REPUBLIC OF SLOVENIA
MINISTRY OF NATURAL RESOURCES AND SPATIAL PLANNING
SLOVENIAN NUCLEAR SAFETY ADMINISTRATION

Eighth Slovenian Report under the

Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

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All Slovenian Reports under the Joint Convention and other information can be found on the website of the Slovenian Nuclear Safety Administration at www.ursjv.gov.si.

PREFACE

The National Report on fulfilment of the obligations under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management has been prepared in fulfilment of Slovenia's obligations as a Contracting Party to this Convention.

This report was prepared by the Slovenian Nuclear Safety Administration. Contributions to the report were made by the company NEK d.o.o., the Jožef Stefan Institute, the Agency for Radwaste Management, the public company Žirovski Vrh Mine d.o.o., the Ministry of the Environment, Climate and Energy, the Institute of Oncology Ljubljana – Department of Nuclear Medicine, the Ljubljana University Medical Centre – Division of Nuclear Medicine, and the Slovenian Radiation Protection Administration. It constitutes an updated document with basically the same structure as previous national reports under the Joint Convention. The issues raised at the seventh review meeting and future plans are addressed in Section K of the report.

The report was approved by the Expert Council for Radiation and Nuclear Safety and adopted by the Government of the Republic of Slovenia.

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LIST OF ABBREVIATIONS

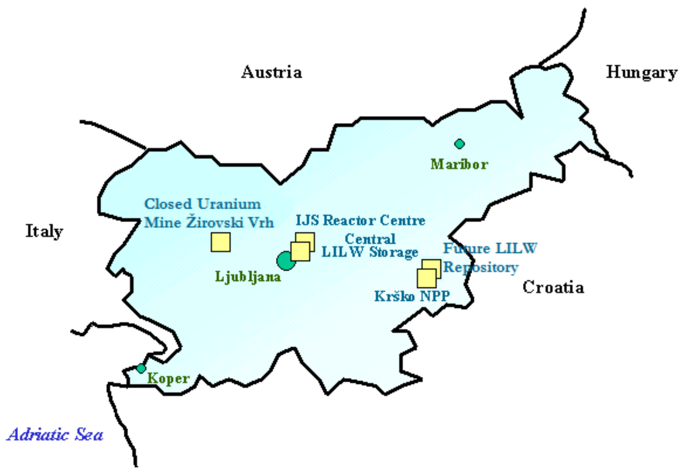
ADR	Agreement Concerning the International Carriage of Dangerous Goods by Road
ALARA	As Low As Reasonably Achievable
ARAO	Agency for Radwaste Management
ASME	American Society of Mechanical Engineers
CFR	Code of Federal Regulations
CRDM	Control Rod Driving Mechanisms
CSF	Central Storage Facility for Radioactive Waste
DSRS	Disused Sealed Radioactive Sources
DRPI	Digital Rod Position Indication
EU	European Union
EPRI	Electric Power Research Institute
ERDO-WG	European Repository Development Organisation – Working Group
FA	Fuel Assemblies
HLW	High-Level Waste
HERCA	Heads of Radiation Protection Authorities
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IGD-TP	Implementing Geological Disposal of Radioactive Waste Technology Platform
JSI	Jožef Stefan Institute
INPO	Institute for Nuclear Power Operation
LILW	Low- and Intermediate-Level Waste
MKSID	On-Line Communication System in the Event of a Nuclear or Radiological Emergency
NPP	Nuclear Power Plant
OECD/NEA	Organisation for Economic Cooperation and Development/Nuclear Energy Agency
OSART	Operational Safety Review Team
PWR	Pressurised Water Reactor
RS	Republic of Slovenia
RW	Radioactive Waste
RTD	Resistance Temperature Detector
SF	Spent Fuel
SFDS	Spent Fuel Dry Storage
SFRY	Socialist Federal Republic of Yugoslavia
SNSA	Slovenian Nuclear Safety Administration
SRPA	Slovenian Radiation Protection Administration
SSC	Systems, Structures and Components
TENORM	Technologically Enhanced Naturally Occurring Radioactive Material
TLD	Thermoluminiscent Dosimeter
TRIGA	Training Research Isotope General Atomic
TTC	Tube-Type Container
USA	United States of America
US NRC	United States Nuclear Regulatory Commission
WAC	Waste Acceptance Criteria
WANO	World Association of Nuclear Operators

EXECUTIVE SUMMARY

The Slovenian Nuclear Programme

The Republic of Slovenia has a small in size but fully developed and functional nuclear programme (Figure 1): one operating nuclear power plant, one research reactor and one central storage facility for institutional radioactive waste and a low- and intermediate-level waste (hereinafter: LILW) repository in the construction phase. In addition, there is also a closed and remediated uranium mine at Žirovski Vrh with two remediated disposal sites for mining and milling waste at the site. The geographical locations of the nuclear and radiation facilities are given in the figure below. The Republic of Slovenia has no facility for the final disposal of spent nuclear fuel.

Figure 1: **The nuclear programme in the Republic of Slovenia**



The Krško Nuclear Power Plant (Krško NPP) is one of the main pillars of the Slovenian power system. It is situated on the left bank of the Sava River in the south-eastern part of Slovenia. It is a Westinghouse two-loop pressurised light water reactor with nominal output power of 727/696 MWe (gross electrical power/net electrical power). It was designed to operate until the end of 2023. In 2012 the Slovenian Nuclear Safety Administration issued a decision approving modifications that will enable the long-term operation of the Krško NPP. In 2023, the operation of the NPP was prolonged for 10 years after the successful conclusion of a periodic safety review. The operation will be extended from 2023 until 2043, pending the successful conclusion of the periodic safety review in 2033. The plant is owned by state-owned Slovenian and Croatian electrical power companies (GEN energija d.o.o., and Hrvatska Elektroprivreda d.d., respectively).

The plant is operated by the company Krško NPP d.o.o. The Krško NPP is the major generator of radioactive waste in the Republic of Slovenia. All operational radioactive waste and spent nuclear fuel are stored within the area of the plant.

Spent nuclear fuel is currently stored under water in the spent fuel pool and in the dry storage facility (DSB). In order to improve the safety of spent fuel storage as one of actions following the Fukushima accident, it was decided to construct a dry storage facility for spent fuel with a design lifetime of 100 years. The dry storage facility operation started in March 2023 followed by the relocation of the first 592 spent fuel assemblies from the spent fuel pool. The next campaign of relocating an additional 592 spent fuel assemblies is planned for 2029.

Solid radioactive waste is treated and then packed into steel drums, which are then stored in the solid radwaste storage facility.

In 2018, the construction of the Waste Manipulation Building was completed. With the construction of the Waste Manipulation Building, the plant provided new premises for the storage of drums in the process of the manipulation and preparation for transport, collection, and sorting of radioactive waste.

The Jožef Stefan Institute Reactor Infrastructure Centre (JSI Reactor Infrastructure Centre) is a part of the Jožef Stefan Institute (JSI). It is located in Brinje, about 10 km north-east of Ljubljana. The main purpose of the Centre is to operate the TRIGA Mark II research reactor for the needs of the JSI and other research groups. The TRIGA Mark II research reactor is a General Atomics open-pool type research reactor with thermal power of 250 kW. It was initially licensed in 1966 and was re-licensed for steady state and pulse operation after renovation and reconstruction in 1991. The facility is used in research projects and for education. The fuel elements are kept in the reactor building of the JSI Reactor Infrastructure Centre. In addition to spent fuel, the reactor generates a small amount of LILW. One part of the JSI Reactor Infrastructure Centre is a hot cell laboratory, which is, *inter alia*, also licensed for the treatment of institutional radioactive waste.

The research reactor is operated by the JSI, a public research institution that is financed from the national budget by the Ministry of Education, Science and Sport. In 2015 the operator of the TRIGA Mark II research reactor decided to extend the operation of the reactor until at least the conclusion of the next periodic safety review in 2024. The PSR3 will be completed before the end of 2024 with SNSA approval of the report and the implementation action plan with an execution period of 5 years.

The Žirovski Vrh Uranium Mine was in operation in the period from 1984 to 1990. Its lifetime production was 610,000 tons of ore, from which 452.5 tons of U_3O_8 were produced. The Žirovski Vrh Uranium Mine ended operations in 1990. The decision to close it was influenced by economic reasons, since its uranium production was no longer economically competitive. In 1992, the Republic of Slovenia, as the owner of the Žirovski Vrh Uranium Mine, established a company named Žirovski Vrh Mine d.o.o. to carry out the permanent closure of the mine (Permanent Cessation of Exploitation of the Uranium Ore and Prevention of the Consequences of the Mining in the Uranium Mine at Žirovski Vrh Act). The financial resources for decommissioning and environmental remediation were provided from the national budget.

All entrances to the underground mine are now closed. The uranium ore mill has been decommissioned and the resulting waste has been disposed of at the Jazbec mining waste disposal site. All mining waste from numerous other mining waste piles has been moved to this site and disposed of. The total amount of disposed material at this site is 1,910,425 tons, with a total activity of 21.7 TBq. At the Boršt hydro-metallurgical tailings disposal site, 610,000 tons of hydro-metallurgical waste, 111,000 tons of mine waste, and 9,450 tons of material collected during the decontamination of the hydro-metallurgical tailings in the Boršt site vicinity have been disposed of, with a total activity of 48.8 TBq. Closure works at the Jazbec disposal site have been completed and the ARAO - Agency for Radwaste Management (ARAO) started the long-term surveillance and maintenance of the site in 2015. The closure of the Boršt disposal site has been delayed due to the activation of a landslide and the required additional remediation works.

Two studies were carried out in 2015 and 2016. In the first study, the distribution of tailings in the case of an extraordinary event (e.g. intensive rain or an earthquake) was assessed. On the basis of the study, the Ministry of the Environment and Spatial Planning ordered an additional study on the radiation exposure of residents and the workers who would carry out the remediation of the deposited material on the riverbeds of the Todraščica, Brebovščica and Poljanska Sora Rivers. In 2016 and 2017, additional intervention measures for reducing the speed of landslide movements were carried out. In 2018, the Expert Project Council for monitoring the remediation work on the hydro-metallurgical tailings prepared a final report. The effects of the maintenance, monitoring and intervention measures to reduce the groundwater impact on the stability of the Boršt hydro-metallurgical tailings disposal site performed between 2010 and 2018 were assessed, as well as the current state of the Boršt disposal site. In 2019, the monitoring network of the Boršt hydro-metallurgical tailings disposal site was renovated and upgraded with nine additional deep piezometers. The safety report for the Boršt hydro-metallurgical tailings disposal site is in the final stage of revision. This document is the basic document for the closure of the disposal facility and the transition to long-term surveillance and maintenance, which will be carried out by the ARAO as part of a mandatory service of general economic interest.

The Central Storage Facility for Radioactive Waste (CSF) in Brinje is intended for the storage of low- and intermediate-level radioactive waste arising from medical, industrial and research applications. The construction of the facility started in 1984 and it was put into operation in 1986. In 1999, the responsibility for managing and operating the storage facility was transferred from the JSI to the ARAO. Following refurbishment and two and a half years of trial operation, a new operating licence was issued in early 2008; in 2018 the first periodic safety review was finished and the new operating licence is valid until 2028.

ARAO – Agency for Radwaste Management (ARAO) is a public utility for the implementation of radioactive waste management as a mandatory service of general economic interest. It also provides technical support regarding radioactive waste management to its stakeholders. It was established by the Slovenian Government and is responsible for radioactive waste management, including the management of institutional radioactive waste, long-term surveillance and maintenance of disposal sites for uranium mining and milling waste, and the disposal of radioactive waste from the Krško NPP. It is financed from the national budget and fees paid by waste generators, whereby the liabilities for further waste management are transferred from them to the State. Activities regarding the siting and construction of an LILW repository are financed from the Public Fund for Financing the Decommissioning of the Krško NPP and Disposal of Radioactive Waste and Spent Fuel from the Krško NPP and from the national budget in proportion of the disposed volume of LILW originating from the Krško NPP and the volume of institutional radioactive waste.

Governmental Policy

The governmental policy in the area of the safety of spent fuel management and the safety of radioactive waste management is governed by national nuclear legislation and international agreements. Based on such legislation, a number of measures have been implemented to protect the environment and the public from the harmful impacts of radioactive waste and spent fuel. The most important measures are:

- the establishment and functioning of the regulatory body, the Slovenian Nuclear Safety Administration (SNSA), which is the competent authority in the area of nuclear and radiation safety and radioactive waste management, which was established in 1987. Previously, the functions of the regulatory body were performed by the Committee for Energy and Industry.
- the establishment of the ARAO as a public utility for radioactive waste management by the Slovenian Government (1991).
- the establishment of Žirovski Vrh Mine d.o.o., a public company for the decommissioning of the uranium production site (1992).
- the establishment of the Fund for Financing the Decommissioning of the Krško NPP and Disposal of Radioactive Waste from the Krško NPP (1995).

In addition, the Government has prepared several documents pertinent to policy in the area of radioactive waste management. The most important are as follows.

On 27 February 2020, the Government of the Republic of Slovenia adopted the **Comprehensive National Energy and Climate Plan of the Republic of Slovenia (NEPN)**, in accordance with EU Regulation 2018/1999 on the Governance of the Energy Union and Climate Action, which, among other things, envisages "continuing the use of nuclear energy and maintaining excellence in the operation of nuclear facilities in Slovenia."

The Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on Regulation of the Status and Other Legal Relations Regarding the Investment, Exploitation and Decommissioning of the Krško NPP (hereinafter: the Agreement). The following policy is adopted in the Agreement:

- the decommissioning of the Krško Nuclear Power Plant and the management of its radioactive waste and spent fuel are the joint responsibility of the contracting parties, and they should ensure efficient common solutions from both economic and environmental protection points of view.
- if the contracting parties do not reach an agreement on a common solution to radioactive waste and spent fuel management during the regular lifetime of the Krško NPP, they undertake that within two years of that time they must complete the removal of the operational radioactive waste and spent fuel from the location of the Krško NPP (one half by each party) and that they will individually bear the costs of the management thereof (including the subsequent division and removal of radioactive waste from decommissioning).
- the contracting parties shall, in equal shares, ensure funds for the preparation of the decommissioning programme and its execution and funds for the preparation of the programme for the disposal of radioactive waste and spent fuel. If the contracting parties agree on a joint solution to the disposal of radioactive waste and spent fuel, they shall finance it in equal shares or shall finance their shares of the activities.

- the Republic of Slovenia and the Republic of Croatia shall jointly establish an Intergovernmental Commission to monitor the implementation of the Agreement and to perform other functions in accordance with the Agreement.
- the Republic of Slovenia and the Republic of Croatia shall jointly prepare and approve a programme for the decommissioning of the Krško NPP (hereinafter: the Decommissioning Programme) and the Krško NPP Radioactive Waste and Spent Fuel Disposal Programme (hereinafter: the Disposal Programme).
- the Republic of Slovenia and the Republic of Croatia shall establish funds for the management and collection of financial resources for decommissioning and radioactive waste disposal costs.

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 practice and recommendations and with the goal of ensuring sustainable nuclear safety. The Intergovernmental Commission also approved the construction of a dry spent fuel storage within the Krško NPP site. The dry spent fuel storage has been in operation since 2023.

At the same session, the Republic of Slovenia presented the project of the Vrbina LILW repository and invited the Republic of Croatia to study its interest in joining the project.

In 2016, a new revision of the Decommissioning Programme and the Disposal Programme started. The Coordination Committee was established in 2017 to monitor the preparation of new revisions of both programmes. In addition to monitoring the preparation of new revisions of both programmes, the Coordination Committee also searched for possibilities for the joint disposal of Slovenian and Croatian radioactive waste from the Krško NPP. The Intergovernmental Commission concluded in September 2019 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 foreseen between the two states.

In 2019, the third revisions of the Decommissioning Programme and the Disposal Programmes were completed, and in 2020 they were approved by the Intergovernmental Commission. In these documents annuities for each country are calculated and presented with respect to the internal rate of return.

By a decision of the Slovenian Government, the Slovenian electrical power company GEN energija d.o.o. should continue to contribute to the Slovenian fund for financing one half of the decommissioning and spent fuel and radioactive waste disposal with payments increased from the previous rate of 0.30 euro cents per kWhe to 0.48 euro cents per kWhe starting 1 August 2020 and since 1 January 2022 the payment has been additionally increased to 1.2 euro cents per kWhe until the next revisions of the Programmes are approved.

Based on the decision of the 17th session of the Intergovernmental Commission, held in October 2023, a new deadline for the takeover of the LILW from the Krško NPP was determined. Fund for financing the decommissioning of the Krško NPP and the disposal of Krško NPP radioactive waste and spent nuclear fuel from Croatia (hereinafter: the Croatian Fund) and the ARAO must start the takeover of the LILW from the Krško NPP by the beginning of 2028 at the latest.

The new Resolution on the National Programme for Radioactive Waste and Spent Fuel Management for the 2023–2032 period (ReNPROIG23–32) was adopted by the Slovenian National Assembly in January 2023, based on the adopted third revision of the Krško NPP Decommissioning Programme and the third revision of the Krško NPP Radioactive Waste and Spent Fuel Disposal Programme. This Resolution replaces the Resolution on the National Programme on Radioactive Waste and Spent Nuclear Fuel Management for the Period 2016–2025. It contains the radioactive waste and spent fuel management policy, as well as strategies (concrete measures) for achieving the policies/objectives. According to the Programme, the Krško NPP, the major radioactive waste generator, shall continue to operate until 2043, pending the successful conclusion of periodic safety reviews in 2033.

The spent fuel will be transferred to dry storage for a period of approximately 60 years, when the spent fuel repository should be operational. The option of regional or multinational disposal has been kept open. The LILW waste repository for the Slovenian share of operating waste generated by the Krško NPP shall be built in Slovenia. The selected type of repository envisages the disposal of radioactive waste in a near-surface silo. The National Programme envisages a scenario allowing for the disposal of half of the waste which, in accordance with the Agreement on the Krško NPP, provides for the disposal of all LILW waste from the Krško NPP. The spent fuel from the Triga Mark II research reactor will be managed (disposed) together with the spent fuel generated by the Krško NPP. The institutional waste stored at the CSF in Brinje that meets the waste acceptance criteria (WAC) shall be disposed of in the LILW repository. Radioactive waste containing naturally occurring radionuclides is to be managed in accordance with the established level of radioactivity and other waste properties.

The new Resolution on Nuclear and Radiation Safety in the Republic of Slovenia (for the period 2024–2033) was adopted by the National Assembly in November 2023. This Resolution on Nuclear and Radiation Safety for the period 2024–2033 replaces the Resolution for the period 2013–2023. The Resolution commits the Republic of Slovenia to maintaining and improving nuclear and radiation safety over the next ten-year period. The Resolution is a programmatic, high-level national policy document that contains a descriptive part divided into chapters; for each chapter, the objectives which must be delivered during the period of validity of the Resolution are set. The Resolution therefore comprises the national policy, strategy and plan.

The focus of the chapters is as follows:

- fundamental safety principles;
- a description of nuclear and radiological activities in Slovenia;
- a description of international cooperation in the field of nuclear and radiation safety;
- a description of the existing legislation (including binding international legal instruments, e.g. conventions);
- a description of the institutional framework;
- the competencies of professional support (research, education and training).

Siting and design of the LILW repository

The Vrbina site (Municipality of Krško) was proposed at the beginning of 2007. Within the process of preparing the Spatial Plan of National Importance for the Vrbina site, the SNSA issued guidelines determining the content and scope of the special safety analysis of the LILW repository. Considerable effort and attention were devoted to communication with the stakeholders, including the local communities and non-governmental organisations.

The municipal council of Krško gave its consent to the proposal of the national spatial plan in July 2009. With the adoption of the Decree on a Detailed Plan of National Importance for an LILW repository in Vrbina in the Municipality of Krško, at the end of 2009 the procedure for the siting of the repository was completed. Further procedures were delayed due to various administrative reasons. The investment programme for the project, which is a prerequisite for most of the other steps, was signed by the responsible Minister first in the summer of 2014 and revised and approved in 2021 and 2024. Since 2014, activities related to the LILW repository project have made significant progress.

In 2021, the cross-border procedure and the public hearing process in Slovenia was finished. The new revision of the safety case (safety report) was prepared in 2021, and in January 2022 the SNSA issued a decision for approving the safety report. The construction license for the disposal part of the Vrbina site was granted in July 2022 and for the infrastructure part in April 2023. Both became final in mid-2023 and the construction of the infrastructure part started in August 2023, the disposal part will start in the summer of 2024. The current target is that the repository could start receiving waste in the second half of 2027.

The following websites are available for additional information:

- Slovenian Nuclear Safety Administration: http://www.ursjv.gov.si/
- Slovenian Radiation Protection Administration: http://www.uvps.gov.si/
- Ministry of the Environment, Climate and Energy: https://www.gov.si/en/state-authorities/ministries/ministry-of-the-environment-climate-and-energy/
- Krško NPP: http://www.nek.si/
- Jožef Stefan Institute Reactor Infrastructure Centre: http://www.rcp.ijs.si/
- Jožef Stefan Institute: http://www.ijs.si/
- Agency for Radwaste Management: http://www.arao.si/
- GEN energija d.o.o.: https://www.gen-energija.si/
- Žirovski Vrh Mine d.o.o.: http://www.rudnik-zv.si/
- Public Fund of the Republic of Slovenia for the Financing of the Decommissioning of the Krško NPP and for the Disposal of Radioactive Waste and Spent Fuel from the Krško NPP: http://www.sklad-nek.si/

An overview matrix is presented in Table 1.

Table 1: **Overview matrix**

Type	Long-term Management Policy	Funding	Current Practice/Facilities	Planned Facilities
Spent Fuel	Geological disposal, as a reference scenario, multinational option kept open	Decommissioning Fund (levy on kWhe)	On-site wet storage and dry storage at the NPP	Geological disposal or disposal in a multinational repository
Nuclear Fuel Cycle Waste	LILW repository HLW together with SF	Decommissioning Fund (levy on kWhe)	On-site storage	LILW repository HLW in a geological repository
Application Waste	Central Storage for Radioactive Waste, then transfer to the LILW repository	Users and the State	Central Storage for Radioactive Waste	LILW repository
Decommissioning Liabilities	Resolution on the National Programme for RW and SF Management Bilateral agreement with Croatia	Decommissioning Fund (levy on kWhe)	Periodic review of the Decommissioning Programme	LILW repository HLW & SF repository in 2065 at the earliest
Disused Radioactive Sealed Sources (DSRS)	Central Storage for Radioactive Waste, then transfer to the LILW repository (DSRS category 3-5)	Users and the State	Central Storage for Radioactive Waste (DSRS category 3-5), removal from the country (repatriation) (DSRS category 1&2)	LILW repository (DSRS category 3-5) or together with high-level waste (DSRS category 1&2)

SECTION A: INTRODUCTION

On 29 September 1997, the Republic of Slovenia signed the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (hereinafter: the Convention). The Convention was ratified by the National Assembly in February 1999. It entered into force for the Republic of Slovenia in June 2001.

