not incinerate, but treat also waste imported from abroad.*"[303]

Challenges related to the foreign RW treatment

The need for a publicly available analysis on the fraction of foreign radionuclides that remain in Slovakia and how these missing radionuclides are replaced by Slovak radionuclides is justified in sec. "*Possible effects on the national radioactive inventory due to foreign RW treatment".*

Financial impacts should be assessed in detail as well. For example, the foreign RW owners do not participate in the future decommissioning of the RW TCT (especially the incinerators and the pre-conditioning line). The corresponding costs are expected to be covered by the National Nuclear Fund that collects money from Slovak electricity consumers. It could be worth analyzing whether the Slovak taxpayers do not subsidize the foreign RW treatment in any (hidden) way (incl. construction, operation and future decommissioning costs, indirect costs – e.g., if the incinerator lifetime was negatively affected by the foreign RW treatment, …).

One can also argue that foreign RW treatment might challenge the ALARA principle. Slovakia is not legally nor morally responsible for foreign RW, so it is reasonable not to incinerate/treat it and thus avoid any kind of unnecessary negative effects or risks. Public Health Authority of the Slovak republic, Section of radiation protection justified its 2017 legislative proposal to ban foreign RW incineration by this argument.

"*And they are employed at JAVYS?"* [mayor] "*Some at JAVYS, some at the power plant*."

300 The author of this report serves as the petition committee representative. The electronic version (there is also a paper one with additional signatures) is available at https://www.peticie.com/peticia_proti_dovozu_a_spracovavaniu_zahranineho_radioaktivneho_odpadu_na_uzemi_sr

301 See minutes of the public hearing.

302 See minutes of the public hearing.

303 https://www.rtvs.sk/novinky/zaujimavosti/227377/budeme-na-slovensku-spalovat-este-viac-odpadu at

Findings and conclusions

In this case the crucial issues are mainly transparency, public access to information, evidence-based decision making and effective public participation, which, among others, represent some of the key principles of the Aarhus convention and the council directive 2011/70/EURATOM. We consider it important to take into account that JAVYS is not a private but state-owned company and that most technologies of the RW TCT received necessary permits when the public and the municipalities implicitly assumed that RW TCT served management of the Slovak RW only and RW from decommissioning of NPP A1 in particular. First of all, the public discussion about foreign RW treatment should have taken place prior to RW treatment services were offered to foreign customers, not years after foreign RW treatment in Slovakia started. The eventual ongoing discussion, which was initiated mainly by the public and the municipalities, is strongly affected by the risk of huge financial penalties in case the already signed contracts are terminated. This significantly reduces the set of options (de facto) available for discussion and subsequently impacts the results.

The second important issue are difficulties in access to (objective and complete) information, information verification and consulting with independent experts in the case of the public and the municipalities. In practice the main source of information about activities at the nuclear site Jaslovské Bohunice for the public are the corresponding EIA processes, since the EIA documentation is easier-to-read for non-experts, is published online and often also the public hearings take place in the affected municipalities. On the other hand, documentation from processes held by the nuclear regulator NRA SR is expert-oriented, can be accessed usually only via physical inspection and sometimes is even declared confidential. However, even in the EIA processes, the effectiveness of public participation is limited by information asymmetry between the public and municipalities on one hand and the project proposer on the other. In case of nuclear installations, this asymmetry is further enhanced because of higher complexity of the problem. Due to limited time, expertise and financial resources the public and municipalities are reliant mostly on information provided by the project proposer either in the EIA documentation or in reactions to additional questions (raised e.g., during the public hearing). Consultations with independent experts appear to be a theoretical option only, not only because of short procedural deadlines and financial constraints, but also due to a lack of suitable independent nuclear experts and/or insufficient free capacities of these experts. Even the Ministry of Environment failed while attempting to obtain an additional independent (expert) opinion on the EIA report within the EIA process "*Optimisation of treatment capacities of radioactive waste treatment and conditioning technologies JAVYS, a.s. at Jaslovské Bohunice*" in autumn 2020.

Effective public participation in the decision-making process requires that the public and municipalities are provided with correct, complete, and evidence-based information about the project, its impacts and purpose as well as tools for easy information verification. The public should not be dependent on extensive and time-consuming investigation and information verification based on independent sources. The situation is negatively affected by the fact that JAVYS claims not to be a liable entity with respect to the Slovak Freedom of Information Act. This is difficult to understand, since this company is state-owned, carries out a public service and receives millions of euros from public budget (through the National Nuclear fund) each year, *de facto* holds a monopoly position in management of RW and SNF in Slovakia and, on top of that, it is also responsible for the project of the Slovak deep geological repository.

If the decision-making process is to be evidence-based, the project proposer shall be required to support all claims by objective and verifiable data.

Besides the deficiency in transparency and public participation and limited public access to information the challenges related to the foreign RW treatment include (1) missing publicly available analyses of radioactivity streams, secondary RW production and corresponding data on the fraction of foreign radionuclides that remain in Slovakia and how these missing radionuclides are replaced by Slovak radionuclides; (2) non-participation of the foreign parties in the future decommissioning of RW TCT and

in the legal responsibility in case of accidents or other indirect impacts; (3) missing publicly available detailed financial analyses including also of all indirect costs (it could be worth analyzing whether the Slovak taxpayers do not subsidize foreign RW treatment in any (hidden) way); (4) reasonable doubts about the need of the second incinerator (in perspective of the Slovak needs) and clarification of the relation between the Caorso contract and the second incinerator (and the preconditioning line); (5) possible conflict of interests – e.g. some members of municipal councils employed at JAVYS; (6) financial power asymmetry between the proposer and the public. The distribution of substantial financial benefits from JAVYS to the affected municipalities in 2019 is highly correlated to the (dis)approval of the proposed RW TCT capacity increase by these municipalities; (7) law enforcement – the Ministry of Environment confirmed that "*the ongoing foreign RW treatment (incineration) is inconsistent*" with the still valid EIS. However, the treatment of foreign RW at RW TCT continues.