In this eighth report, fulfilment of the obligations in the period 2020–2023 is evaluated. The report presents the achievements in and contributions to enhancing the safe handling and disposal of spent fuel and radioactive waste.

This report has been prepared in order to meet the obligation to report under Article 32 of the Convention. It is structured in accordance with IAEA guidelines Draft INFCIRC/604/Rev.5. In order to ensure more readability, certain information is provided in the form of attachments and referred to in the text. The information provided in the report presents the status as of the end of 2023.

In the following sections, fulfilment of Articles 3 to 32 of the Convention is evaluated separately. It can be concluded that Slovenian regulations and practices are in compliance with the obligations of the Convention.

Four challenges were identified for Slovenia at the seventh review meeting. For each of them, the measures implemented and the progress made are presented and summarised in this section.

Retaining the technical capabilities of nuclear institutions, including the regulatory body, is a constant challenge for countries with small nuclear programmes.

In recent years, the SNSA increased and improved the training programme by the implementation of a systematic approach to training. The financial situation in Slovenia has improved in the last few years, and since 2017 the SNSA has been able to again finance some research and development necessary for the administrative control of radioactive waste and spent fuel management. In 2020, the SNSA adopted a *Research and Development Strategy at the SNSA*, which was prepared with the aim of defining a multi-annual orientation towards research on and the development of nuclear and radiation safety to support the administrative control of nuclear and radiation safety, including radioactive waste and spent fuel management. On the basis of this document, the SNSA prepares annual operational research and development plans. In 2023, the SNSA carried out a project to assess all its duties and needed competences and staff to preform adequately these duties and compare the number of staff employed by the SNSA with foreign regulatory authorities that have a similar workload. The result of this study will serve as one of the bases for justifying the need to increase the SNSA's staff. The other two bases are the needs analysis for the new nuclear power plant and the needs analysis for the complete and adequate fulfilment of all tasks to be performed by the SNSA.

Since June 2023, the Government of the Republic of Slovenia has been actively involved in the new nuclear power plant project. A national strategic document, namely the Resolution on the Long-Term Peaceful Use of Nuclear Energy in Slovenia, has been approved by the Government and sent to the Parliament for adoption. Notably, the resolution underscores a commitment to high levels of nuclear and radiation safety.

The SNSA started to prepare a research and development strategy in the field of nuclear and radiation safety in Slovenia. A common strategy for such research and development would help reduce the dispersion of areas and help secure adequate funding.

The SRPA is continuing the development and implementation of the safety-oriented regulatory system at all levels of its activities.

The Krško NPP has established systematic training and human resource processes to support the recruitment of new staff and the transfer of knowledge to younger generations.

In December 2022, the Slovenian Government approved the ARAO long-term work programme for the period 2023–2027. An important part of the long-term programme is the personnel plan. It is planned that a total of 40 people will be employed at the ARAO at the beginning of 2027.

Agreement with Croatia on the decommissioning of the NPP, the disposal of RW and the management of SF

After searching for possibilities for the joint disposal of Slovenian and Croatian radioactive waste from the Krško NPP in 2018 and 2019, it was determined by the Intergovernmental Commission in September 2019 that a joint solution to the disposal of LILW was not possible and consequently such waste will be divided in half and each country will proceed to develop its own disposal capabilities.

In October 2023, the Intergovernmental Commission decided that the division and takeover of LILW from the Krško NPP by the ARAO and the Croatian Fund, will start in 2028, instead of end of 2023, as the previously scheduled deadline. The Intergovernmental Commission has therefore tasked this the ARAO and the Croatian Fund.

By a decision of the Slovenian Government, the Slovenian electrical power company GEN energija d.o.o., should continue to contribute to the Slovenian fund for financing one half of the decommissioning and spent fuel and radioactive waste disposal with payments increased from the previous rate of 0.30 euro cents per kWhe to 0.48 euro cents per kWhe starting 1 August 2020 and since 1 January 2022 the payment has been additionally increased to 1.2 euro cents per kWhe until the next revisions of the Programmes are approved.

Timely commissioning and operation of the National LILW repository

In a process that had taken place since November 2004 and in which the public had also been intensively involved, the location of the LILW repository was selected in December 2009.

The conceptual design of the LILW repository was drawn up in 2016 on the basis of the design of the project for the acquisition of a construction permit and as an appendix to the application for obtaining an environmental permit. The ongoing process of cross-border environmental impact assessment and the process of environmental approval in Slovenia took place between 2019 and 2021 and the environmental permit was issued in July 2021.

For the construction permit the safety report was prepared, which was approved by the SNSA in 2022. Together with the documentation for the construction and environmental permit, the procedure of gaining the permit lasted from 2020 to 2022/23. The construction permit for the nuclear facility was issued in 2022, while the construction permit for the infrastructure was gained early in 2023.

The contractors for the construction of the infrastructure for the LILW repository and concrete containers were selected in 2023. The contractors for the nuclear facility were also selected in 2024. The repository operator will be the ARAO, as the provider of radioactive waste management as a mandatory service of general economic interest.

The repository construction started in August 2023 and is planned to be built in three and a half years. Regular operation is planned for the beginning of 2028 after the successful completion of the trial operation period and an operating permit has been obtained.

Long term management of former uranium milling site Boršt, including achievement of an acceptable closure licence

The Boršt hydro-metallurgical tailings disposal site is situated on a hillside and the closure of this facility has been delayed due to the activation of a landslide and the required additional remediation works.

In 2021, an additional study was carried out in order to assess the consequences of the worst-case scenario of an extraordinary event (extreme rainfall combined with an earthquake) in terms of radiation protection and assessment of the additional radiation exposure of the residents and workers carrying out remediation. Based on the study, the authors concluded that only a fraction of the landslide material would travel to the valley, and damming the stream in terms of total damming would not occur.

The safety report on the Boršt hydro-metallurgical tailings disposal site is now under revision. The results of all the studies were included in the revised safety report, which is the basic document for the closure of the disposal site and the transition to long-term surveillance and maintenance, which will be carried out by the ARAO as part of the mandatory service of general economic interest.

A number of planned measures to improve safety were discussed for future development as regards the management of spent fuel and radioactive waste during the 7th Review meeting. In this section, the brief summary of the achievements are summarised.

Resolution on the National Programme

The new revision of the National Programme for Radioactive Waste and Spent Fuel Management for the Period 2023–2032 was adopted by the Slovenian Government in October 2022 and finally approved by the National Assembly in January 2023.

The 2023 Resolution was drafted as a continuation and update of the 2016 Resolution to remedy a few instances of non-compliance with EU Directive 2011/70/Euratom, pursuant to the Ionising Radiation Protection and Nuclear Safety Act – ZVISJV-1 (Official Gazette of the Republic of Slovenia, No. 76/17, 26/19, 172/21 and 18/23 – ZDU-1O; hereinafter: the 2017 Act) and all the regulations adopted on its basis. The 2023 Resolution was adopted primarily due to the improved estimates of radioactive waste and spent fuel inventories for all facilities and practices throughout the period of validity.

Key performance indicators for achieving the main objectives and 2023 Resolution strategies were added to enable more effective monitoring of the progress and implementation of the planned measures.

Completion for the ongoing 3rd PSR for the Krško NPP

The 3rd PSR project (PSR3) for the Krško NPP started in 2020 and was finished in December 2023. The implementation of the periodic safety review is one of conditions for the long-term operation of the Krško NPP, as required by the SNSA. Under the PSR3, Safety Factor 16 (Radioactive Waste and Spent Fuel) was reviewed in order to address all relevant aspects relating to the Krško NPP's radioactive waste and spent fuel management. It is planned that the implementation action plan shall be resolved by the end of 2028.

Completing the licensing process for building and the operation of the LILW disposal facility

The construction permit for the repository facilities of the LILW repository was issued in July 2022, but due to the filing of a lawsuit, it only became final in 2023. The construction permit for the infrastructure facilities of the LILW repository was issued in 2023.

Implementation of the outcomes from the IRRS/ARTEMIS mission

The IRRS mission took place on the premises of the SNSA from 4 to 14 April 2022. It was organised back-to-back with an ARTEMIS mission. The mission summed up its findings in 20 Recommendations, 21 suggestions, one example of Good Practice and three examples of Good Performance.

The SNSA and the SRPA prepared and started to implement the Action Plan intensively after the mission. The independence of the two regulatory bodies is already emphasised in the new Resolution on Nuclear and Radiation Safety in the Republic of Slovenia for the Period 2024–2033, adopted in 2023. Some of the requirements will be fulfilled with the revision of subsidiary legislation. Guidance on the treatment of human intrusion scenarios for the ARAO has also been added, which is to be taken into account before the next update of the safety analysis for the LILW repository. A few more actions have been completed following additional proposals from the mission.

The ARTEMIS mission was hosted by the ARAO in May 2022. The conclusion of the ARTEMIS team was that Slovenia has a comprehensive, robust and well-functioning system for spent fuel and radioactive waste management, while also noting areas where it could be further enhanced. The ARTEMIS team acknowledged that Slovenia will need to meet a number of critical milestones and objectives within the next years and needs to address the challenges in managing the operational and decommissioning waste from the Krško NPP by planning and developing the required infrastructure that is needed as its programme for the management of radioactive waste and spent fuel expands. The experts found Slovenia to have an exemplary commitment to the proactive pursuit of a wide range of opportunities for waste minimisation across all forms of radioactive waste.

Based on the mission's final report, an action plan was prepared in 2022 with measures to mitigate identified discrepancies. Subsequently in 2022 and 2023, many of the measures from the action plan were implemented.

Based on the evaluation of the fulfilment of the obligations under the Convention for the period since the last review meeting, several areas of good performance were identified:

- the Krško NPP made great improvements in dose reduction from waste manipulation in 2021, 2022, and 2023 by modernising the equipment used in the process;
- Key Performance Indicators (KPIs) were developed as a tool for quantitatively measuring progress towards reaching the goals and objectives of the new Resolution on the National Programme for Radioactive Waste and Spent Fuel Management;
- proactive pursuit of a wide range of opportunities for waste minimisation across all forms of radioactive waste.

Despite the progress achieved, some challenges remain open:

- the agreement with Croatia on the decommissioning of the NPP, the disposal of RW and the management of the SF;
- the timely commissioning and operation of the LILW repository;
- the closure of the Boršt hydro-metallurgical tailings disposal site at the Žirovski vrh uranium mine; and
- implementation of the outcomes from the IRRS/ARTEMIS mission.

SECTION B: POLICIES AND PRACTICES

Article 32, Paragraph 1: Reporting

In accordance with the provisions of Article 30, each Contracting Party shall submit a national report to each review meeting of Contracting Parties. This report shall address the measures taken to implement each of the obligations of the Convention. For each Contracting Party the report shall also address its:

(i) spent fuel management policy;

(ii) spent fuel management practices;

(iii) radioactive waste management policy;

(iv) radioactive waste management practices;

(v) criteria used to define and categorise radioactive waste.

(i) Spent Fuel Management Policy

The first strategic document related to radioactive waste and spent fuel management was approved in 1996, only five years after the Republic of Slovenia became independent. This document was the 1996 Strategy on Spent Fuel Management, which included general directions regarding how to manage all spent fuel in Slovenia.

On the basis of the Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on the Regulation of the Status and Other Legal Relations Regarding the Investment, Exploitation and Decommissioning of the Krško NPP (hereinafter: the Agreement), the Republic of Slovenia and the Republic of Croatia jointly prepared and approved a Programme for the Decommissioning of the Krško NPP and the Programme for Disposal of LILW and High-Level Waste. In accordance with the requirements from the Agreement, a revision of the documents should be adopted every five years.

In 2006, Slovenia approved the first revision of the national strategy: The Resolution on the 2006–2015 National Programme for Managing Radioactive Waste and Spent Nuclear Fuel (hereinafter: the 2006 Resolution). This resolution included all relevant topics regarding the management of radioactive waste and spent fuel, from legislation and the identification of different waste streams in Slovenia, to the management of radioactive waste and spent fuel. The 2006 Resolution duly implements the relevant provisions of the Agreement with Croatia.

In 2016, Slovenia adopted the second revision of the national strategy: The Resolution on the National Programme for Managing Radioactive Waste and Spent Nuclear Fuel 2016–2025 (hereinafter: the 2016 Resolution). Regarding spent fuel management and disposal, one of the main changes is that in the 2016 Resolution the dry storage of SF generated at the Krško NPP is foreseen to start approximately 6 years earlier, mainly for safety reasons.

As a consequence of the Fukushima nuclear accident in March 2011 and in view of reducing the risk of a nuclear accident at the Krško NPP and in light of the SNSA decision to assess the options for improving the safety of the spent fuel pool, the Krško NPP decided to construct a dry storage facility.

This was also addressed by the Intergovernmental Commission for monitoring the implementation of the bilateral Slovenian-Croatian Agreement on the Krško NPP at its 10th session in July 2015. The Intergovernmental Commission decided that the construction of a dry storage facility at the Krško NPP site to be used until the cessation of the NPP's operation is part of a joint solution to spent fuel disposal and in accordance with point seven of Article 10 of the bilateral Slovenian-Croatian Agreement on the Krško NPP. According to the decision of the Intergovernmental Commission, the construction and operation of the joint dry storage facility until 2043 should be financed from the Krško NPP's operational costs.

The dry storage facility for spent fuel at the Krško NPP will serve for the storage of all HLW and spent fuel generated at the NPP until a deep geological repository is set up.

The Krško NPP obtained a construction permit in December 2020. Construction of a new facility started in 2021 and ended in 2022. The dry storage facility operation started in March 2023, followed by the first campaign of 592 spent fuel assemblies relocated from the spent fuel pool.

Figure 2: **Transfer of storage casks loaded with spent fuel assemblies to the dry storage facility**

The facility is a significant safety upgrade which, with its passive nature and reduction of the amount of SF in the pool, enhances nuclear safety.

In January 2023, the Slovenian Parliament adopted the Resolution on the National Programme for Radioactive Waste and Spent Fuel Management for the Period 2023–2032 (hereinafter: the 2023 Resolution). The 2023 Resolution was drafted as a continuation and update of the 2016 Resolution to remedy a few instances of non-compliance with Directive 2011/70/Euratom, pursuant to the 2017 Act and all the regulations adopted on its basis.

Both the 2016 and 2023 Resolutions require that the Krško NPP spent fuel owners evaluate reprocessing as an option that could reduce the volume and radiotoxicity of waste for final disposal.

After the period of dry storage, spent fuel or high-level waste generated from the Krško NPP decommissioning or spent fuel processing is to be further treated, packaged, and disposed of. For spent fuel or HLW, a deep geological repository should be built to ensure adequate isolation of the waste from the environment.

The disposal of HLW and spent fuel in a deep geological repository (national, regional or multinational) or any of the other disposal options (e.g. disposal in deep boreholes) is an urgent and necessary solution regardless of the selected option of storage, processing and other forms of spent fuel and HLW management prior to disposal.

In the national strategy, the search for a location is to start in 2045, along with the procedure for the siting of the repository, the national spatial plan determining the location of the repository for spent fuel and HLW is to be drawn up and adopted by 2055, and the location is to be finally approved in 2055. The construction of the spent fuel and HLW repository is to be carried out between 2055 and 2065, with the repository becoming operational in 2065. The repository is to operate for 10 years, then it is to be decommissioned and closed after 2075, when the long-term monitoring and maintenance of the repository is to start. There is a possibility of a different solution being agreed on within the Intergovernmental Commission (the commitment to seek a joint solution) and/or an international solution for the permanent disposal of spent fuel and HLW.

Both the 2016 and 2023 Resolutions included the option of shared facilities and regional cooperation in waste management, including a dual-track approach. For long-term spent fuel management, a dual-track strategy has been adopted as a reasonable solution in the present situation. The dual-track approach in the

Slovenian strategy includes the option of multinational disposal and the basic reference conceptual scenario for national geological disposal.

Given that the operator of the TRIGA Mark II research reactor decided to continue the operation of the facility, according to 2023 Resolution, the operator and the owner of the TRIGA Mark II research reactor are to explore the option of returning the spent fuel to the USA, the country of origin. If the return is not feasible under acceptable terms, an analysis of possible solutions for the storage and disposal of spent fuel from the research reactor after its shutdown must be prepared that will include options for the reprocessing, storage and disposal of spent fuel from the TRIGA Mark II research reactor and seeking solutions for the disposal of spent fuel and HLW from the Krško NPP.

The ARAO, as the provider of a mandatory service of general economic interest in Slovenia, will continue to monitor international developments in spent fuel and HLW management – permanently. According to the 2023 Resolution, the ARAO is to conduct planning and carry out development-related activities for the continuation of dry storage after the cessation of Krško NPP operation and for ensuring the final disposal of the spent fuel and HLW generated by the Krško NPP, and of the reprocessed spent fuel and HLW generated by the TRIGA Mark II research reactor and the Krško NPP, in a national, regional, or multinational repository.

(ii) Spent Fuel Management Practices

The Republic of Slovenia has no facilities for off-site management of spent fuel. The spent fuel generated by the Krško NPP and the JSI Reactor Infrastructure Centre (the TRIGA Mark II research reactor) is managed in wet storage and/or dry storage facilities that are an integrated part of these nuclear facilities.

Krško NPP

Spent fuel is stored in the Spent Fuel Pool (SFP) inside the Fuel Handling Building (FHB, wet storage), as well as in the Dry Storage Building (DSB, dry storage) inside a HI-STORM cask of the Krško NPP. As of the end of 2023:

- 885 locations in the SFP are filled with nuclear fuel, and
- 592 spent fuel assemblies are stored inside the DSB.

Part of the spent fuel was transferred to the DSB in the 1st dry storage campaign in 2023 (16 casks, each containing 37 spent nuclear fuel assemblies), later to be followed by other campaigns.

Technical characteristics of the spent fuel pool

In 2003, the project of increasing the storage capacity of the spent fuel pool (reracking) was completed. Following the reracking, 1,694 storage locations are available for spent fuel. Following the accident at Fukushima in 2011, more restrictive requirements were implemented for the safe storage of nuclear fuel in the spent fuel pool under potential beyond design bases accidents.

The spent fuel racks are now of two types. The old racks are designed without neutron poison control. These racks provide 621 cells (6 × 72, plus 3 × 63 cells), and constitute a storage capacity for spent fuel plus one full core for emergency unload. The new racks are designed with neutron poison control and comprise nine modules providing 1,073 usable cells.

The spent fuel racks are designed to withstand shipping, handling, normal operating loads (impact and dead loads of fuel assemblies), and Safe Shutdown Earthquake and Operating Base Earthquake seismic loads meeting Seismic Category I and American Institute of Steel Construction requirements.

The spent fuel pool structure is made of reinforced concrete. The walls and floor of the pool are covered with a stainless-steel liner. Underneath the liner plates there is a system of embedded leak collection channels. A spent fuel pool leak detection system is provided to monitor the integrity of the liner of the spent fuel pool, the fuel transfer canal, and the cask loading area.

Removable gates are provided in the spent fuel pool to enable the submerged transfer of fuel assemblies between the spent fuel pool and the transfer canal or the cask loading area. When the gates are in place, the canal and the cask loading area may be drained.

The spent fuel pool cooling and clean-up system is designed to remove the decay heat generated by the spent fuel assemblies stored in the spent fuel pool and to maintain the cooling water at the desired temperature, level, clarity and chemical specifications. The cooling system consists of two redundant pumps and three heat exchangers with associated piping, valves and instrumentation. The third heat exchanger was installed in April 2002 in the framework of spent fuel pool reracking.

The water purification system with a spent fuel pool demineraliser and filter is designed to provide adequate purification in order to enable the plant personnel unrestricted access to the spent fuel storage area and to maintain the optical clarity of the spent fuel cooling water. Water surface clarity is maintained by the operation of the spent fuel skimmer system.

System piping is arranged in such a way that the failure of any pipeline cannot drain the spent fuel pool below the water level required for radiation shielding. A depth of approximately 3.05 m of water over the top of the stored spent fuel assemblies is required to limit direct radiation to 0.025 mSv/h.

Whenever a fuel assembly with defective cladding is removed from the reactor core, a small quantity of fission products may enter the spent fuel cooling water. The provided purification loop removes fission products and other contaminants from the water. By maintaining radioactivity concentrations in the spent fuel cooling water at 18.4×10^4 Bq/cm^3 (β and γ radiation) or less, the dose at the water surface is 0.025 mSv/h or less, thus providing the plant personnel unrestricted access.

A criticality analysis for the spent fuel pit racks was performed as a design basis criterion. For the old racks, calculations were performed for an infinite array of cells with a spacing of 296.42 mm by 304.80 mm to verify that the configuration is critically safe. For the new racks, criticality safety is ensured by geometrically safe configuration, the use of a borated stainless steel absorber sheet and a procedure to verify that the reactivity equivalence curve is met.

Technical characteristics of the dry storage building

As a consequence of the Fukushima nuclear accident in March 2011, in view of reducing the risk of a nuclear accident at the Krško NPP and in light of the SNSA decision to assess the options for improving the safety of the spent fuel pool, a decision was made to construct a dry storage facility for spent fuel with a design lifetime of 100 years. The dry storage facility was put into operation in March 2023, closely followed by the first spent fuel transfer campaign.

The whole system has a separate Final Safety Analysis Report (FSAR) and is designed to safely operate under all normal, abnormal and postulated accident conditions as defined by Krško NPP Design Extended Conditions.

The dry storage building is designed to hold 70 dry storage casks (holding all spent fuel to be produced within the 60 years lifetime of the plant + 10% extra space for operational reserve). The dry storage cask is of a multipurpose vertical design type with each cask holding up to 37 spent fuel assemblies with inserts.

It utilises passive cooling for its operation and therefore requires no additional systems for its operation.

Fuel management strategy

Part of the spent fuel is stored in the spent fuel pool and part in the dry storage cask. To minimise the amount of spent fuel and reduce fuel costs, the Krško NPP is extending the burnup of fuel elements. The average spent fuel burnup in the spent fuel pool is 39.6 GWD/MTU, while the last three spent fuel regions had an average burnup of 52.3 GWD/MTU. The Low Leakage Loading Pattern was introduced in the design several years ago. By using this type of design, an additional reduction in spent fuel production was achieved.

Fuel assemblies that are determined to be of no further use for future core designs are stored in the spent fuel pool and declared as spent nuclear fuel or are placed inside dry storage casks and transferred to the dry storage building. The Krško NPP is applying a balanced approach when choosing spent fuel for dry storage to even out the heat loads and dose rates throughout the lifetime of the plant. Half of the stored spent fuel is older (cooler) and part of the spent fuel is newer (hotter), saving some of the older spent fuel for the final campaign.

The JSI Reactor Infrastructure Centre

Two spent fuel pools are part of the TRIGA Mark II research reactor. The first spent fuel pool was constructed with the reactor in 1966 and is no longer used. The second one was constructed in 1992. Its capacity is 195 spent fuel elements, and it is located in the basement of the reactor building. It is accessible by crane through a cover in the reactor hall floor. The pool is 3.5 m deep and is lined with stainless steel sheets. Water samples are taken and measured on a gamma spectrometer on a weekly basis.

Both pools have been empty since 1999, when all spent fuel elements (219) were shipped to the USA. The new pool is maintained as operational and prepared for immediate use if necessary.

In 2007, 10 fresh fuel elements were transferred to the French company AREVA and shipped to France. The total number of the remaining fuel elements (irradiated and fresh) at the reactor is 84.

A detailed criticality analysis of the spent fuel racks design was performed. Heat removal is not applicable for the TRIGA Mark II research reactor fuel. A safety analysis of accidents involving spent fuel during normal operation and fuel handling was performed and is included in the safety analysis report.

(iii) Radioactive Waste Management Policy

In the 2016 and the 2023 Resolutions, LILW management is treated as an integral process, covering all stages from waste generation to waste disposal. Various current and near-future radioactive waste streams are taken into account, considering both present and planned waste management practices. Besides radioactive waste from the Krško NPP, other small generators (from medicine, industry and research) and other activities involving radioactive waste (the uranium mine undergoing closure activities, NORM, the decommissioning of reactors, etc.) are also described. The Programme includes an analysis of measures for the minimisation of radioactive waste generation and its treatment and conditioning before disposal.

The strategy for radioactive waste management during the operation of nuclear and radiation facilities is founded on the principle of using such processes, technologies, and methods that generate the least operational waste, and on further radioactive waste management that reduces the waste volume in the radioactive waste storage facilities and at their final disposal sites. The strategy promotes the usage of such processes, technologies, and methods that reduce the volume and quantity of radioactive waste and meet the waste acceptance criteria for final disposal, where they exist.

The prime responsibility for radioactive waste management in nuclear and radiation facilities rests with the holders of operating licences. Radioactive waste is to be managed in accordance with the approved safety analysis reports for the operation of individual nuclear facilities. Storage is to be implemented for the purpose of efficient and safe phased disposal at the LILW repository. In the field of radioactive waste management, the strategy promotes the concept of the clearance of radioactive materials from regulatory control in accordance with the prescribed criteria in order to avoid the unnecessary generation of radioactive waste.

The construction and operation of a repository for short-lived LILW is one of the principal goals of LILW management in Slovenia.

A significant step forward in solving this problem was made by the selection and approval of a site for LILW disposal in 2009. The Vrbina site in the municipality of Krško was adopted by the governmental decree on the national spatial plan. The selected type of repository envisages the disposal of LILW by packing it in appropriate containers and depositing it in near-surface disposal units – silos. The location and design of the repository allow for further expansion with the construction of additional silos. The disposal concept combines the properties of surface repositories (surface deposition) and those of underground repositories (depositing disposal units in low permeable water-saturated geological formations).

The Vrbina LILW repository is equipped with technological systems and devices that are technically necessary for the disposal of waste conditioned in disposal containers. Waste will be conditioned for disposal at the Krško NPP site. Disposal containers that are suitably certified and allow relatively easy transport and handling are to be used in conditioning for disposal.

The Vrbina repository will thus accommodate half of the LILW from the Krško NPP (i.e. LILW generated during the operation and decommissioning of the Krško NPP and also other LILW, such as replaced or removed equipment). In addition, the repository will also accommodate LILW from the CSF, LILW from the decommissioning of the CSF and the TRIGA Mark II reactor, as well as LILW generated during the operation, decommissioning and closure of the repository. An exception is LILW that will be generated by the decommissioning of the dry storage facility at the Krško NPP after the Vrbina repository is already closed according to current plans. A solution for the disposal thereof will be sought when HLW and spent fuel is to be disposed of.

In April 2019, following the examination and supplementation of the documents for the LILW repository, which included the environmental impact report, the draft safety report, the conceptual design, the design basis, the expert opinion of an approved expert in radiation and nuclear safety and other reference documents, the SNSA issued a draft prior consent regarding nuclear and radiation safety. At the end of 2019, a transboundary environmental impact assessment procedure was initiated, which was carried out throughout 2020 and the first half of 2021 and successfully concluded in June 2021. Following the public display of documentation in 2020 and public debate, the LILW repository project was granted environmental approval by way of decision No 35402-29/2017-169 adopted by the Slovenian Environment Agency on 30 June 2021 and a supplementary decision on environmental approval, No 35402-29/2017-172 of 5 July 2021. In January 2022, the SNSA approved the safety analysis report for the Vrbina LILW repository, Krško, by issuing opinion No 3510-3/2019/162 on the construction of the LILW repository.

The building permit for the disposal part of the LILW repository No 35105-95/2021-2550/37 was issued in July 2022 and became final in 2023 after a lawsuit against the building permit was rejected by an administrative court. The building permit for the infrastructure part of the LILW repository (the access road, sewage system, water supply, electric and communication systems, etc.) was granted in April 2023 and construction started in mid-2023. The disposal part of the repository with silo construction, the technological building and other will start in the summer of 2024. According to the repository timetable, trial operation is planned to start in the second half of 2027 and regular operation in the 2028.

Responsibility in the field of LILW management is clearly defined. Three independent parties – the generators of radioactive waste, the SNSA as the regulatory body, and the ARAO as the provider of radioactive waste management as a mandatory service of general economic interest – are involved in the process of radioactive waste management. The operators of nuclear and other radiation facilities are responsible for radioactive waste management at their facilities. The ARAO is an independent implementing organisation that concludes contracts in connection with its activities within the ministry competent for the waste management. The ARAO has responsibility for takeover, collection, transport, preliminary treatment and storage prior to disposal, the construction of a repository, and the disposal of radioactive waste and spent fuel not originating from power-generating nuclear facilities. The ARAO's mandatory service of general economic interest also encompasses the conditioning of radioactive waste and spent fuel prior to its disposal and the disposal of radioactive waste and spent fuel originating from power-generating nuclear facilities, as well as the management, long-term surveillance and maintenance of the disposal sites for mine and hydro-metallurgical tailings originating from the extraction and exploitation of nuclear minerals, and the management and long-term surveillance and maintenance of radioactive waste and spent fuel repositories. All activities are made transparent to the public through annual reports, via the internet and through outreach activities.

(iv) Radioactive Waste Management Practices

Within the scope of the Convention, the Central Storage Facility for Radioactive Waste in Brinje, the Boršt hydro-metallurgical tailings disposal site and the Jazbec mine waste disposal site at the former Žirovski Vrh Uranium Mine are the only radioactive waste management facilities in the Republic of Slovenia. The LILW that is generated by the operation of the Krško NPP is managed and stored at the Krško NPP site, while the waste produced by the operation of small producers (the JSI Reactor Infrastructure Centre and in industry, research and medicine) is managed in the Central Storage Facility for Radioactive Waste in Brinje.

Central Storage Facility for Radioactive Waste in Brinje

Institutional radioactive waste is stored in the Central Storage Facility (CSF), situated in Brinje near Ljubljana. The facility holds an operating license valid until the year 2028 and it is operated by the ARAO. In addition to the facility operating license, the ARAO also possesses a license for the following activities:

- the collection of radioactive waste from known waste generators or holders;
- the collection of radioactive waste in cases where the waste generator is unknown;
- the collection of radioactive waste in the event of accidents;
- the dismantling of devices containing sealed radioactive sources at the user's premises (less complex sources);
- the treatment and conditioning of radioactive waste for storage purposes, and
- the transport of radioactive materials.

The Radioactive Waste Management Program, revision 4 from 2020, is in force. It includes information on the organisation of activities, methods of carrying them out, recording and reporting procedures, definitions of responsibility for service provision, details on essential documents for activity implementation, packaging information, details on types, categories, and origins of radioactive waste, procedures and methods for handling it, measures to minimise radioactive waste generation, licenses and capacities. Additionally, it emphasises the consideration of interdependence between all levels of management and the harmonisation of management procedures with the 2023 Resolution.

The activities conducted on stored radioactive waste in the CSF include waste processing for storage. This process encompasses segregation, cutting larger pieces into smaller ones, packaging, repackaging, disassembling devices containing radiation sources into radioactive and non-radioactive components, and solidifying liquids. Some of these activities result in the waste occupying less space in the storage facility after processing than it did in its unprocessed form. Over the past decade, there have also been exports of radioactive waste abroad for recycling or repatriation to the country of origin. Additionally, the concept of "clearance" has been applied, wherein radioactive materials are released from regulatory control when their activity decreases below clearance levels due to radioactive decay.

The structures, systems, and components of the CSF undergo regular maintenance and updates. The facility adheres to an aging programme, incorporating technological advancements and adopting best practices. A series of new documents related to the CSF and revisions of existing documents have been produced in the last three-year period, including the third revision of the safety report for the CSF. The measures from the action plan of the first periodic safety review of the CSF have been implemented. Activities for the next safety review will commence at the end of 2024 with the development of the programme for the second periodic safety review of the facility.

Žirovski Vrh Uranium Mine

The uranium mine ceased operation in the summer of 1990. The environmental remediation project which ensures conditions for the closure of mining facilities is carried out by the public company Žirovski Vrh Mine d.o.o. Long-term surveillance and maintenance of the mine waste disposal site and the hydro-metallurgical tailings disposal site after their closure is ensured by the ARAO. Environmental remediation activities as well as long-term management activities are financed from the national budget.

All surfaces in the mining area affected by uranium production have been decontaminated and have been returned to unrestricted land use. The contaminated material produced by mining, uranium ore processing and decontamination has been disposed of at two disposal sites nearby the mine: the Jazbec mine waste disposal site and the Boršt hydro-metallurgical tailings disposal site. All other former temporary mine waste disposal piles and contaminated waste materials (metal, plastics and construction waste) have been relocated to the Jazbec mine waste disposal site.

Parts of the mine's galleries have been backfilled with mine waste and some contaminated scrap material arising from the decommissioning of the ore processing area. All entrances to the mine have been sealed. Long-term monitoring of the water flow and the radiological and chemical parameters of mine water discharges is ensured by the ARAO.

No regular monitoring is required at the decommissioned site where the processing of uranium ore took place. The site was released without restriction to the local municipality for the development of the local economy.

Environmental remediation works at the Jazbec mine waste disposal site were finished in 2009. A five-year transitional post-operational period followed when the efficiency of the remediation measures was checked by monitoring the relevant radiological and chemical parameters. After proving that the remediation had been successful, the administrative procedure for the permanent closure of the mine waste disposal site was completed in 2015. The area acquired the status of a facility of the state infrastructure. The management of the site with the aim of maintaining the achieved environmental performance of the site has been assigned to the ARAO. The scope of long-term surveillance is defined in the safety report, which must be reviewed every ten years or more frequently in the case of extraordinary events. The revision of the safety report regarding the monitoring programme and authorised limit values for air and water discharges was confirmed in 2019.

The Boršt hydro-metallurgical tailings disposal site is situated on a hillside, 535–565 m above sea level. The environmental remediation of the Boršt hydro-metallurgical tailings disposal site is not yet finished and the conditions for its closure are not yet fulfilled. The main problem is a landslide at the base of the tailings site.

In 2015 and 2016, two studies were carried out. In the first study, the distribution of tailings in the case of an extraordinary event (e.g. intensive rain or an earthquake) was assessed. On the basis of the study, the Ministry of the Environment and Spatial Planning ordered an additional study on the radiation exposure of residents and the workers who would carry out the remediation of the deposited material on the riverbeds of the Todraščica, Brebovščica and Poljanska Sora Rivers. Dose assessment covered all important exposure pathways originating from disposal material. In the event of the total disintegration of the disposal facility, the radiological impact on the environment and the local population in the Todraščica Valley would be 4.52 mSv/year for a member of the public who would remain there and continue to live as before. This is one order of magnitude higher than during the operational period of the mine. The authorised limit for population exposure after the remediation of the uranium exploration site was set at 0.3 mSv/year. A conservative exposure assessment was carried out also for workers engaged in remediation work. The workers would receive 1.5-2.9 mSv/year. In 2021, an additional study was carried out in order to assess the consequences of the worst-case scenario of an extraordinary event (extreme rainfall combined with an earthquake) in terms of radiation protection and assessment of the additional radiation exposure of the residents and workers carrying out remediation.

The results of both studies were included in the revised safety report.

In the meantime, it was decided to implement the emergency drainage measures that were proposed by the expert advisory board. In years 2016 and 2017 new drainage holes in the passageway of the tunnel under the hydro-metallurgical tailings of the Boršt site were added to the existing drainage system. Furthermore, it is supposed that the groundwater level will not rise critically in the case of intensive or long-lasting precipitants and that it will be lower in the pile's base and in the pile itself in the impact area of drainage wells.

In 2018, the Expert Project Council for monitoring the remediation work on the hydro-metallurgical tailings prepared a final report. The effects of the maintenance, monitoring and intervention measures to reduce the groundwater impact on the stability of the Boršt hydro-metallurgical tailings performed between 2010 and 2018 were assessed, as well as the current state at the Boršt disposal site. The current rate of movement is approximately 2 cm per year (2023). Although an expert group concluded that the probability of the collapse of the slope is negligible, they proposed the investigation of the landslide by additional deep piezometers. In 2019, the monitoring network of the Boršt hydro-metallurgical tailings disposal site was renovated and upgraded with nine additional deep piezometers.

In 2021, an additional study was carried out. In the study, the assessment of the consequences of the worst-case scenario of an extraordinary event (extreme rainfall combined with an earthquake) in terms of radiation protection and assessment of the additional radiation exposure of the residents and workers carrying out remediation were assessed. The authors of the study concluded that only a fraction of the landslide material would travel to the valley, and damming the stream in terms of total damming would not occur.

The current arrangement of the hydro-metallurgical tailings ensures protection against background waters, prevention of the spread of soluble components into underground and surface waters, the reduction of radon exhalation and the prevention of erosion by rainfall. The multilayer cover with a total thickness of 2.05 m is composed of a drainage layer (mine waste and crushed stone), compacted clay (the sealing layer), local material (the protecting layer), and grassed topsoil. The radon exhalation rate from the hydro-metallurgical surface before the arrangement was 1 – 5 Bq/m^2s, and after final arrangement it is now less than 0.1 Bq/m²s. Institutional control of the radioactivity of the effluent water, ground water, air, ground water level, surface integrity and stability will be needed in the future.

The safety report for the Boršt hydrometallurgical tailings disposal site is under revision. This is the basic document for the closure of the disposal facility and the transition to long-term surveillance and maintenance, which will be carried out by the ARAO as part of a mandatory service of general economic interest.

By carrying out the final arrangements of the Boršt hydro-metallurgical tailings disposal site and the Jazbec mine waste disposal site, the radiation limitations set according to the authorised limits were achieved.

Krško NPP

The Krško NPP has its own Radioactive Waste Management Programme, supplemented by a technical report. The Programme is revised and updated at least every two years. The Krško NPP considers this document a valuable source of input for future decision-making and long-term planning in the area of operational radioactive waste management. Waste generation rates are predicted based on the present situation and future options. The available storage capacity for radioactive waste at the Krško NPP is assessed by extrapolation. In addition, a Radioactive Waste Committee was formed at the Krško NPP as an interdisciplinary team, through which communication and transparency in the area of radioactive waste management have been enhanced. Due to slow progress in the construction of the repository for LILW, the storage capacities at the NPP are almost exhausted. The NPP provided additional storage capacity in the waste preconditioning area of the storage building. The entrance area of the storage building has been adjusted for the preconditioning of waste by the construction of a Waste Manipulation Building. With the construction of the Waste Manipulation Building, the plant provided new premises for the storage of drums in the process of the manipulation and preparation for transport, collection, and sorting of radioactive waste.

Radioactive waste treatment and conditioning

During the operation of the Krško NPP, various radioactive substances in liquid, gaseous and solid form are generated. Radioactive substances are collected, segregated and processed to obtain a final form for storage in the plant's radioactive waste storage locations. Depending on the processing method, radioactive substances are collected and segregated. These radioactive substances are processed in a system for radioactive waste treatment. The system is constructed for collecting, processing, storing and packaging waste in a suitable form to minimise releases into the environment. Three fundamental systems are used for radioactive waste management, i.e. systems for liquid, solid and gaseous radioactive waste.

The plant is provided with a **Gaseous Waste Processing System** consisting of two parallel closed loops with compressors and catalytic hydrogen recombiners and six decay tanks for compressed fission gases. Four of the tanks are used during normal plant operation, while the remaining two are used during reactor shutdown. The capacity of the tanks is adequate for more than one month's gaseous waste hold-up. Within this period, the majority of the short-lived fission gases decay, while the remaining gases are released into the atmosphere under favourable meteorological conditions. Automatic radiation monitors in the ventilation duct prevent uncontrolled release when the radioactive gas concentration exceeds the permissible level.

Liquid radioactive waste arising from all sources during the operation of the Krško NPP is processed by the **Liquid Waste Processing System**, consisting of tanks, pumps, filters, evaporators and two demineralisers. The system is designed to collect, segregate, process, recycle and discharge liquid radioactive waste. The system design considers the potential exposure of personnel and ensures that the quantity of radioactivity released into the environment is as low as reasonably achievable.

All solid radioactive waste generated during plant operation, maintenance activities and servicing is collected in the Solid Radwaste Storage Facility. Used spent resins, evaporator concentrates (boric acid), used filters and other contaminated solid waste, such as paper, towels, working clothes, laboratory equipment and various tools, form most of the solid waste. Compressible solid waste is compressed and encapsulated in standard 208 l drums, while dried evaporator concentrate and sludges and dried spent resin are stored in stainless steel drums. These drums are presently stored in the Solid Radwaste Storage Facility within the plant area.

The radioactive waste volume reduction programme

Numerous programme improvements, design changes and work practice improvements have been pursued at the Krško NPP to decrease the generation rate of radioactive waste of various types. With the introduction of an 18-month fuel cycle, the generation of radioactive waste has been additionally reduced.

Segregation techniques are used for collecting non-contaminated materials separately, which allows waste streams to be processed separately. Metal materials exceeding exemption/clearance levels are stored onsite before melting. To reduce the volume of the solid radioactive waste to be stored, super compaction campaigns are carried out.

The original Westinghouse procedure for evaporator bottoms and spent resin treatment was replaced with a treatment system for these types of waste called the In-drum Drying System. The drying process converts the accumulated wet spent resins into a dry free-flowing bead resin condition. The dried primary resins are filled directly into 200 l stainless steel heavy drums with biological shields (150 l of usable volume). Dried secondary spent resins are filled into 200 l stainless steel drums without biological shields. The drying and volume reduction process for evaporator bottoms and sludges converts the concentrate into dry solid waste products with low residual moisture and no free water. The Krško NPP uses an external service for the incineration of combustible waste and the melting of radioactive metallic waste material.

The risks associated with radioactive waste management are kept reasonably low. Different types of waste are segregated in an early collection phase and stored separately to avoid chemical interactions. Tube-type containers are used as an overpack for the storage of standard 200 l drums and the products of super compaction in the plant's radioactive waste storage facility. Any new type of radioactive waste resulting from a new technology being used is evaluated and incorporated into the safety analysis report.

Safety Review

The 3rd Krško NPP periodic safety review was completed on 4 December 2023. For the first time, a separate safety factor regarding radioactive waste and spent fuel management was reviewed separately from the other safety factors. The radioactive waste management programme was reviewed, including an evaluation of the design basis for the durability and integrity of waste packages. The periodic safety review showed that the durability and integrity of the radioactive waste packages are within acceptable levels.

There was also a recommendation by the IRRS mission in 2011 dealing with strengthening administrative control over the storage of radioactive waste at the Krško NPP, particularly in terms of the accessibility and integrity of the containers. After the IRRS mission in 2011, a thorough analysis was carried out that showed that any solution to this problem before the removal of the waste to the final repository would represent such an additional radiation protection burden and such costs that could not justify the small benefit of slightly reducing the current risk. The final repository is expected to be operational in a few years.

Small Generators of Radioactive Waste in the Republic of Slovenia

Management of institutional radioactive waste (from medical and industrial applications and research activities) was delegated to the relevant public utility as a mandatory service of general economic interest, i.e. to the radioactive waste management organisation ARAO. This includes the collection of waste at the generator' premises, the transport of waste, and the treatment, conditioning, storage and disposal of waste. The ARAO is also responsible for the management of radioactive waste in the event of industrial accidents and for historical waste.

The Jožef Stefan Institute Reactor Infrastructure Centre

Only a small amount of solid radioactive waste has been produced during the lifetime of the TRIGA Mark II research reactor (approximately 200 litres per year). This waste mainly consists of contaminated material and equipment (paper, plastics, glassware, etc.) and contaminated mechanical and chemical filters (e.g. ion exchange resins). Spent resins are collected in drums. The activity content is estimated to be less than 1 GBq/m^3. The waste is transferred to the CSF in Brinje.

The reactor does not directly produce any radioactive liquid waste. However, some radioactive liquids are generated during the chemical treatment of irradiated samples in the adjacent research laboratories. All liquid waste is collected and further conditioned. Wastewater containing radionuclides is collected in a special

20 m^3 decay tank. After measuring the isotope concentration and activity, the liquids are released into the Sava River under the prescribed limits.

No gaseous radioactive waste that needs further treatment or storage is produced. Radioactive gases generated due to normal reactor operation (mainly argon) are released through controlled atmospheric release venting.

Radioactive Waste Management in Industry and Research

Radioactive sources are widely used in industry and research. There are a number of industrial applications, for example in industrial radiography, thickness, level and density gauges, moisture detectors, eliminators of static electricity, etc. In the Republic of Slovenia, 72 industrial and research organisations were using 703 sealed sources as of the end of 2023. Spent and disused radioactive sources were either returned to the suppliers or shipped to the CSF in Brinje.

The requirements for the use and storage of disused radioactive sources and waste are set out in the 2017 Act (Articles 16–23). A licence must be obtained to conduct radiation practices. An applicant shall submit a plan for the use and storage of the radiation source, as well as a plan for the handling of the radioactive waste resulting from the radiation practice.

During the decontamination and decommissioning of buildings at the Reactor Infrastructure Centre of the Jožef Stefan Institute used for the processing of uranium ore, which took place from 2005 until 2007, as many as 31 drums of waste contaminated with naturally occurring radioactive material (NORM) were produced. Part of this material (12 drums) was transferred to the CSF in February 2010. In accordance with the SNSA's approval of conditional clearance, the Institute sent part of the material, i.e. 12 drums of contaminated construction material and soil, to a municipal landfill in June 2011. Three drums containing scrap metal were, based on the SNSA's approval of the clearance, transferred to a scrap metal collector in 2020. Another four drums, containing mostly contaminated wood, were transferred to the CSF in Brinje.

Radioactive Waste Management in Medicine

In the Republic of Slovenia, unsealed radioactive sources (radiopharmaceuticals) for diagnostics and therapy are used in seven clinics or hospitals. The main users are the Institute of Oncology and the Ljubljana University Medical Centre's Division of Nuclear Medicine. There is no production of radiopharmaceuticals in the Republic of Slovenia.

The Institute of Oncology imported (among other sources) 0.39 TBq of ^{131}I, and the Ljubljana University Medical Centre's Division of Nuclear Medicine imported 0.50 TBq of ^{131}I in 2023. All other users together imported 0.08 TBq of ^{131}I in 2023. The Institute of Oncology uses decay storage tanks to control releases of radioactive effluents. The Ljubljana University Medical Centre's Division of Nuclear Medicine releases the effluents directly into sewerage systems. Patients from other hospitals are not hospitalised. It is estimated that less than 0.3 TBq of ^{131}I is released annually into the environment.

Short-lived radioactive waste (residues contaminated with ^{131}I, ^{123}I, ^{125}I, ^{99m}Tc, ^{99}Mo, ^{201}Tl, ^{177}Lu, ^{90}Y, ^{111}In, ^{67}Ga, ^{18}F or ^{223}Ra) produced during medical practices is stored locally at the users' locations. After decay, the material is transferred to the municipal disposal sites. Some municipal waste disposal sites are equipped with portal radiation monitors, which have raised an alarm on several occasions in the last ten years. It was determined that certain short-lived radioisotopes from medical practices had not decayed below clearance levels before being transferred to the disposal site. Corrective measures and procedures were later agreed upon and implemented by medical institutions.

Other small amounts of solid radioactive waste, mainly containing ^{57}Co, ^{137}Cs, ^{68}Ge, ^{153}Gd or ^{106}Ru (in total, less than 1 GBq) are temporarily stored at local sites and periodically transported to the CSF in Brinje.

(v) Criteria used to define and categorise radioactive waste

The Regulation on Radioactive Waste Management and Classification of Radioactive Waste takes into account, with some modifications, the radioactive waste categorisation system recommended by the "EC Recommendation on a Classification System for Solid Radioactive Waste" (OJ L 265, 13 October 1999, p. 37).

The provisions of this regulation apply to substances in gaseous, liquid or solid form; they apply to objects or equipment containing radioactive substances or that are so contaminated that they exceed clearance levels, if generated as waste from radiation practices or from intervention measures, if their holder intends or has to discard them since their further use is not foreseen, or if the holder does not have a licence for their use in accordance with the regulations on protection against ionising radiation.

Regarding their aggregation state, radioactive waste is divided into solid, liquid and gaseous waste.

Regarding the level and type of radioactivity, solid radioactive waste is categorised as follows:

1. transitional radioactive waste;
2. very low-level radioactive waste, for which the competent regulatory body for nuclear and radiation safety may approve conditional clearance;
3. low- and intermediate-level radioactive waste (LILW), with insignificant heat generation, which is classified into two groups:
   - 3.1.1 short-lived LILW, containing radionuclides with a half-life shorter than 30 years and a specific activity of alpha emitters equal to or lower than 4,000 Bq/g for an individual package, but on average not higher than 400 Bq/g in the overall amount of LILW;
   - 3.1.2 long-lived LILW, where the specific activity of alpha emitters exceeds the limitations for short-lived LILW;
4. high-level radioactive waste, which contains radionuclides whose decay generates such an amount of heat that this has to be considered in its management;
5. radioactive waste containing naturally occurring radionuclides that are produced in the processing of nuclear mineral materials or other industrial processes and are not sealed sources of radiation in accordance with the regulations on the use of radioactive sources and radiation practices.

The Decree on Activities Involving Radiation defines the clearance of radioactive material.

The regulatory control of solid radioactive material is terminated with a decision of the ministry competent for natural resources and spatial planning or health, if the specific concentration of radionuclides in the material does not exceed the values determined in Table 1 or Table 2 of the Decree on Activities Involving Radiation (clearance levels). In case the specific concentration of radionuclides in the material exceeds clearance levels, the decision on clearance is based on a radiation protection assessment.

SECTION C: SCOPE OF APPLICATION

Article 3: Scope of Application

1. *This Convention shall apply to the safety of spent fuel management when the spent fuel results from the operation of civilian nuclear reactors. Spent fuel held at reprocessing facilities as part of a reprocessing activity is not covered in the scope of this Convention unless the Contracting Party declares reprocessing to be part of spent fuel management.*
2. *This Convention shall also apply to the safety of radioactive waste management when the radioactive waste results from civilian applications. However, this Convention shall not apply to waste that contains only naturally occurring radioactive materials and that does not originate from the nuclear fuel cycle, unless it constitutes a disused sealed source or it is declared as radioactive waste for the purposes of this Convention by the Contracting Party.*
3. *This Convention shall not apply to the safety of management of spent fuel or radioactive waste within military or defence programmes, unless declared as spent fuel or radioactive waste for the purposes of this Convention by the Contracting Party. However, this Convention shall apply to the safety of management of spent fuel and radioactive waste from military or defence programmes if and when such materials are transferred permanently to and managed within exclusively civilian programmes.*
4. *This Convention shall also apply to discharges as provided for in Articles 4, 7, 11, 14, 24 and 26.*

The Convention applies to the safety of spent fuel management at the Krško NPP and at the JSI Reactor Infrastructure Centre. There is no reprocessing facility in the country.

It also applies to the safety of the operational waste from the Krško NPP, the safety of the mining, milling and decommissioning waste from the Žirovski Vrh Uranium Mine and the safety of the waste from small non-power applications which are stored in the Central Storage Facility for Radioactive Waste in Brinje.

The 2017 Act does not stipulate any special legal provision for the spent fuel or radioactive waste that results from military or defence programmes. Therefore, the same legal provisions are applicable to such waste. However, it should be noted that there is no radioactive waste from the defence programme of the Republic of Slovenia.

SECTION D: INVENTORIES AND LISTS

Article 32, Paragraph 2: Reporting

This report shall also include:

(i) a list of the spent fuel management facilities subject to this Convention, their location, main purpose and essential features;

(ii) an inventory of spent fuel that is subject to this Convention and that is being held in storage and of that which has been disposed of. This inventory shall contain a description of the material and, if available, give information on its mass and its total activity;

(iii) a list of the radioactive waste management facilities subject to this Convention, their location, main purpose and essential features;

(iv) an inventory of radioactive waste that is subject to this Convention that:

(a) is being held in storage at radioactive waste management and nuclear fuel cycle facilities;

(b) has been disposed of; or

(c) has resulted from past practices.

This inventory shall contain a description of the material and other appropriate information available, such as volume or mass, activity and specific radionuclides;

(v) a list of nuclear facilities in the process of being decommissioned and the status of decommissioning activities at those facilities.

(i) List of Spent Fuel Management Facilities

The Republic of Slovenia has no off-site spent fuel management facilities. The spent fuel that is generated by the operation of the Krško NPP and the JSI Reactor Infrastructure Centre (the TRIGA Mark II research reactor) is managed in storage facilities that are integral parts of these nuclear facilities.

(ii) Inventory of Spent Fuel

Krško NPP

The Fuel Handling Building (FHB) is a part of the Krško NPP. It is operated under the plant's licence and is therefore not considered an independent nuclear facility. The FHB consists of a Spent Fuel Pool (SFP) and the fuel handling system.

There were 487 spent nuclear fuel assemblies in the SFP at the end of 2023. There are altogether 855 fuel assemblies in the SFP (including the Fuel Rod Storage Basket and Strainer Basket for Fuel Rods), but not all have been declared to be fully used. The fuel batches of the spent fuel assemblies with corresponding region numbers are listed in Section L, Annex (d), Table 9. These fuel assemblies will probably never return to the core unless emergency core loading has to be performed.

The Dry Storage Building (DSB) is also a part of the Krško NPP. It is currently operated under the plant's licence utilising some Systems, Structures and Components (SSC) from the Krško NPP. For Safeguards (IAEA, EURATOM) purposes, the building is designated as an independent MBA (Material Balance Area). This enables the possibility to alter its status to an independent nuclear facility in the future once the Krško NPP is decommissioned. The DSB consists of a technical area, and a handling and storage area containing casks with spent nuclear fuel assemblies. There were 592 spent nuclear fuel assemblies in the DSB casks at the end of 2023. The fuel batches of the spent fuel assemblies are listed in Section L, Annex (d), Table 10.

The Krško NPP declares a fuel element to be spent according to these criteria:

- all Westinghouse standard type fuel assemblies, as well as Siemens KWU fuel assemblies, which do not have a Removable Top Nozzle, are considered spent fuel (fuel batches No. 1 ["A"] to No. 18 ["T"] and KWU ["H"].
- fuel assemblies from fuel batches No. 19 ["U"] to No. 33 ["AL"] with either:
  - an average burnup higher than 50 GWD/MTU and discharge time more than 5 years, or
  - they have previously been declared as spent fuel.
- the Fuel Rod Storage Basket (FRSB) containing single fuel rods from repaired fuel assemblies is also considered to be spent fuel.
- fuel rod segments containing nuclear material stored in the Strainer Basket for Fuel Rods (SBFR).
- damaged fuel assemblies that cannot be repaired and reused in the core (AD11, AD12, AD13, AD17 and AE03).
- fuel assemblies stored in dry storage casks (added in 2023).

JSI Reactor Infrastructure Centre

Two interim storage pools are part of the JSI Reactor Infrastructure Centre. The old storage pool is drained and cannot be currently used for spent fuel storage. The newer storage pool is maintained in operational condition and prepared for immediate use if necessary. Both pools have been spent fuel-free since 1999, when all fuel elements (a total of 219) were shipped to the USA for final disposal.

(iii) List of the Radioactive Waste Management Facilities

The CSF in Brinje, the Boršt hydro-metallurgical disposal site and the Jazbec mine waste disposal site at the Žirovski Vrh Uranium Mine are the only radioactive waste management facilities in the Republic of Slovenia pursuant to the Convention. The operational waste from the Krško NPP is managed and stored in storage under the operating licence for the Krško NPP.

Central Storage Facility for Radioactive Waste in Brinje

The storage facility is a near-surface concrete building whose roof is covered by a layer of soil. The building is subdivided by concrete walls into ten storage sections and an entrance area. The ground plan of the facility is 10.6 m × 25.7 m and its height is 3.6 m. A small area is intended as a checkpoint between the radiologically controlled and supervised area, the area for loading and unloading waste, and for internal transport. The storage section at the back of the building is deeper relative to the level of the other sections.

The facility is equipped with a ventilation system for reducing the radon concentration and air contamination in the storage facility. To obtain relatively low and constant humidity, it is equipped with an air-drying system. The water and sewage collection system is designed as a closed system to retain all liquids from the storage facility in the sump. Liquids are discharged after measurements of radioactive contamination show that this is below the regulatory limit. The storage facility is physically and technically protected against fire, acts of violence, burglary, sabotage, etc.

Jazbec Mine Waste Disposal Site at the Žirovski Vrh Uranium Mine

The Jazbec mine waste disposal site has been remediated and closed since 2015. It is located on the north-eastern slope of the hill named Žirovski Vrh at an altitude of 427 to 509 metres above sea level, and the area inside the security fence is 74,239 m^2. The waste inventory is provided in Table 17. The pile area was reshaped and covered with a final 1.95-m-thick layer of radon exhalation barrier and soil. The whole surface is grass covered; the growth of shrubs and trees is prevented by regular mowing.

The remediation design and the safety analysis report on the final remediation of the Jazbec mine waste disposal site were realised in 2004. The remediation was completed in 2008. Since September 2013, the Jazbec mine waste disposal site has been a national infrastructure facility. After proving that the remediation was successful, the administrative procedure for permanently closing the Jazbec mine waste disposal site was completed in 2015. The management and maintenance of the closed site is provided by the ARAO, as the provider of a mandatory service of general economic interest.

Boršt Hydro-metallurgical Tailings Disposal Site at the Žirovski Vrh Uranium Mine

The Boršt hydro-metallurgical tailings disposal site is located on the north-western slope of Boršt Hill at an altitude 535-565 metres above sea level. The waste inventory is provided in Table 18. During the operation and construction of the Boršt hydro-metallurgical tailings disposal site some mine waste was used to consolidate the surfaces used for hydro-metallurgical tailings transportation. In the remediation process the slopes were minimised and a rock support scarp was constructed at the head of the hydro-metallurgical tailings. The surfaces were covered by a 0.5 m-thick layer of mining waste or inert material overlaid by a layer of a radon exhalation barrier and soil with a thickness of 2.05 m, thus a total of 2.55 m.

In 1991, a few months after a heavy rainfall, a landslide beneath the deposited hydro-metallurgical tailings was activated. About 4.5×10^6 m^3 of the hillside became unstable and sliding started at a rate of about 0.5 to 1.0 mm per day. The main reason for the landslide was probably the extremely high groundwater level. In 1994 and 1995, a drainage tunnel of nearly 600 metres in length was constructed together with vertical drainage wells. Consequently, the speed of the landslide's movement was reduced in 1995 to a rate of less than 0.1 mm per day.

The design of the remediation and the safety analysis report on the final remediation were approved in 2005. The remediation was completed in 2010. In 2008, during intensive work on the implementation of the final arrangement of the hydro-metallurgical tailings, the landslide was reactivated. An expert team was set up to assess the situation and to propose mitigation measures. The team concluded that the probability of a sudden collapse of the landslide was negligible, but proposed investigation of the incoming water using drill holes.

The safety report for the Boršt hydrometallurgical tailings disposal site is under revision. This is the basic document for the closure of the disposal facility and the transition to long-term surveillance and maintenance, which will be carried out by the ARAO.

Krško NPP

The Krško NPP includes the following buildings for radioactive waste management:

The Auxiliary Building, where the systems for solid, liquid and gaseous waste processing are located. The building is located adjacent to the Fuel Handling Building and the Reactor Building within the Radiologically Controlled Area. Appropriate monitoring and radiological control are provided during all stages of radioactive waste processing. The main activities related to waste management in this building are pre-treatment (waste collection, segregation, chemical adjustment, decontamination), treatment (radionuclide removal, volume reduction) and conditioning (drying, immobilisation, packaging). The conditioned waste is transported to the Solid Radwaste Storage Facility by forklift or an electric cart (using a special shield when necessary).

The Solid Radwaste Storage Facility, an interim storage, originally built as a five-year storage. Its operating licence was extended in 1988 due to the lack of an LILW repository. It is a reinforced concrete structure, seismically designed, located adjacent to the Auxiliary Building. The total area is 1,470 m^2; following an area optimisation project, by applying a special steel structure to support the storage of waste on the second level, the useful volume was increased to allow waste storage for a longer period of time. The storage time in the Solid Radwaste Storage Facility is variable and dependent on waste generation rates and waste management plans. The inner area is divided into six fields by 60-cm-thick interior concrete walls; the exterior walls and the ceiling are 100 cm thick, providing appropriate insulation and radiological shielding. The facility has provisions for storing different types of solid radioactive waste separately and retrieving them for further processing (supercompaction, incineration, melting and clearance after the decay of the radionuclides) or disposal at a later time. The Storage Facility is equipped with a ventilation system, smoke detectors and a local radiation monitor.

The Decontamination Building, an interim storage, built for decay storage of two old steam generators and radioactive waste produced through the replacement of steam generators and other larger components. The Decontamination Building is also used for the storage of ingots and solid noncompressible radioactive waste. It is a seismically-designed reinforced concrete structure consisting of the following three areas: the decontamination area, a "mock-up" area, and an area for the storage of old steam generators. The building meets the requirements for a LILW storage. The outer wall and the roof slab design were governed by radiological shielding requirements.

The Waste Manipulation Building (WMB) is a seismically-designed reinforced concrete shielded structure, located near the Auxiliary Building and the Solid Radwaste Storage Facility, providing a functional connection between the two buildings. Systems and equipment in the WMB provide capabilities for the collection, treatment and conditioning of low- and intermediate-level waste (LILW) as well as waste assay measurements, preparation for transport, and radiological control of materials. Maintenance hot-shops and the holdup of borated primary water in excess from refuelling operations are enabled in the building as well.

(iv) Inventory of Radioactive Waste in the Central Storage Facility for Radioactive Waste in Brinje

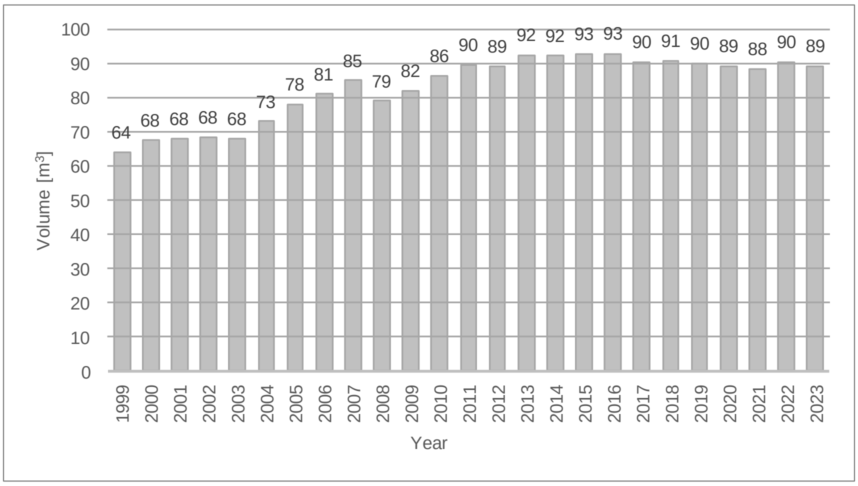
At the end of 2023, the CSF held 89.3 m^3 of radioactive waste (RW), weighing a total of 50.3 tons and with a cumulative activity of 3 TBq. The majority of the RW within the CSF is securely packed in 200-litre steel drums. Currently, the storage facility is occupied at 80% of its capacity, necessitating the implementation of measures to reduce the volume.

To address the challenge of limited storage capacity, the facility operator employs various methods for waste volume reduction. The CSF operator employs the following methods for managing RW:

- radioactive materials are segregated and packed based on appropriate categorisation. Containers for solid waste are lined with durable plastic bags, while sharp objects are collected separately and stored in rigid, puncture-resistant containers (e.g. metal containers). Disused sealed radioactive sources (DSRS) are kept in their shielding. In specific cases, previously stored waste packages may need repacking, and campaigns are conducted to optimise packing.
- decontamination is performed when a removable layer of surface contamination is confirmed.
- compaction of solid RW is carried out to reduce the volume of the compressible fraction.
- disused ionisation smoke detectors and calibration sources are disassembled and packed in steel drums. Other disused sealed radioactive sources of category 3 to 5 are conditioned by encapsulation in steel capsules to facilitate further management. A specially designed container with adequate protection is used for storing capsules with radiation sources. These campaigns, routinely carried out in the last decade, contribute significantly to volume reduction. In the CSF, there are no disused sealed radioactive sources of category 1 or 2.
- Slovenia generates minimal quantities of liquid RW. Before storage, it needs to be solidified. Various treatment methods, such as polymer solidification, are employed.
- where appropriate, radioactive material may be reused or recycled in accordance with regulations. Over the past six years, a substantial quantity of ionisation detectors has been permanently exported abroad for recycling.
- to obtain clearance, the CSF operator applies with the requisite supporting documents to the regulatory authority. Material can be considered for clearance upon receiving authorisation from the regulatory body.

These strategies have proven effective, as evidenced by the consistent total amount of stored waste over the past decade, despite the continuous input of new RW into storage (Figure 3).

Figure 3: **Annual net accumulation of institutional RW stored in the CSF**



RW in the CSF is categorised into three main groups: solid waste (Group I), disused sealed radioactive sources (Group II), and other radioactive waste, which includes liquid and mixed waste (Group III).

Details regarding the inventory of RW can be found in Section L, Annex (e), Table 16. DSRS constituted 96% of the RW activity stored at the CSF by the end of 2023; the remaining activity is represented by solid RW. 60% of the stored RW contained short-lived radionuclides (^{60}Co, ^{137}Cs, ^{90}Sr, etc.), while the remaining portion contained long-lived radionuclides (^{226}Ra, ^{241}Am, ^{232}Th, etc.).

In 2023, the majority of the RW at the CSF, in terms of volume fraction, belonged to Group I. Solid RW comprised approximately 90% of the stored inventory volume. Among solid RW, combustible waste (compressible and incompressible waste) constituted 30%; slightly less than half of the combustible waste was also compressible. 34% of the solid RW are non-compressible and non-combustible waste for which further processing is not feasible. Despite DSRS contributing significantly to the activity, their volume share in the storage facility was only 10% (including ionisation smoke detectors). RW from the other radioactive waste group (liquid and mixed waste) is rarely accepted, as it requires pre-treatment before being introduced to the CSF.

The Jazbec mine waste disposal site and the Boršt hydro-metallurgical tailings disposal site

Basic data on mine waste and other debris at the Jazbec and Boršt disposal sites are summarised in Section L, Annex (e), Tables 17 and 18, which present the situation as of the end of 2023. The inventory of the radioactive material disposed of at both sites is not expected to change since the Jazbec waste pile is already closed and the Boršt hydro-metallurgical tailings disposal site is in the final phase of environmental remediation and is also not in a position to accept additional waste material.

Krško NPP

See Section L, Annex (e), Tables 9, 10, 11, 12, 13, 14 and 15.

(v) Nuclear Facilities in the Process of Being Decommissioned

There are no nuclear facilities currently being decommissioned. The Žirovski Vrh Uranium Mine, which is a radiation facility in accordance with the definition in the 2017 Act, is the only facility which has been successfully decommissioned in the Republic of Slovenia.

SECTION E: LEGISLATIVE AND REGULATORY SYSTEM

Article 18: Implementing Measures

Each Contracting Party shall take, within the framework of its national Act, the legislative, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention.

The legislative, regulatory and administrative measures, and other steps necessary for implementing the obligations of the Republic of Slovenia under the Convention are discussed in this report.

Article 19: Legislative and Regulatory Framework

1. *Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management.*
2. *This legislative and regulatory framework shall provide for:*

(i) the establishment of applicable national safety requirements and regulations for radiation safety;

(ii) a system of licensing of spent fuel and radioactive waste management activities;

(iii) a system of prohibition of the operation of a spent fuel or radioactive waste management facility without a license;

(iv) a system of appropriate institutional control, regulatory inspection and documentation and reporting;

(v) the enforcement of applicable regulations and of the terms of the licenses;

(vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management.

3. *When considering whether to regulate radioactive materials as radioactive waste, Contracting Parties shall take due account of the objectives of this Convention.*

1. Legislative and Regulatory Framework

The most prominent piece of legislation is the 2017 Act, which entered into force in January 2018. The previous Act was adopted in 2002 and was subsequently revised four times. Due to the implementation of the European Directives and the transposition of the latest international standards in the field of radiation protection and nuclear safety, the decision was made to draw up a new law instead of amending the existing one. It has to be noted that after the adoption of the 2017 Act substantial work was devoted to updating the whole set of secondary legislation (the so-called Rules).

Less than half year after the entry into force of the 2017 Act, the SNSA started preparations for amending the Act due to perceived problems in implementing the provisions on the security clearance of foreign nationals who perform work in a nuclear facility and involving the handling of radioactive materials and the transport of nuclear materials. The Act Amending the Ionising Radiation Protection and Nuclear Safety Act (ZVISJV-1A) was adopted by the National Assembly on 16 April 2019. Afterwards the 2017 Act was amended for the second time in 2021 with the Act Amending the Ionising Radiation Protection and Nuclear Safety Act (ZVISJV-1B). The proposed amendments to the Act were published on the eDemocracy website on 16 November 2020, and at the end of December 2020, before the internal legal procedure for its adoption continued, the draft was sent, in accordance with Article 33 of the Treaty on the Establishment of the European Atomic Energy Community (Euratom), via the Slovenian Permanent Representation in Brussels, also to the European Commission, Directorate for Energy. The adoption process then continued in 2021 and ended with the publication of the ZVISJV-1B in the Official Gazette of the Republic of Slovenia, No. 172/21 of 29 October 2021, which entered into force on 13 November 2021.

These last amendments were the result of a letter of formal notice from the European Commission for not transposing all the provisions of Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom (hereinafter: BSS directive), received in October 2020. In response to the letter of formal notice, Slovenia undertook to eliminate the alleged violations by adopting amendments to some valid regulations and by adopting some new ones. Beside the amendments to the Ionising Radiation Protection and Nuclear Safety Act, Slovenia committed to adopt the amendments to the Rules on Special Radiation Protection Requirements and the Method of Dose Assessment, new Rules on Radioactive Waste and Spent Fuel Management, and Rules on Requirements for New Constructions and Interventions in Existing Buildings in order to protect the Health of Individuals from the Harmful Effects of Radon.

In the area of radioactive waste and spent fuel management, the 2017 Act defines the rules on the functioning of the ARAO and its organisation, funding, infrastructure and criteria for the determination of fees. The 2017 Act furthermore clearly defines the duties of the ARAO regarding the management of orphan sources. The 2017 Act also contains some provisions on acquiring title to land or an easement for the infrastructure that is needed for radioactive waste and spent fuel management.

In 2021, the SNSA, prepared the proposal of the Decree on the Method and Subject of and Conditions for Performing the Public Utility Service of Radioactive Waste Management and the new Ordinance on the establishment of the public utility service ARAO. One of the main goals of the new regulations was to determine the organisational form and conditions for the operation of the ARAO, which will enable it to perform its tasks more efficiently, especially activities related to the construction of a low- and intermediate-level waste disposal site in Vrbina. Both the Decree and the Ordinance were adopted at the beginning of 2022 and were amended in March 2024. The amendments became valid on 23 March 2024 and were necessary to clarify certain provisions, to complete the list of state infrastructure facilities and to align the method of financing the public utility service for radioactive waste management with the Act on the Public Fund of the Republic of Slovenia for the Financing of the Decommissioning of the Krško NPP and the Disposal of Radioactive Waste and Spent Fuel from the Krško NPP. The amendment also equalises the position of all holders or generators of institutional radioactive waste regarding the payment of the costs for the public service for the management of radioactive waste not originating from a nuclear facility for the production of electricity and removes the exemption currently applicable to the Jožef Stefan Institute. The amendments of the Ordinance contain the provisions related to the place of the establishment of the institution.

At the end of 2022 the Price List of services of the mandatory state utility service for the management of radioactive waste, which is not waste from nuclear facilities for energy production, was also adopted.

Regarding the letter of formal notice issued to the Republic of Slovenia by the European Commission in 2018 due to the non-fulfilment of the obligations referred to in certain provisions of Directive 2011/70 Euratom of 19 July 2011, the SNSA began the process of adopting a new resolution, even though the 2016 Resolution was adopted for the period from 2016 until 2025. In 2021, the ARAO, in accordance with the 2017 Act, prepared the professional basis for the 2023 Resolution, with a more detailed breakdown of the measures for reducing the generation of radioactive waste, its processing before disposal, and its disposal, as well as measures for the processing and disposal of radioactive waste.

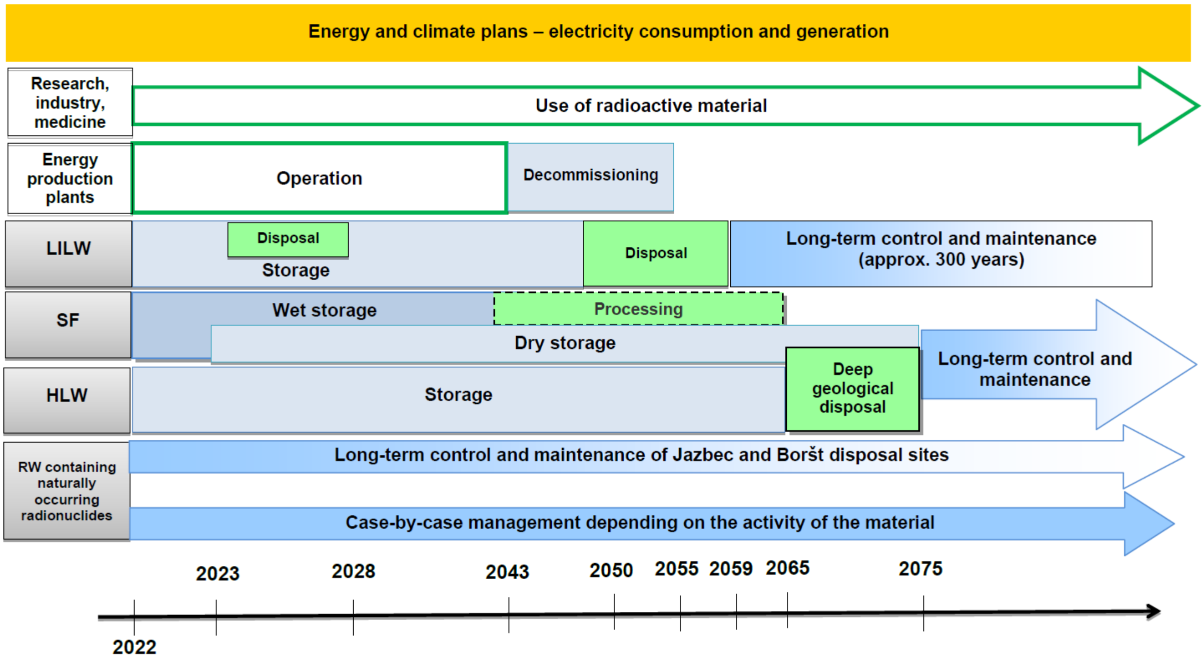
The main objective of the 2023 Resolution is to ensure safe and efficient management of radioactive waste and spent fuel in Slovenia in accordance with the principles of decision-making and actions based on the latest findings from domestic and foreign research, cutting-edge technologies and the best practices and operational experiences, and, consequently, to ensure the safety of people and the environment at all times and to simultaneously provide long-term, technologically modern and rational infrastructure support to users of nuclear and radiation technologies, including the necessary scientific and research activities, funding and communication with the public. The programme includes the principle of seeking a joint solution with the Republic of Croatia to the disposal of radioactive waste from the Krško NPP.

The 2023 Resolution, which represents a high-level national policy paper, is appropriately placed in the overall Slovenian legal framework in this field. Based on the provisions of the 2017 Act, it is in line with the provisions of the Intergovernmental Agreement between Slovenia and Croatia on the co-ownership of the

Krško NPP and its content now fully complies with the requirements of the EU directive on the safe management of spent fuel and radioactive waste[1].

Based on the 2023 Resolution, the SNSA must report to the Government and the National Assembly on the implementation of the provisions of the Resolution once a year; such report is an integral part of the SNSA's Annual Report on Radiation and Nuclear Safety, which is adopted by the Government and subsequently by the National Assembly of the Republic of Slovenia. In such report, success in achieving the objectives of the Resolution must be presented.

Figure 4: **Basic elements of the National Programme for the Management of Radioactive Waste and Spent Fuel for the Period 2023–2032 and the timeline**



The Resolution on Nuclear and Radiation Safety, which was adopted in mid-2013, was valid until the end of 2023. Therefore, in the second half of 2021 the SNSA started internal activities to prepare a new resolution for a new ten-year period. The proposal was sent for public discussion in 2022 and the formal continuation of the legislative process was completed in 2023 with its adoption by the National Assembly of the Republic of Slovenia on 5 December 2023. The Resolution on Nuclear and Radiation Safety in the Republic of Slovenia for the Period 2024–2033 is a programme document that sets out the basic political orientation and long-term commitment of the Republic of Slovenia to nuclear and radiation safety, considering the basic standards of the IAEA.

A comprehensive overview of the legislative and regulatory framework that governs nuclear and radiological safety is attached to this report (Section L, Annex (f)). The list consists of the national legal framework and the international instruments (multilateral and bilateral treaties, conventions, agreements and arrangements) to which the Republic of Slovenia is party.

(2i) National Safety Requirements and Regulations on Radiation Safety

In addition to the main principles (*inter alia*, "justification", "optimisation", "ALARA", "prime responsibility for safety", and the "causer pays" principles), the 2017 Act also includes, with respect to radiation protection areas, provisions on:

- notification to carry out radiation practices or to use a radiation source;
- the licensing of radiation practices or use of a radiation source;
- general principles on the protection of people against ionising radiation;

[1] 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, OJ L 199 (2 August 2011).

- the classification of facilities (nuclear, radiation and less important radiation facilities);
- licensing procedures with respect to the siting, construction, trial operation, operation and decommissioning of nuclear, radiation and less important radiation facilities;
- radioactive contamination and intervention measures;
- radioactive waste and spent fuel management;
- the import, export and transit of nuclear and radioactive materials, radioactive waste and spent fuel;
- the physical protection of nuclear materials and facilities;
- non-proliferation and safeguards;
- administrative tasks and inspection, and
- penalties.

Based on the 2017 Act, nine decrees have been adopted by the Government and 26 rules have been adopted by the competent ministers. Some of the rules and decrees are not newly adopted and continue to apply, even though they were adopted based on the Ionising Radiation Protection and Nuclear Safety Act from 2002. In the period since the seventh report under the Joint Convention, amendments to the Decree on the National Radon Programme, prepared by the Slovenian Radiation Protection Administration (SRPA), were adopted. The amendment to the Decree determines that the dose assessment methodology defined within the Decree shall enter into force in 2023.

At the beginning of 2024 the Decree amending the Decree on Radiation Activities (UV1) was adopted. The amendments made concern consumer information relating to articles of consumer products. These are objects in which a radionuclide is deliberately incorporated in order to add certain properties such as luminosity, strength, etc., to a general-purpose object. Such an object is freely available and accessible to consumers. The safety and health of consumers are ensured through the design of the general-purpose article itself and no special radiation protection measures are required during the use of such articles. The amendments to the Regulation provide for more detailed rules on the labelling of such items or on consumer information. The amendment to the Regulation also clarifies in more detail the licensing of the radiological activity of transporting radioactive materials, where such transport is subject to authorisation by both the SNSA and the SRPA.

Several ministerial rules were also adopted after the last national report.

In 2020, amendments to the Rules on Monitoring Radioactivity in Drinking Water, prepared by the SRPA, were adopted. This amendment specifies more precisely the sampling frequency for small-scale drinking water supply systems. In November 2020, the new Rules on Ensuring the Qualification of Workers in Radiation and Nuclear Facilities (JV4) were published in the Official Gazette of the Republic of Slovenia, which, *inter alia*, regulate the professional training and testing of workers' knowledge in nuclear power plants. Since part of the content of the valid Rules on Ensuring the Qualification of Workers in Radiation and Nuclear Facilities was duplicated by the provisions of the Rules on Professional Training and Knowledge Testing for an Operator of Energy Devices, thus creating an unnecessary administrative and substantive burden for the Krško NPP personnel, the SNSA and the Ministry of Infrastructure amended both Rules, eliminating the duplication of knowledge tests for certain categories of workers employed at the nuclear power plant.

As a result of the European Commission's letter of formal notice, the SRPA has also prepared amendments and additions to the Rules on Special Radiation Protection Requirements and the Method of Dose Assessment. In addition to some minor editorial corrections, the adopted amendments mainly relate to the scope and content of the assessment of eligibility for the use of a new type of radiation activity, the use of a new type of radiation source, or the implementation of a new method of using an already tested radiation source. Another more extensive and substantively important amendment concerns the assessment of doses during an emergency, in which protection and rescue plans are used in the event of a nuclear or radiological accident.

On 30 July 2021, the new Rules on Radioactive Waste and Spent Fuel Management were published in the Official Gazette, which came into force on 14 August 2021. The new Rules basically follow the rules from 2006. With the new Rules, the requirements of WENRA (Western European Nuclear Regulators Association) and provisions regarding the determination of releases of radioactive substances into the environment in accordance with the BSS directive are transposed into the Slovenian legal system. Also, some other provisions have been supplemented with the knowledge and experiences from years of use of the current Rules and alignment with the 2017 Act. The Rules prescribe new requirements regarding acceptance criteria for the storage and disposal of radioactive waste and spent fuel. The public service provider must make changes to the acceptance criteria within three years of the entry into force of the new Rules.

The last of the regulations whose adoption and implementation announced the elimination of the alleged violation in the transposition of the BSS directive, are the Rules on Requirements for New Constructions and Interventions in Existing Buildings to Protect Human Health from the Harmful Effects of Radon.

In 2021, the work of the representatives of the Ministry of the Interior and the SNSA on the review of regulations in the field of physical protection continued. The review and exchange of expert opinions hitherto indicated that after eight years of the application of both regulations many changes and corrections were necessary, which, however, will not drastically change the way the area is regulated. The Rules on the Physical Protection of Nuclear Facilities, Nuclear and Radioactive Materials and the Transport of Nuclear Material were adopted in September 2023 and became valid on 14 October 2023. The Order on determining the Programme of Basic Professional Training and the Programme of Periodic Professional Training of Security Personnel Who Carry Out the Physical Protection of Nuclear Facilities, Nuclear or Radioactive Materials, and the Transport of Nuclear Material was also adopted in September 2023, but became valid on 30 September 2023.

As already mentioned, in January 2022, the new Rules on Requirements for New Constructions and Interventions in Existing Buildings to Protect Human Health from the Harmful Effects of Radon were adopted, which came into force on 30 June 2022, and which prescribe the requirements for anti-radon-safe construction and the rehabilitation of existing buildings. Although the original rules were adopted recently, the need for changes soon became apparent. The provisions of the rules had to be harmonised with the provisions of the part of the Building Act that refers to the preparation of documentation, i.e. the Radon Protection Elaboration. The project documentation for the implementation of construction will have to include the planned system of anti-radon measures comprehensively, descriptively, and graphically. Its amendments were adopted in July 2023.

In 2022, the SNSA began the preparation of the new Rules on Authorised Experts for Radiation and Nuclear Safety (JV3), which were not revised when the 2017 Act was adopted in 2017. These Rules were adopted in December 2023 and became valid on 30 December 2023.

(2ii) Licensing System

A system for licensing spent fuel and radioactive waste management is provided in the 2017 Act, while the Rules on Radiation and Nuclear Safety Factors (JV5) lay down details on the documentation that must be submitted together with the application in a particular phase of licensing. The prescribed licensing process is of a general nature, so it is applicable to the whole spectra of nuclear and radiation facilities.

The basic classification of facilities is provided by the 2017 Act itself, where in definition No. 29 of Article 3 it provides that a nuclear facility is "a facility for the processing or enrichment of nuclear materials or the production of nuclear fuels, a nuclear reactor in critical or sub-critical assembly, a research reactor, a nuclear power plant or heating plant, a facility for the storage, processing, treating or disposing of nuclear fuel or high radioactive waste, or a facility for the storage, processing or disposal of low- and intermediate-level radioactive waste." Therefore, the entire spectrum of licensing requirements (for siting, construction, trial operation, operation, decommissioning and/or closure of the repository) must be complied with by the applicant (the investor or operator of the facility) in accordance with the provisions of the 2017 Act and of the Rules on Radiation and Nuclear Safety Factors.

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 Natural Resources and Spatial Planning, with the approval of the SNSA;
- the application for a license for trial operation – the competent body is the Ministry of Natural Resources 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.

The general requirements for the design basis for a radioactive waste or spent fuel storage facility and for a radioactive waste repository are laid down in the Rules on Radiation and Nuclear Safety Factors.

In the licensing processes intended to obtain prior consent (of the SNSA) to the construction permit for the facility, the investor/operator shall attach to the licence application, in addition to the design documentation, a safety analysis report, the opinion of an authorised radiation and nuclear safety expert (authorised by the SNSA), and other prescribed documentation as determined by the Rules on Radiation and Nuclear Safety Factors.

In the subsequent licensing processes (for approval of the trial operation, operation, decommissioning or closure of the facility), the licensee must submit the above-described application with an appropriately amended set of documents and opinions. The operating experience and feedback and any modifications to the facility must be clearly documented and described.

The general provisions and the responsibilities of holders of radioactive waste and spent fuel (as well as of the State) are defined in Section 4.7., "Radioactive waste and spent fuel management", of the 2017 Act. The 2017 Act (Articles 121-129) contains provisions on the following:

- radioactive waste and spent fuel management;
- mandatory service of general economic interest (management of radioactive waste, radioactive waste disposal, long-term surveillance and maintenance of closed radioactive waste repositories or mining waste disposal and tailings);
- the long-term surveillance and maintenance of closed radioactive waste repositories or repositories of mining and hydro-metallurgical tailings;
- the national programme for radioactive waste and spent fuel management; and
- national infrastructure facilities.

The Rules on Radioactive Waste and Spent Fuel Management contain, *inter alia*, provisions on the following:

- the classification of radioactive waste with regard to the aggregation state and level and type of radioactivity;
- the requirements for radioactive waste and spent fuel management (general requirements – radioactive waste or spent fuel management procedures, programmes and plans; special requirements – sorting, treatment and packing, labelling, keeping, storing, decay-keeping, handover and takeover, reshuffling, liquid and gaseous radioactive waste release, disposal, acceptance criteria for storage or disposal, waste from the exploitation and reprocessing of raw nuclear mineral material, and very-low-level radioactive waste management); and
- record-keeping and reporting (the holder's records, the central records, reporting, loss and findings).

The Decree on the Method and Subject of and Conditions for Performing the Public Service of Radioactive Waste Management contains, *inter alia*, provisions on the following:

- the scope and type of the public service;
- the general requirements for performing the public service;
- the requirements that must be fulfilled by the performer of the public service;
- the rights and duties of the use of the public service;
- financial sources and the method of establishing the price; and
- inspection.

The public service for radioactive waste management referred to in Article 122 of the 2017 Act was established in 1991 as the ARAO with the Governmental Decree on the Establishment of a Public Agency for Radwaste Management adopted at that time based on the Environmental Protection Act.

(2iii) System of Prohibition of the Operation of a Spent Fuel or Radioactive Waste Management Facility without a Licence

Spent fuel and radioactive waste management facilities are defined by the 2017 Act as nuclear facilities. Consequently, all relevant licences are needed, including an operating licence. The operation of such a facility without a licence is prohibited according to Article 87 of the Act.

In the penal provisions of the 2017 Act, a financial penalty is foreseen for the violation the above-mentioned prohibition.

(2iv) System of Appropriate Institutional Control, Regulatory Inspection, and Documentation and Reporting

Institutional control and regulatory inspection with respect to the safe management of spent fuel and radioactive waste rests with the SNSA. Within the scope of inspection, an inspector may:

- issue decisions and orders within the framework of administrative proceedings;
- order measures for radiation protection and measures for radiation and nuclear safety to ensure that the licensee fulfils all legal requirements regarding safety;
- order the termination of a radiation practice or use of a radiation source where the inspector finds that a proper licence has not been issued or if there is a failure in following the prescribed methods for handling the radiation source or radioactive waste; an appeal against such a decision of an inspector shall not hinder its execution; and
- seal any radiological device that does not meet the acceptance criteria for proper operation.

The 2017 Act has only one article (Article 178) on inspection, since the Inspection Act prescribes the general principles of inspection, its organisation and status, the rights and duties of inspectors, inspection measures and other issues relating to inspection, which are to be followed also by nuclear and radiation safety inspectors.

The Rules on Radioactive Waste and Spent Fuel Management also contain provisions regarding documentation and reporting. They determine that a holder who temporarily stores, stores, conditions or disposes of radioactive waste or spent fuel and a holder who discharges radioactive waste shall keep records of radioactive waste or spent fuel, provide information on its temporary storage, conditioning through any technological process, storage or discharge, or clearance and handover to the public service provider. The holder shall keep this record in accordance with the programme or radioactive waste management plan and must send the data regarding the generation of radioactive waste or spent fuel to the Central Register of Radioactive Waste or Spent Fuel, managed by the SNSA.

(2v) The Enforcement of Applicable Regulations and of the Terms of Licences

The enforcement of applicable regulations and of the terms of licences is ensured by the application of penal provisions, inspection, and provisions relating to the issuance, renewal, amendment, withdrawal and expiration of licences, as provided for in the 2017 Act.

Based on the Inspection Act as well as on the 2017 Act, a graded approach in enforcement policy is ensured. Inspectors may (if in their assessment such a measure is sufficient and appropriate) only warn the licensee of the irregularities and set a date by which the corrective measures must be carried out. The inspector may also (among other measures) perform all measures (as listed below) in line with the Minor Offences Act or report (in the case of a criminal offence) the licensee to the public prosecutor.

Within the scope of an inspection, an inspector may:

- issue decisions, conclusions and/or orders within the framework of administrative proceedings;
- order measures for radiation protection and measures for radiation and nuclear safety;
- order the cessation of a radiation practice or use of a radiation source when it is established that an applicable license has not been issued or if the prescribed methods of handling a radiation source or radioactive waste have not been followed. An appeal against such decision of an inspector does not prevent its execution.

Inspectors may also terminate a radiation practice or prohibit the use of a radiation source if someone performs/carries out a radiation practice or uses a radiation source without an appropriate licence; however, inspectors do not revoke or suspend any of these licences. This can only be done by the authority that issued the licences (in most cases, the SNSA), although the inspector may propose such a measure.

(2vi) Allocation of Responsibilities

As described above, the legislative framework (the 2017 Act, the Decree on the Method and Subject of and Conditions for Performing the Public Service of Radioactive Waste Management and the Rules on Radioactive Waste and Spent Fuel Management) determines a clear allocation of the responsibilities of the bodies involved in the management process of spent fuel and radioactive waste (generator, holder, mandatory state-owned public services, regulatory body), and also defines the system of recording and reporting.

Article 20: Regulatory Body

1. *Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 19, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.*
2. *Each Contracting Party, in accordance with its legislative and regulatory framework, shall take the appropriate steps to ensure the effective independence of the regulatory functions from other functions where organisations are involved in both spent fuel or radioactive waste management and in their regulation.*

1. Regulatory Body – the Slovenian Nuclear Safety Administration (SNSA)

The SNSA, as a regulatory body in the area of nuclear and radiation safety, is a functionally autonomous body within the Ministry of Natural Resources and Spatial Planning (hereinafter: the Ministry). The SNSA's responsibilities and competences are defined in the Governmental Decree on Administrative Authorities within Ministries.

The SNSA performs administrative and developmental tasks in the field of nuclear and radiation safety, radiation practices and the use of radiation sources (with the exception of medicine and veterinary medicine), radiation monitoring of the environment, protection of the population and the environment against ionising radiation, cyber security of nuclear facilities, the physical protection of nuclear materials and facilities and the protection of radioactive sources, the non-proliferation and safeguarding of nuclear goods, the transport of nuclear and radioactive materials and the implementation of the rules on liability for nuclear damage, radioactive waste and spent fuel management, and preparedness for nuclear and radiological accidents and performs tasks in the field of critical infrastructure protection (nuclear power plants); it also carries out inspection tasks in all of the above-mentioned fields and participates in the fulfilment of international obligations under international treaties in the field of nuclear and radiation safety and performs international data exchange tasks.

The legal basis for its administrative and professional tasks in the field of nuclear safety, radiation protection and inspection are given by the 2017 Act and implementing decrees and rules adopted on the basis thereof and by-laws within the wider area of nuclear and radiation safety, as well as by ratified and published international treaties in the field of nuclear energy and nuclear and radiation safety. A detailed presentation of the legislation in force is available on the SNSA website.

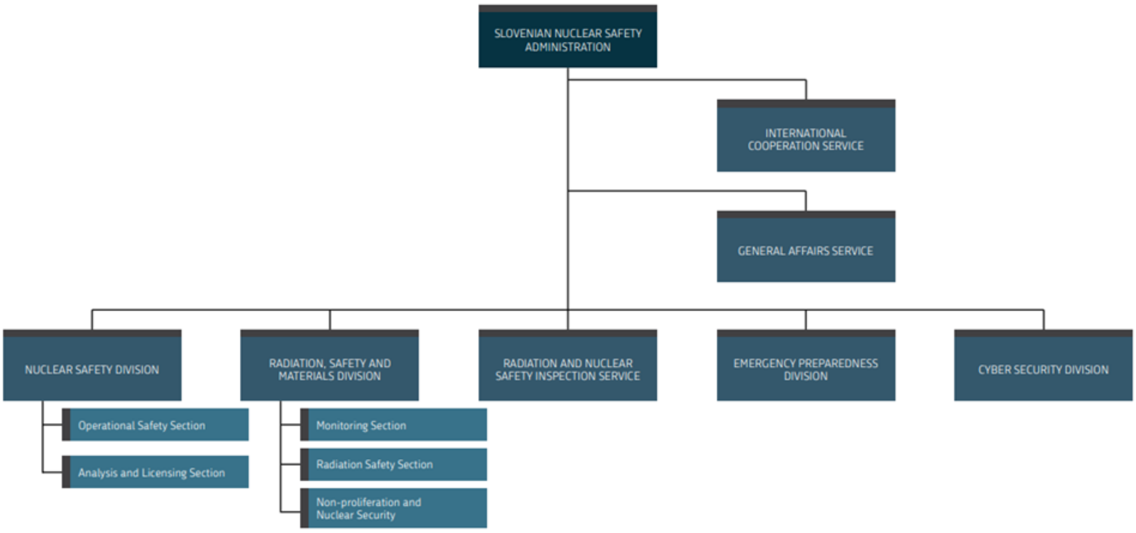
The precise competences of the SNSA and other relevant administrative bodies that are entrusted with the implementation of the legislative framework to govern the safety of spent fuel and radioactive waste management are prescribed in particular in the 2017 Act and other legislation listed in Section L, Annex (f) of this report.

The SNSA is generally organised into four divisions and three services. These are:

- the Nuclear Safety Division;
- the Radiation Safety and Materials Division;
- the Emergency Preparedness Division;
- the Radiation and Nuclear Safety Inspection Service;
- the International Cooperation Service;
- the Cyber Security Division, and
- the General Affairs Service.

The SNSA's internal organisational units are shown in Figure 5.

Figure 5: **Internal organisational units of the SNSA**



The staff of the SNSA are interdisciplinary, consisting of employees with a range of educational backgrounds: physicists, mechanical, electrical and chemical engineers, geotechnologists, metallurgists, geologists, lawyers, linguists, and administrative workers.

At the end of 2023, the SNSA had 43 employees, of whom 11 held a doctorate and 6 a master's degree; 26 had completed higher or university education. With respect to gender structure, there are 23 women employed at the SNSA (53%) and 20 males (47%), while the average age of the employees is 48.0 years, ranging from 27 to 63 years.

The human resource processes at the SNSA are designed to support the SNSA's mission, objectives and vision. The SNSA's mission, vision and long-term goals are set out in the Management Manual and within the annual work plan approved each year, which details these goals. The SNSA has clearly defined the skills and competencies required to effectively cover all areas and tasks within its remit.

The system for ensuring competencies and optimising the internal organisation of the SNSA was primarily designed and built on the basis of the IAEA Systematic Approach to Training (SAT). During the development process, the concept was adapted to the needs of the SNSA. In the period 2018–2020, a project was carried out in the public administration to create a competency model for the public administration. The SNSA has also supplemented its model with the competencies of this model and has achieved a better definition of the skills required to perform the work tasks within the processes defined in the Management Manual. The SNSA carries out needs analyses based on the skills that staff have and their number, on the one hand, and the necessary tasks and the skills required for them, on the other. Needs analyses show two things. Firstly, they show where to supplement the skills of employees to ensure that they have the necessary skills to perform their tasks. On this basis, an annual training and development plan is drawn up. The second question is whether the SNSA has enough employees to perform all the necessary tasks. Last but not least, part of the human resources processes is the career plan that is drawn up for SNSA employees as part of the SAT, which is adapted each year to the needs of the SNSA, on the one hand, and the individual, on the other.

The course "Fundamentals of Nuclear Technology" was attended by some new staff members of the SNSA and other courses at the Nuclear Training Centre in Ljubljana are frequently included in such programmes; a part of such individual programmes are events (courses and workshops) organised by the IAEA, and many SNSA staff attended courses on Westinghouse technology organised at the US NRC Training Centre in Chattanooga, TN.

The Director of the SNSA is the head of the regulatory authority and represents the SNSA. At the governmental and parliamentary level, the SNSA is represented by the Minister of Natural Resources and Spatial Planning. The Director is responsible to the Minister for his or her work and for the work carried out by the SNSA. The organisation of the SNSA is prepared by the Director and approved by the Government on the motion of the Minister.

Regulatory matters relating to spent fuel and radioactive waste management are dealt with by the Radiation Safety and Materials Division.

The budget of the SNSA is determined based on the activities carried out in the previous year, taking into account new needs, which have to be well justified. The budget is the only source of financing for the SNSA's basic activities. The operators of nuclear or radiation installations and other licensees do not pay any licensing or inspection fees. The only fee that is applicable under the general Act on Administrative Fees is the so-called administrative tax for the licensing (administrative) procedure, which is of symbolic value. Such fees are paid into the national budget and not directly to the SNSA. Furthermore, if the SNSA determines that some expertise is needed within the licensing (administrative) procedure, the applicant bears the costs under the relevant provision of the Act on General Administrative Procedure.

Although the SNSA is part of the Ministry, it still has its own share of the Ministry's budget and is independent in allocating funds for the programmes, projects and other expenses from its budget. The national budget is prepared based on a biannual cycle. The composition of the SNSA's budget for 2020, 2021, 2022 and 2023 is shown in Table 2. This budget comprises all activities within the SNSA's areas of competence.

Table 2: **The SNSA budget for 2020, 2021, 2022 and 2023**

Structure		**2020 (in EUR)***	**2021 (in EUR)***	**2022 (in EUR)***	**2023** (in EUR)*
Salaries		1,638,865	1,764,029	1,763,586	1,860,000
Material expenses		76,373	80,903	145,882	175,000
Investments and maintenance costs		46,269	496,225	236,982	129,000
Membership fees (IAEA, OECD/NEA membership)		536,102	380,000	410,000	458,550
International projects		158,772	131,500	171,500	86,500
Outsourcing	Nuclear safety	29,445	82,349	77,418	131,673
	Radiation safety	164,332	182,673	229,195	301,019
Total		**2,650,158**	**3,117,679**	**3,034,563**	**3,141,742**

Note: *The figures for individual years are slightly different from those presented in previous reports because the SNSA budget for each year occasionally changes in line with adjustments to the national budget.

2. Other Regulatory Bodies

The 2017 Act assigns responsibility in the area of radiation practices and the use of radioactive sources in health and veterinary care to the SRPA within the Ministry of Health. In general, the responsibilities are divided between the SNSA and the SRPA in the area of radiation protection, while the area of nuclear safety is the SNSA's sole responsibility. The SNSA is responsible for monitoring emissions into the environment, while the SRPA is responsible for monitoring the exposure of the population. Based on the 2017 Act, the SNSA is competent for issuing consents for mining work, licensing operations, the completion of decommissioning and the closure of repositories, while the SRPA performs inspection tasks in the area of radiation protection (dose limits, the protection of exposed workers, etc.).

The SRPA's responsibilities and competences are (as for all other governmental bodies) also defined in the Decree on Administrative Authorities within Ministries: "The SRPA performs technical, administrative and developmental tasks in the area of radiation practices and the use of radiation sources in health and veterinary care; the health protection of people against the detrimental effects of ionising radiation; systematic inspection of work premises and living spaces due to the exposure of people to natural radiation sources; implementation of monitoring the radioactive contamination of foodstuffs and drinking water; assessment of compliance and the authorisation of radiation protection experts; inspection duties in the above-mentioned areas; and the reduction, restriction and prevention of the effects of non-ionising radiation detrimental to health."

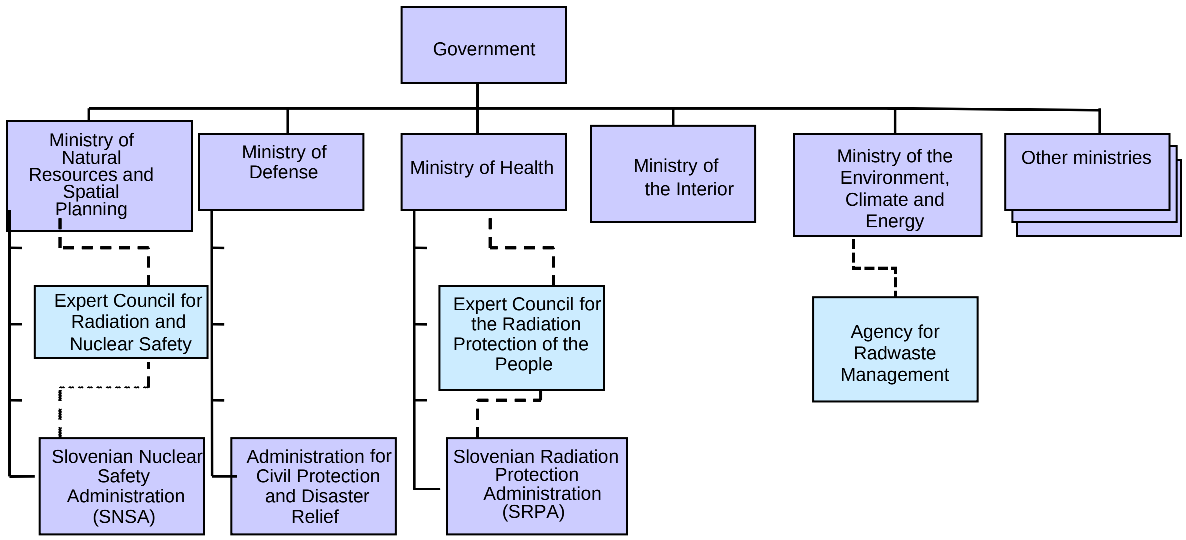
Besides the SNSA and the SRPA, some other administrative bodies, ministries and organisations are also entrusted with the implementation of the 2017 Act, in particular:

- The Administration for Civil Protection and Disaster Relief (within the Ministry of Defence), as the leading authority for emergency preparedness and response;
- The Ministry of the Interior has, *inter alia*, competences in the area of the physical protection of nuclear materials and nuclear facilities in general, while the SNSA approves the safety analysis report, to which the physical protection plan is attached as a separate and restricted document; for the physical protection plan of nuclear facilities, the prior consent of the SNSA is needed and then it is approved by the Ministry of the Interior;
- The Environmental Agency within the Ministry of the Environment, Climate and Energy;
- The Spatial Planning Directorate within the Ministry of Natural Resources and Spatial Planning; and
- The Directorate for Energy (within the Ministry of the Environment, Climate and Energy).

Based on the 2017 Act, the Expert Council for Radiation and Nuclear Safety was appointed as an advisory body to the Ministry of Natural Resources and Spatial Planning and the SNSA; at the same time, the Expert Council for the Protection of People against Ionising Radiation, with responsibility for radiological procedures and the use of radiological sources in health and veterinary care, was appointed as an advisory body to the Ministry of Health and the SRPA.

The position of the SNSA, the SRPA and the ARAO in the governmental structure is shown in Figure 6.

Figure 6: **The SNSA, the SRPA and the ARAO within the governmental structure**



3. Effective Independence

The effective independence of the regulatory body (the SNSA) is ensured 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 national budget; the reporting scheme within the governmental framework; and the decision-making hierarchy in appeal processes within administrative procedures.

The SNSA is a part of the state administration. Based on the Public Administration Act, the SNSA, in terms of its administrative decisions, is an independent body within the Ministry of Natural Resources and Spatial Planning. Administrative decisions encompass all decisions taken by the SNSA within the licensing process and within inspection control. Decisions adopted by the SNSA within its scope of competence are taken solely and exclusively by the SNSA and cannot be dictated or imposed on the SNSA by the Ministry of Natural Resources and Spatial Planning, the Minister or any other body within the Ministry. In some cases, the 2017 Act provides that an appeal against an SNSA ruling is not possible. This does not mean, however, that the licensee has no judicial remedy available. The licensee may not file an appeal in an administrative procedure (where the decision would be taken by the Ministry of Natural Resources and Spatial Planning), but does have a constitutional right to submit its case to a court within a civil law procedure.

In accordance with the 2017 Act, besides licensing, also the inspection and enforcement of nuclear and radiation safety fall within the competence of the SNSA. The inspection powers include control over implementation of the provisions of the 2017 Act, regulations and decrees issued in accordance with the 2017 Act, and other terms of licences. Within the scope of inspection, an inspector may:

- issue decisions, conclusions and/or orders within the framework of administrative proceedings;
- order measures for radiation protection and measures for radiation and nuclear safety; and
- order the cessation of a radiation practice or use of a radiation source when it is established that the applicable licence has not been issued or if the prescribed methods of handling a radiation source or radioactive waste have not been followed.

An appeal against a decision of an inspector does not prevent its execution.

The enforcement of applicable regulations and the terms of licences is ensured by the application of penal provisions and inspection provisions, as well as by provisions related to suspending the operation of a nuclear facility, as provided by the 2017 Act.

The office of the Director of the SNSA is not a political position in the Slovenian legal system (unlike the office of a Minister or State Secretary), but rather it is the highest level in the structure of employees (i.e. civil servants) within the governmental administration. Open competition for the position of Director of the SNSA (or certain other positions in governmental bodies, for example managing directors, secretaries-general and the heads of bodies within ministries and of administrative units) is carried out by a special Competition Commission, which in each case shall be appointed by the governmental Council of Officials. The whole procedure is set out in the Civil Servants Act. Once appointed, the Director of the SNSA is directly subordinate to the Minister and reports to the Minister, but in administrative decisions he or she is independent of the Minister or any other body within the Ministry. The Public Administration Act and the 2017 Act ensure the *de jure* independence of the SNSA.

SECTION F: OTHER GENERAL SAFETY PROVISIONS

Article 21: Responsibility of the Licence Holder

1. *Each Contracting Party shall ensure that prime responsibility for the safety of spent fuel or radioactive waste management rests with the holder of the relevant license and shall take the appropriate steps to ensure that each such license holder meets its responsibility.*
2. *If there is no such license holder or other responsible party, the responsibility rests with the Contracting Party which has jurisdiction over the spent fuel or over the radioactive waste.*

The provisions on the prime responsibility of the licence holder for the safety of nuclear and radiation facilities and also for the safety of spent fuel management or radioactive waste management is one of the main principles of the 2017 Act.

Article 87 of the 2017 Act provides the following specific requirement: "A nuclear facility, a radiation facility or a less important radiation facility may not be constructed, tested, operated or used in any other way, or permanently ceased to be used, without a prior approval or permit issued pursuant to this Act. The safety of a facility, including the safety of handling radioactive substances, radioactive waste or spent fuel which is found or produced in the facility, must be ensured by the operator."

The system of licences is set up to ensure that facilities are designed, constructed, commissioned and prepared for operation in accordance with national and international codes, standards and experiences.

A clear requirement for the handling of radioactive waste and spent fuel is determined in Article 121 of the 2017 Act, which provides that a holder of radioactive waste and spent fuel shall ensure that the radioactive waste and spent fuel are handled in the manner prescribed and that the transfer of the burden of disposing of radioactive waste and spent fuel to future generations is avoided as far as is possible. The producers responsible for the occurrence of radioactive waste and spent fuel must ensure that the radioactive waste is produced in the smallest possible quantities.

The costs of radioactive waste and spent fuel management must be paid by the person responsible for its generation or by the holder of the waste if the ownership was transferred thereto by the person responsible for its occurrence, or if the person acquires it in any other way.

If the person responsible for the generation of radioactive waste or spent fuel is not known, the State must assume full responsibility for its management.

The holder of radioactive waste and spent fuel must forward the information on the generation thereof to the central registry of radioactive waste and spent fuel, which is maintained by the Slovenian Nuclear Safety Administration.

Article 22: Human and Financial Resources

Each Contracting Party shall take the appropriate steps to ensure that:

(i) qualified staff are available as needed for safety-related activities during the operating lifetime of a spent fuel and a radioactive waste management facility,

(ii) adequate financial resources are available to support the safety of facilities for spent fuel and radioactive waste management during their operating lifetime and for decommissioning,

(iii) financial provision is made which will enable the appropriate institutional controls and monitoring arrangements to be continued for the period deemed necessary following the closure of a disposal facility.

The licensee has the prime responsibility for the safety of its facilities. This responsibility includes the provision of adequate financial and human resources both to support the safety of facilities for spent fuel and radioactive waste management during their operating lifetime and for their decommissioning.

Krško NPP

(i) Human Resources

The Krško NPP has overall responsibility for its design, engineering, construction, licence application, operation, fuel management, procurement and quality assurance procedures, as well as for radioactive waste management. The Krško NPP is organised in several divisions, including the Technical Operations Division, which is responsible for operating, maintenance and technical services; the Engineering Services Division, responsible for design, engineering, configuration management, licensing, procurement engineering and the process information system; the Quality and Nuclear Oversight Division, which is responsible for quality assurance, quality control and independent nuclear oversight; the Procurement Division; the General Administrative Division; and the Finance Division. In all positions, qualified personnel perform all the various activities needed for radioactive waste and spent fuel management. At the end of 2023, 659 people, both technical and non-technical staff, were employed at the Krško NPP.

The handling of radioactive waste is the responsibility of the Chemistry Department, which is a part of the Technical Operations Division. The Chemistry Department is also responsible for decontamination activities.

The Nuclear Fuel Engineering Department, which is a part of the Engineering Service Division, is responsible for the accountability and control of special nuclear materials and for spent fuel management. The handling of processes themselves is carried out by the Nuclear Fuel Engineering Department and the Operations Department.

Radiological control is carried out by the Radiation Protection Department, which is also part of the Technical Operations Division.

Personnel Qualifications and Experience

All technical posts at the Krško NPP are assessed. The minimum requirements in terms of educational qualifications, the number of years of experience in relevant positions and certified competence to undertake certain tasks are ensured by the Krško NPP.

The qualifications consist of basic formal education and special knowledge. Special knowledge involves basic principles of the operation of nuclear power plants, radiological protection, industrial safety, safety culture, and other areas. The courses and training exercises are organised by the Training Department, which is also responsible for the record keeping of personnel qualifications.

The process of identifying potential candidates for leadership positions and for succession planning was implemented in accordance with best industry practices. Employee engagement and motivation are monitored on an annual basis to support the expectations defined in the human resources policy.

Training

All personnel working at the plant receive basic introductory training. The training course is comprehensive, addressing, *inter alia*: organisational arrangements, area designations and arrangements for working in radiologically controlled areas, plant layout and services, industrial safety, quality assurance, and emergency response.

Training in radiological protection is provided at different levels of complexity, depending on the level of responsibility of the employee. A basic training course is given to all personnel before they enter a radiologically controlled area, with the objective of ensuring that they have sufficient understanding of the principles of ionising radiation to enable them to work safely in the controlled area. A more advanced course is provided for the personnel permanently working in a controlled area or with systems that contain radioactive material. Personnel specialised in health physics attend the most advanced course.

Personnel dealing with radioactive waste and spent fuel are educated and trained to perform their duties. Special services in this area are also provided from abroad.

(ii) Financial Resources

The expenses for radioactive waste treatment, conditioning and storing, and for spent fuel storage are part of the production costs. The financial resources for these activities are ensured during the operational period of the Krško NPP.

According to the Agreement, the owners of the Krško NPP, GEN energija d.o.o., and Hrvatska Elektroprivreda d.d., are obliged to ensure the funds for the decommissioning and final disposal of radioactive waste and spent fuel.

The Slovenian share of funds for the decommissioning of the Krško NPP and for the post-operational radioactive waste and spent fuel management were until October 2022 ensured through the Act Governing the Fund for Financing the Decommissioning of the Krško NPP and the Disposal of Radioactive Waste from the Krško NPP. In November 2022 a new Act Governing the Public Fund for Financing the Decommissioning of the Krško NPP and the Disposal of Radioactive Waste and Spent Fuel from the Krško NPP was adopted.

The new Act established the transformation of the Fund into a public fund with the aim of adequately financing measures to ensure the decommissioning of the NPP and the disposal of radioactive waste and spent fuel from the NPP. The law specifies in detail the fees for the decommissioning of the NPP and the disposal of RW and SF. The Act prescribes the authority to determine the amount of the levy based on the decisions of the Government of the Republic of Slovenia and the authority to monitor and verify the collected funds and the corresponding amount of the levy. The operation of the fund, its business and investment policy and asset management are also determined in detail.

The Croatian share of the funds for the decommissioning of the Krško NPP and for post-operational radioactive waste and spent fuel management is ensured in accordance with the bilateral Agreement through the adequate Croatian Fund for Decommissioning and Spent Fuel Management. The Croatian Fund was established by the Act on Governing the Fund for Financing the Decommissioning and Disposal of Radioactive Waste and Spent Fuel of the Krško NPP. This act was adopted by the Croatian legislature in October 2007.

Jožef Stefan Institute Reactor Infrastructure Centre

(i) Human Resources

The TRIGA Mark II research reactor operation staff (the full-time staff consist of four reactor operators, five radiological protection technicians, the head of the radiological protection group, the quality assurance manager, and a secretary, while the part-time staff consists of the head of reactor operation and the head of the reactor infrastructure centre) are responsible for spent fuel and radioactive waste handling and management. The staff are appropriately trained and equipped.

The Hot Cell Laboratory operates under the TRIGA Mark II research reactor operating licence. The staff are the same as for the TRIGA research reactor.

The TRIGA Mark II research reactor operation staff are responsible for and trained to perform specific tasks in spent fuel management and radioactive waste management. The specific knowledge, training, skills and certificates required for reactor operators to carry out these tasks are a radiological protection certificate, a crane operator certificate, a forklift driver certificate and remote manipulation skills.

The personnel must also have some practical experience with spent fuel shipment projects and the treatment of spent sealed sources for storage.

(ii) Financial Resources

The financial resources for maintaining the safety of spent fuel and radioactive waste at the JSI Reactor Infrastructure Centre are provided from the budget for the reactor operation. Financial provisions for decommissioning are not provided. However, as the Republic of Slovenia owns the facility, it will also be responsible for ensuring financial resources for proper decommissioning and spent fuel management.

The Agency for Radwaste Management

(i) Human Resources

The ARAO is a mandatory service of general economic interest public utility service, and the number of employees is defined by the Government. At present, there are four organisational units and several independent services, including the QA/QC Service and the Radiation Protection Service. The ARAO had a qualified staff of 24 persons at the end of 2023, who perform all phases of institutional radioactive waste management as a mandatory service of general economic interest and staff competent to manage the licensing phase for the LILW repository, where subcontractors are also involved in performing specialised tasks.

In 2022, the ARAO prepared the long-term programme of work for the period 2023–2027 pursuant to the Ordinance on the Establishment of the ARAO Public Utility Institute. The programme was approved by the Slovenian Government in December 2022 and includes the ARAO staffing plan with up to 40 persons in 2027. The plan reflects the needs regarding specialist staff whose employment will enable the safest and smoothest radioactive waste and spent fuel management, and the operation, planning and supervision of nuclear and radiation facilities (including those that have already been closed). The current number of employees will be increased, as the ARAO will have to perform additional functions and duties. The recruitment of new staff is required mostly due to the construction and operation of the LILW repository, the implementation of the long-term monitoring and maintenance of the closed Jazbec and Boršt disposal sites, the implementation of measures for the planning and maintenance of the high-level radioactive waste repository, and other functions.

The ARAO radiation protection service is responsible for the implementation of radiation protection measures and supervision of the radiation exposure of the workers. The Radiation Protection Service is also responsible for monitoring the environmental impacts of facilities for radioactive waste management (the Central Storage Facility, the Jazbec mine waste disposal site) and for general surveillance and management of the Jazbec waste pile since 2016.

In the ARAO, all professional positions require a broad professional background and flexibility on the part of the staff, who have a diverse and adequate professional structure. The employees at the ARAO have at least the level of education required for the job classification, some even higher. More than two thirds of the employees have a degree in science or technology. The ARAO has also taken on younger professionals who were involved in specialised professional training courses and other types of education. In the last few years, special attention has been devoted to the professional development of employees working in the field of the LILW repository project. The professional development of employees is an important part of ARAO policy. Participation in training courses, workshops, seminars and conferences is supported in order to maintain the high quality of the team and its outputs.

(ii) Financial Resources

Until 2023, the financing of the ARAO was based on the annual work plan and is subject to annual contracts between the ARAO and both the Government and the Fund for the Decommissioning of the Krško NPP. Since the adoption of the Decree on the method and conditions for providing the mandatory national public service of general economic interest of radioactive waste management, the ARAO in 2023 operated on the basis of the two-year work programme and financial plan adopted by the Government of the Republic of Slovenia as its founder.

The operation of the ARAO is financed from the budget of the Republic of Slovenia and with dedicated revenues, which the Public Fund of the Republic of Slovenia for financing the decommissioning of the Krško Nuclear Power Plant and the disposal of radioactive waste and spent fuel from the Krško Nuclear Power Plant must pay into the national budget and are solely used for the Krško NPP radioactive waste management activities specified by the Public Fund law.

The contribution of the national budget and the Public Fund to the investment of the disposal of LILW is proportional to the estimated volume of LILW originating from the Krško NPP and the expected volume of institutional radioactive waste that will be disposed of in the Vrbina repository. Financing of ARAO activities for the management of radioactive waste, other than waste from nuclear facilities for energy production, so called institutional RW, is provided from the general budget of the Republic of Slovenia and to a lesser extent also by payments of holders or generators of RW according to the price list valid when the RW is handed over to the ARAO. The fees are defined by the Government and were changed in 2022.

Activities related to the preparation and disposal of high-level waste and spent fuel from the Krško NPP are financed exclusively from a dedicated item in the budget, to which the Public Fund pays the necessary funds.

Institutional radioactive waste management is financed from the national budget and from fees paid by waste generators when liabilities for further waste management are transferred therefrom to the State.

The money in the Public Fund for the Krško NPP is collected through a levy per kWhe delivered to the Slovenian grid and changed in July 2020 by a decision of the Slovenian Government whereby the Slovenian electrical power company GEN energija d.o.o., should continue to make increased payments in the amount of 0.48 euro cents per kWhe, starting 1 August 2020. Since 1 January 2022, GEN energija d.o.o., has been paying a contribution of 1.2 euro cents per kWhe to the Fund in accordance with Decision of the Government of the Republic of Slovenia number 306-106/2021/5 from December 2021 and decision number 360-20/2023/14 from April 2023.

Žirovski Vrh Uranium Mine

(i) Human Resources

At the beginning of 2002, the Žirovski Vrh Uranium Mine was transformed into the public company Žirovski Vrh Mine d.o.o. At the same time, a new company organisation was also established.

Žirovski Vrh Mine d.o.o. has an adequate and experienced staff of seven people (three permanent staff and four other staff), mostly monitoring staff. It is standard practice that additional expertise, the elaboration of projects and major remedial activities are contracted out on a commercial basis.

(ii) Financial Resources

The financial resources for the activities of the public company Žirovski Vrh Mine d.o.o. are provided solely from the national budget.

The Institute of Oncology Ljubljana – Department of Nuclear Medicine

(i) Human Resources

There are 32 persons working with radioisotopes at the Institute of Oncology. The staff have appropriate education and experience, as required by the national legislation. The number of staff has been relatively constant in recent years, although it may need to be increased if new nuclear medicine techniques are introduced.

(ii) Financial Resources

The Institute of Oncology is mainly financed by the Slovenian health insurance scheme and to a lesser extent from the budget of the Ministry of Health. The Department of Radiological Safety at the Institute of

Oncology strives to ensure additional financial resources for its projects connected to radiological safety and the safe storage and disposal of radioactive waste.

Ljubljana University Medical Centre – Division of Nuclear Medicine

(i) Human Resources

The Division of Nuclear Medicine consists of nine departments and units performing hospital activities and outpatient and diagnostic activities. At present, 114 persons work with radioisotopes at the Department. The staff working with radioisotopes in this Department have appropriate education and experience, as required by the national legislation.

(ii) Financial Resources

The functioning of the University Medical Centre's Division of Nuclear Medicine is ensured by the Health Insurance Institute and the Ministry of Health.

Article 23: Quality Assurance

Each Contracting Party shall take the necessary steps to ensure that appropriate quality assurance programmes concerning the safety of spent fuel and radioactive waste management are established and implemented.

Article 93 of the 2017 Act and its 2019, 2021 and 2023 amendments and the Rules on Radiation and Nuclear Safety Factors (hereinafter: Rules JV5) explicitly require that safety management measures are taken for all activities related to nuclear and radiation facilities, from the design stage, through operation, and to the decommissioning stage. An investor or an operator of a radiation or nuclear facility must ensure that the facility is managed safely and in accordance with the provisions of the Act. The operator of the radiation or nuclear facility must develop, apply, evaluate and continually improve its management system and must describe the latter in documents according to the requirements determined in detail by the minister competent for the environment.

Krško NPP

The company NEK d.o.o., as the licence holder, is responsible for the overall quality of the design, construction, operation, maintenance and modification of the plant. The quality assurance programme was already implemented in the design and construction of the plant and was in full compliance with the following: the United States Atomic Energy Commission (subsequently abolished and succeeded by the Nuclear Regulatory Commission) Appendix B to Title 10, Part 50 of the United States Code of Federal Regulation (10CFR50) Quality Assurance Criteria for NPPs and Fuel Reprocessing Plants, the quality assurance (QA) guidance provided in the US Atomic Energy Commission documents WASH 1283 Guidance on QA Requirements During the Design and Procurement Phase of Nuclear Power Plants, and the WASH 1309 Guidance on QA Requirements During the Construction Phase of Nuclear Power Plants.

Since the beginning of its operation, the overall Krško NPP Quality Assurance Programme and its applicable procedures have been implemented to ensure that all planned and systematic actions necessary to provide adequate confidence that all items or services will satisfy the given requirements as regards quality are in place. The overall requirements for quality, as one of the major objectives of Krško NPP operation, are set forth in the updated safety analysis report, which serves as a basis for the operating licence. The Krško NPP Quality Assurance Programme is implemented and maintained so as to comply with national legislation, best international practice and recognised industrial standards.

The Krško NPP's policy is to establish and implement an integrated management system bringing together in a coherent manner all the requirements for managing the organisation. The main aims of the system are to achieve and improve safety by planned and systematic actions necessary to provide adequate confidence that all these requirements are satisfied, and to ensure that health, environmental, security, quality and economic requirements are not considered separately from safety requirements. The policy is established by the Management Board's Statement of Policy and Authority and implemented through the Quality Assurance Programme presented in the quality document QD-1 and applicable programmes and procedures. The QD-1 is developed and maintained by the Quality and Nuclear Oversight Division and approved by the Management Board.

The Krško NPP management system is a set of interrelated and interacting elements; it establishes policies and objectives and enables those objectives to be achieved in a safe, efficient and effective manner. Safety is the paramount element in the Krško NPP management system, overriding all other demands. Having an integrated management system in accordance with Slovenian regulatory requirements (Rules JV5) and IAEA Safety Standards requirements is essential for maintaining and continuously enhancing safety. An integrated management system provides a number of benefits, together with enhanced safety and business performance. Over the 40 years of the Krško NPP's operation, the quality requirements and related documents have been revised and upgraded several times. The latest revision of the QD-1 Quality Assurance Plan was issued in 2020.

One of the most obvious changes to the QD-1 was to harmonise all elements with an integrated management system defined in Plant Management Programme MD-2: "Management System – Process Organisation", bringing together in a coherent manner all the requirements for managing the organisation.

The Quality Assurance Programme applies to safety-related and seismically-designed structures, systems and components (SSC), including their foundations and supports, and non-safety related SSC (Augmented Quality), as identified on the Q-List in the Master Equipment Component Database. Activities affecting the quality of these structures, systems and components are controlled to an extent consistent with their importance to safety. The Quality Assurance Programme is implemented by all Krško NPP departments, while programme requirements are also extended to contractors and suppliers in line with the importance of their services and scope of supply for nuclear safety.

The ISO 14001:2004 environmental management standard was implemented in 2008 and amended by ISO 14001:2015 in 2017. In addition, the internationally recognised standard for industrial safety, i.e. BS OHSAS 18001:2007, was introduced into Krško NPP practice in 2011 and was superseded by ISO 45001:2018 in 2020.

To ensure that the competencies of the Krško NPP radiological protection (RP) and radiochemistry laboratories are consistent with the Laboratory Management Programmes and legal requirements, the ISO/IEC 17025:2005 standard has been effectively implemented since 2007 in the RP laboratory for the measurement of activities, since 2008 in the RP laboratory for dosimetry, and since 2009 in the radiochemistry laboratory. In 2019 and 2020, laboratories adopted ISO/IEC 17025:2017.

Internal audits within the Krško NPP are performed in annual and two-year intervals in accordance with the requirements. Internal audits cover functional and cross-functional areas in accordance with IAEA, ANSI, NRC, EPRI and WANO guidelines. Audit results are reported and documented through the company's Corrective Action Programme, where audit findings are tracked until they are implemented.

Krško NPP suppliers are audited in three-year intervals, in accordance with the requirements. For international suppliers, the Krško NPP takes part in NUPIC audits and surveys.

In line with its policy of monitoring and constantly upgrading nuclear safety and QA requirements, the Krško NPP has been following the efforts of the nuclear industry at large (the IAEA, WANO, INPO, EPRI, ASME, and others) and enhancing its management system to improve safety and excel in operation. The Krško NPP will continue to develop its internal management system processes and requirements in the future. The most important objective of the entire organisation – to ensure safe and efficient power plant operation – will continue to be the most important goal of the Quality Assurance Programme.

Jožef Stefan Institute Reactor Infrastructure Centre

The management system at the JSI Reactor Infrastructure Centre is part of the Jožef Stefan Institute's QA Programme. The document Quality Assurance Programme of the Reactor Infrastructure Centre (RIC), RIC-QA-101, 3rd edition, August 2021, together with the safety report for the TRIGA MARK 2 Research Reactor and the IJS Quality Assurance Programme Manual (PPZK), constitute the basis for the quality assurance of the Reactor Infrastructure Centre.

The purpose of the document is to present the requirements for a comprehensive RIC management system. The second chapter presents the general requirements for the management system, including those related to safety policy and safety culture. The third chapter presents the requirements related to management responsibility (Chapter 3). This is followed by resource management requirements (Chapter 4) and process requirements (Chapter 5). Finally, there are requirements for measurement, non-conformance control and improvement.

The Director of the JSI and the head of the reactor operation department are responsible for its implementation. Specific internal quality assurance and quality control-related documentation is applied. Management system activities connected with reactor operation are subject to both internal audits (Jožef Stefan Institute management system management and an audit team) and external inspections by the regulatory body. The QA Programme is subject to periodic reviews.

The JSI Reactor Infrastructure Centre Management system is implemented and maintained to a great extent in accordance with the following standards:

- SIST EN ISO 9001:2015;
- IAEA GSR Part 2; and
- Slovenian legislation and other international standards.

The operation of the research reactor is characterised by the following processes:

- core work processes: starting the reactor, the operation of the reactor, the approval of operation upon order, changes to the TRIGA reactor project, the control of radiation safety, conducting experiments, the irradiation of samples, the training of trainees, hot cell operation, the decommissioning of the reactor, design, and the development of products and services;
- training processes: the training of RIC employees; and
- support processes: response to emergency events, inspections, calibrations and testing, the maintenance of systems, structures and components, procurement, project requirements, offers, contracts, the handling of hazardous substances and waste, and quality assurance.

Agency for Radwaste Management

The integrated management system, including all aspects related to safety, health, the environment, quality, security and economics, based on the IAEA safety standard GSR Part 2, ISO 9001:2015 and Rules JV5 (Chapter 5), places the required priority on safety. Safety culture will continue to be a comprehensive element of all segments of the ARAO's operations.

Annual internal audits and management reviews are implemented to assess the suitability, adequacy and effectiveness of the ARAO management system. Independent management system certification is conducted according to ISO 9001:2015. The ARAO sees an opportunity to continuously improve its operations by putting in place an integrated management system. The ARAO policies are based on the fundamental principles and values of radioactive waste management. The ARAO will ensure a high level of protection of human health and the environment within and beyond the borders of the country, both now and in the future. It carries out its activities so that future generations will not face undue burdens.

The strategic goal is to construct a LILW repository for final disposal of the waste produced in Slovenia. The ARAO continuously improves an efficient and client-friendly service of institutional radioactive waste management for medical and research institutions and for industries that use radioactive materials and radiation sources. It also continuously improves the management concept regarding spent fuel and high-level radioactive waste that takes into account the strategic value of the inventory and fulfils the safety requirements at all stages of management, despite the large timespan involved, by paying due consideration to national and international policy frameworks.

Based on the ARAOs mission and vision, the main goals are presented through the public website of the ARAO.

Žirovski Vrh Uranium Mine

The basic objective of Žirovski Vrh Mine d.o.o. is to ensure the permanent cessation of uranium ore exploitation and to mitigate the consequences of uranium production at the Žirovski Vrh Uranium Mine. The system of quality control and quality assurance was formally introduced in Žirovski Vrh Mine d.o.o. for the purpose of uranium mine remediation at the end of 2005 (Quality Assurance Manual – 1st edition, December 2005). The Manual was revised following personnel and organisational changes (Quality Assurance Manual – 2nd edition, June 2007).

The Quality Assurance Manual, together with the reference document, contains instructions and procedures with reference to quality control and defines efficient implementation of the responsibility for the operational quality of the company.

Internal audits of individual activities and procedures were carried out until 2020 on the basis of the annual programme. On the basis of finding discrepancies, corrective measures were introduced to ensure quality during the implementation of the permanent cessation of uranium ore exploitation and the prevention of the consequences of mining in the Žirovski Vrh Uranium Mine and the protection of the environment and people against the consequences of the mining operations.

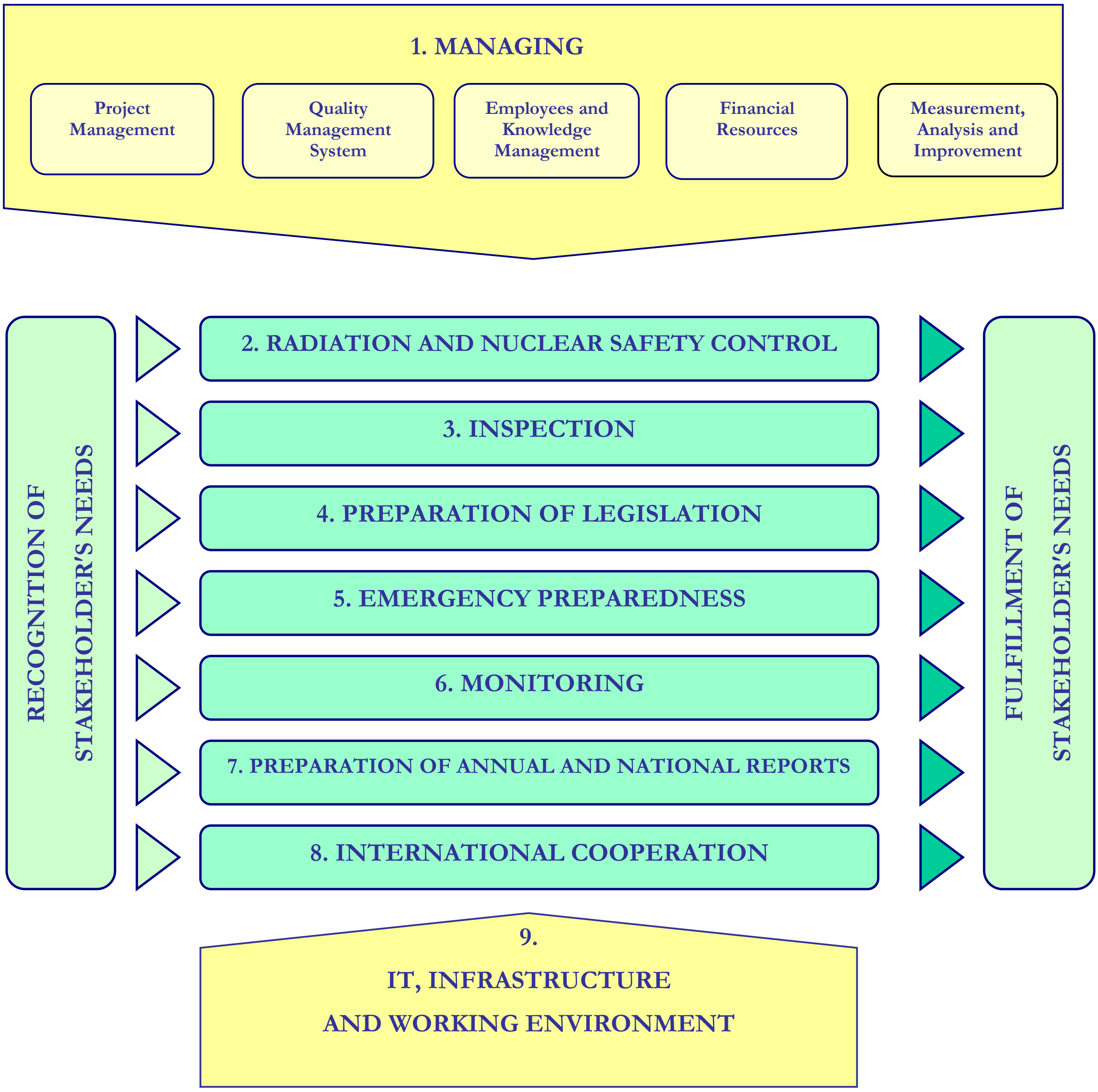
Slovenian Nuclear Safety Administration

In 2001, the SNSA decided to establish and implement a documented quality management system based on the Government Programme on Management for Excellence in the State Administration, taking into consideration IAEA Safety Series No. 50-C/SG-Q, "Quality Assurance for Safety in Nuclear Power Plants and Other Nuclear Installations", Code and Safety Guides Q1–Q14, IAEA-TECDOC-1090, "Quality Assurance within Regulatory Bodies", and simultaneously ISO 9001, "Quality Management Systems – Requirements". As of recently, the SNSA management system also complies with ISO 27001:2022.

In 2006, the SNSA upgraded the quality management system by introducing an integrated management system, supported by the requirements of the new IAEA safety standard GS-R-3 "Management System for Facilities and Activities". In December 2007, the SNSA successfully obtained the ISO 9001:2000 certificate for its management system. In December 2010, an external recertification audit was carried out in accordance with ISO 9001:2008. After 2013, the SNSA decided not to pursue a second external recertification audit, even though the SNSA continues to carry out all activities in accordance with the requirements of ISO 9001:2015, IAEA GSR Part 2 "Leadership and Management for Safety", IAEA GSG-12 "Organisation, Management and Staffing of the Regulatory Body for Safety", and IAEA GSG-13 "Functions and Processes of the Regulatory Body".

The aim of the SNSA management system is to ensure the implementation of the SNSA's mission and to achieve its vision while taking into consideration the SNSA's values and optimally use the available resources. The SNSA's management system covers all SNSA activities and is designed in such a way that it integrates all requirements relating to safety, health, environmental, security, quality, human and organisational factors, and societal and economic elements, so that safety is not compromised. The SNSA's management has continuously ensured that SNSA employees are familiar with the management system, its documentation and its vision, mission, values, management policy and safety culture policy. The SNSA's management system is based on a process approach. The processes are divided into one management process, eight core processes, and one supporting process (Figure 7).

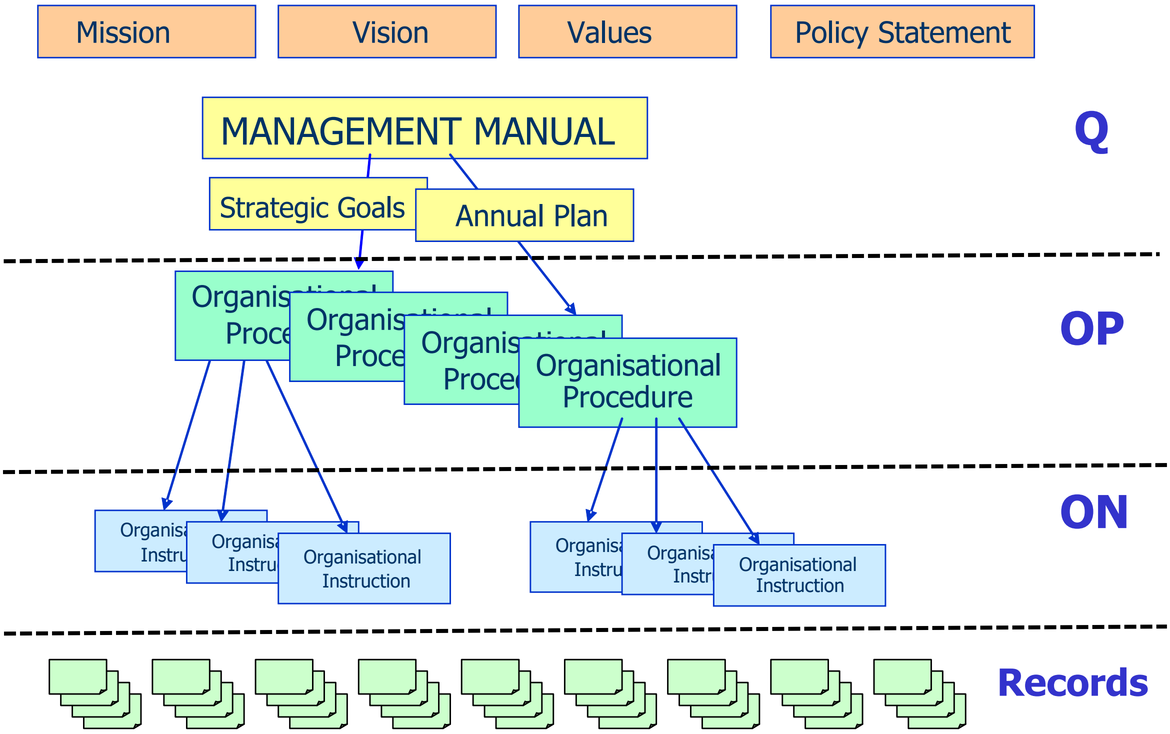
Figure 7: **The SNSA Management System**



The SNSA management system is documented at five levels of management system documentation (Figure 8):

- Level 0: The mission, vision, values and policy statement of the SNSA;
- Level 1: The management manual (Q), which defines the concept of the management system in the SNSA. This level also includes the SNSA's strategic goals and annual plan;
- Level 2: Organisational procedures (OP), where the management of processes is described;
- Level 3: Organisational instructions (ON), where the detailed performance of individual activities is defined;
- Level 4: Records resulting from the performance of SNSA activities.

Figure 8: **The SNSA Management System documentation**



Internal audits of the SNSA's processes are performed for each process in two-year intervals. At the beginning of each calendar year, a management review of the SNSA's management system is carried out to ensure its continuing suitability, effectiveness and efficiency. Based on the findings, deficiencies have been remedied and several improvements to the management system have been introduced.

According to requirement 14 of GSR Part 2 "Measurement, Assessment and Improvement of Leadership for Safety and Safety Culture", the SNSA implemented the first safety culture self-assessment by using two methods – a questionnaire and interviews. The first safety culture self-assessment was finalised in 2023.

The regulatory requirements for the licensee's management systems are defined in Slovenian legislation, namely in the 2017 Act and its amendments in 2019, 2021 and 2023 and subsidiary legislation.

The 2017 Act defines the requirements related to management systems. Namely, Article 93, *inter alia*, additionally defines that as part of its management system the operator of a radiation or nuclear facility shall:

- establish, implement, assess and continually improve the management system, which shall ensure appropriate compliance with the requirements as to radiation and nuclear safety, nuclear protection, readiness for emergencies, health, the environment, the security of information systems and data, quality and efficiency, and ensure that safety aspects are appropriately considered in all activities of the operator of the radiation or nuclear facility;
- set up controls of contactors of equipment and providers of works depending on their importance for radiation and nuclear safety;
- set up controls and ensure that works are performed by companies that have an established management system and have qualified and experienced workers in the expert area of the works concerned; and
- ensure that the relationships and behaviour of employees in its organisation lead to a good safety and security culture. The safety culture and security culture must be included in the management system. Through self-assessment and regular reviews of the management system, the operator shall review the effectiveness and efficiency of the safety and security culture.

Furthermore, Article 94 of the 2017 Act determines that the provisions of Article 93 on establishing, implementing, assessing and continuously improving the management system shall, *inter alia*, also apply to the authority for nuclear safety.

The most important regulation defining quality management systems is the Rules on Radiation and Nuclear Safety Factors (JV5). Chapter Five (Articles 52 to 74) of the above-mentioned regulation, i.e. "Management

System", is dedicated to the requirements as to ensuring a process-oriented integrated management system. Currently, the regulation is under revision. Changes to the provisions of Chapter 5 are based on the requirements of the IAEA standard GSR Part 2 "Leadership and Management for Safety", as well as on WENRA reference levels. In 2023, the JV5 was reviewed. Its amendment is planned to be adopted in 2024.

Article 24: Operational Radiation Protection

1. *Each Contracting Party shall take the appropriate steps to ensure that during the operating lifetime of a spent fuel or radioactive waste management facility:*

(i) *the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable, economic and social factors being taken into account;*

(ii) *no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection; and*

(iii) *measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment.*

2. *Each Contracting Party shall take appropriate steps to ensure that discharges shall be limited:*

(i) *to keep exposure to radiation as low as reasonably achievable, economic and social factors being taken into account; and*

(ii) *so that no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection.*

3. *Each Contracting Party shall take appropriate steps to ensure that during the operating lifetime of a regulated nuclear facility, in the event that an unplanned or uncontrolled release of radioactive materials into the environment occurs, appropriate corrective measures are implemented to control the release and mitigate its effects.*

Legislation, Regulations and Requirements

Radiation protection legislation as applied to nuclear and radiation facilities, including radioactive management, is regulated by the 2017 Act. The subsidiary regulations and decrees published more recently are mostly based on Council Directive 2013/59/Euratom.

Subsidiary regulations concerning the licencing and management of radiation and nuclear facilities, as well as their operational safety, is constantly being updated with the latest revisions of the Rules on providing qualification for workers in radiation and nuclear facilities and the Rules on radioactive waste and spent fuel management.

The two competent authorities for radiation protection are the SNSA, under the Ministry of Natural Resources and Spatial Planning, and the SRPA, under the Ministry of Health. The SNSA is responsible for licensing and inspections in industry (including nuclear facilities), research, education, and administration, while the SRPA has adequate competence for sources used in medicine and veterinary care.

According to the 2017 Act, the design, planning, subsequent use and operation of sources and their handling (including the handling of radioactive waste) shall be performed in such a manner so as to ensure that exposure is as low as reasonably achievable (ALARA), taking into account economic and social factors. Radiation protection experts and technical support organisations are authorised to perform, *inter alia*, consultation, radiation safety assessments and dose calculations. Several technical support organisations are authorised in Slovenia to perform specific tasks regarding the radiation protection of workers and the public, radiological surveillance, the monitoring of individuals, the monitoring of the radioactivity of the environment, interventions, etc. Five medical institutions are authorised to carry out health monitoring of workers in this field.

The prescribed annual limit of an effective dose for workers is 20 mSv and the annual equivalent dose limit for skin or extremities is 500 mSv, except in the case of eye lenses, regarding which the annual limit is 20 mSv. In general practice, it has been found in the last decade that exposure of 20 mSv per year was exceeded in only a few cases. Since 2000, the Republic of Slovenia has had a computerised registration system for the occupational radiation exposure of workers in the country, including outside radiation workers. In total, approximately 21,200 workers (together with external radiation workers) have been registered so far, including workers who have ceased to work with radiation sources. Altogether there are about 9,000 exposed workers yearly in Slovenia, with on average 1,000 workers per year in the nuclear fuel cycle.

The general limit for the annual effective dose for members of the public is 1 mSv. Additionally, the annual equivalent dose limit for ocular lenses is 15 mSv per year, and for the skin 50 mSv per year. Dose constraints were used for specific cases (the nuclear power plant, the research reactor, the uranium mine, the central storage facility, and carrying out radiation practices).

1. **Steps taken to ensure that during the operating lifetime of a spent fuel or radioactive waste management facility the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable**

The radiation protection standards in radioactive waste management facilities and structures and spent fuel storages were already implemented during the licensing procedure. The Report on the Safety Assessment of Exposed Workers against Radiation must be submitted as part of the licensing documentation and the licensee must ensure comprehensive measures to protect workers and the public, as required by Article 27-29 ("Basis of radiation protection") of the 2017 Act. In implementing the ALARA principle, these measures devote special attention to the protection of pregnant women, breastfeeding women, students and workers employed by contractors, among others. The holder of a licence for the operation of a nuclear facility (including radioactive waste storage) shall ensure its own special organisational unit for radiation protection, which is responsible for planning and implementing measures for radiation protection. In all other cases, the person responsible for radiation protection may be contracted by the licensee. The individual dosimetry is based on thermoluminescent (TL) dosimetry or optically stimulated luminescent (OSL) and/or the monitoring of workplaces, as appropriate. Dosimetric services are authorised by the SRPA.

According to Article 158 of the 2017 Act and the Rules on the Monitoring of Radioactivity, operational monitoring of radioactivity shall be ensured by the radiation facility or nuclear installation to protect the public and the environment. Operational monitoring of radioactivity shall entail:

- the monitoring of radioactive discharges from a radiation facility or nuclear installation into the environment;
- the monitoring of radioactivity (in environmental media, such as air, surface and underground waters, and soil) drinking water, foodstuffs and animal feed. The media chosen and the scope of measurement depends on the specific radioactive discharges from the facilities and exposure pathways.

Radioactive discharges are monitored and reported at regular intervals (weekly, monthly, quarterly and annually), as prescribed in the licencing documents and in the Rules on the Operational Safety of Radiation and Nuclear Facilities. Public exposure is estimated annually via all exposure pathways. The operator shall also carry out monitoring of the effects of remediation works in the event of an emergency.

2. **Steps to ensure that discharges are limited to keep exposure to radiation as low as reasonably achievable and that no individual is exposed, in normal situations, to radiation doses that exceed national prescriptions for dose limitation, with due regard to internationally endorsed standards on radiation protection**

The legal bases for the control of discharges in normal operation are the 2017 Act (Article 159, "Monitoring of radioactivity in the environment"), the Rules on the Monitoring of Radioactivity, and the Rules on Radioactive Waste and Spent Fuel Management.

According to the 2017 Act, two levels of radiation monitoring ensure that no individual is exposed to radiation above the prescribed dose limits in normal situations.

(a) Monitoring of the discharges from radiation facilities and nuclear installations

The control of radioactive discharges into the environment from nuclear installations is carried out regularly by the operator. Independent measurements of discharges are also provided, although in a limited scope, by technical support organisations under the supervision of the SNSA as the regulatory authority. The discharge limits for nuclear installations were set by the SNSA in relation to the dose constraints. The monitoring of radioactive discharges from nuclear installations and radiation facilities in the Republic of Slovenia started in the early 1980s, with extensive programmes at the Krško NPP (1981), the Žirovski Vrh Uranium Mine (1985), the JSI Reactor Infrastructure Centre (1986), and the Central Storage Facility for Radioactive Waste in Brinje (1986). Radioactive discharges from hospitals with nuclear medicine departments are discharged after decay in storage tanks and monitored by approved radiation protection experts to verify if annual effective doses for reference individuals in the environment are below 10 μSv. When the specific activity decreases below the authorised limits, the liquid waste is discharged into the municipal sewerage system. Where it is appropriate, rough estimates of discharged activities for very short-lived isotopes are calculated every year, based on the purchased and applied activity of radioisotopes.

(b) Environmental monitoring of radioactivity

Monitoring of environmental radioactive contamination in the surroundings of nuclear facilities is performed exclusively by the authorised technical support organisations. The radiation exposures of representative members of the population are estimated based on measured data and modelling.

Monitoring of radioactivity in the environment is performed in accordance with the Rules on the Monitoring of Radioactivity. Samples are taken from the environment and analysed – air, water soil, underground and drinking water, as well as foodstuffs and animal feed. The exposure of the public as a result of environmental contamination due to the operation of facilities in the nuclear fuel cycle is estimated and compared with the dose constraints and limits.

An automatic radiation monitoring system in the Republic of Slovenia was developed soon after the Chernobyl accident. The monitoring network has been modernised in the last few years, where old, outdated measuring devices are being replaced by new, state-of-the-art instruments, offering better sensitivity and redundant communication channels. The SNSA has also established a comprehensive database on past discharges and environmental radioactivity measurements. The database is updated on a yearly basis with data collected through various monitoring programmes. The objective of this computerised database is to analyse and visualise the statuses and trends of historical records. All these data could be used as the input data for modelling the radiation exposure of a representative person of a reference group(s).

A dedicated application for the assimilation and analysis of all available data on radioactivity, as well as the issuance of alerts in the event of elevated values, was developed and is also undergoing constant improvement. Presently, it gathers data from all on-line measuring sites (72 dose rate stations, 3 aerosol radioactivity measurements, and 2 ground deposition spectrometers) as well as all laboratory measurements performed within the framework of environmental and operational monitoring. Additionally, it also serves as an informational sharing point where the public and expert communities can see real-time data on environmental radioactivity in Slovenia.

During the operating lifetime of the nuclear facility, in the event of an unplanned or uncontrolled release of radioactive materials into the environment, appropriate corrective measures are ensured to control the release and mitigate its effects. See also Article 25: Emergency Preparedness.

Measures Taken by Licence Holders

Krško NPP

(a) Radiation Protection

In accordance with the 2017 Act, the Radiological Protection Unit at the Krško NPP is organised to implement radiation protection measures, such as measurements, assessments and keeping records of received effective doses for all workers who have access to the controlled area, regardless of whether they are members of the NPP staff, contractors, inspectors or visitors. Radiation protection related to the management of radioactive waste at the plant site is one of the most important tasks of the Radiological Protection Unit. This task is in compliance with the general radiation protection measures established in the plant.

From the viewpoint of radiological protection, the power plant area comprises the controlled area and the supervised area. The controlled area (the area under constant radiological surveillance) includes the Reactor Building, the Fuel Handling Building, the Auxiliary Building, the Waste Manipulation Building, a part of the Intermediate Building, the primary laboratory, the hot machine workshops, the decontamination area, the Decontamination Building, and the areas for the processing and storage of radioactive waste.

In the controlled area – where irradiation and contamination, or both, are highly probable – the Krško NPP staff and contractors must be equipped with regular protection equipment, electronic alarm dosimeters and optically stimulated luminescent personal dosimeters (OSLs). Internal contamination is measured using a whole-body counter for all workers working in the radiologically controlled areas where there is a risk of internal contamination (i.e. during annual outages or major maintenance works).

The ALARA committee is responsible for adopting and reviewing the ALARA programmes. During the ALARA planning procedure, radiological conditions are analysed, personal protection equipment is defined, and radiological control determined, so all key elements are taken into account.

The Monitoring Programme covers the measurements of liquid and gaseous discharges, measurements of activity in plant systems, the inventory of the onsite radioactive waste storage facility, environmental radioactivity and meteorological measurements, and preparedness for radiation measurements in case of emergency. The operator is obliged to notify the SNSA in advance of all gaseous discharges into the atmosphere.

Organisational arrangements for controlling the production and release of radioactive discharges and waste are in place. The existing top-level plant policy and waste management programme keep the radiological impact from radioactive discharges and waste within the authorised limits and as low as reasonably achievable. Arrangements for the minimisation of radioactive waste generation are in place. All relevant elements regarding waste minimisation are taken into consideration (the fuel integrity programme, the reduction of leakages, the decontamination process, segregation practices, etc.).

The three-year average collective dose for the whole plant is shown in Figure 9. The rise in recent years is a result of Safety Upgrade Project modifications (PNV or SUP), which were done to increase the safety of the plant. In the years 2021 and 2022, the two modifications that had the highest exposures were the mechanical stress improvement process (MSIP) of welds near the reactor and the spent fuel dry storage campaign. The further increase in collective radiation exposure in 2023 was the result of corrective actions on safety injection lines and other maintenance works during the forced outage, which was performed after the detection of a leakage from the primary system on the safety injection line. The Krško NPP made great improvements in dose reduction from waste manipulation in 2021, 2022, and 2023 by modernising the equipment used in the process. New technology, which includes cameras, remotely operated cask lifts, and a modernised processing system, allows operators to handle and process waste without receiving a dose, which resulted in reducing the received dose by almost half, while the amount of work was much greater than in past years due to preparations for waste handover to organisations responsible for the disposal of waste.

Figure 9: **Collective radiation exposure – three-year rolling average at the Krško NPP in the period 2003–2023**

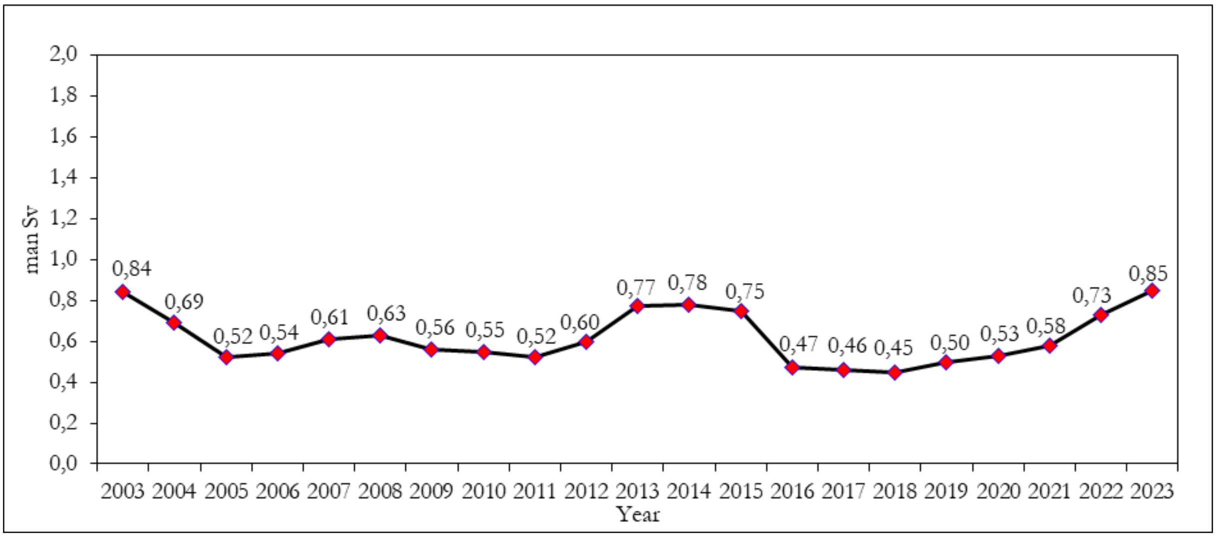


Table 3 shows the dosimetry data for the last four years (2020 without an outage; 2021 and 2022 were outage years; while 2023 was a year with a forced outage).

In this period, the maximum individual doses were due to waste manipulation in 2020, mechanical maintenance in 2021, the MSIP project in 2022, and decontamination activities during the forced outage in 2023.

Table 3: **Dosimetry data from the 2020–2023 period at the Krško NPP**

Year	Collective dose (man Sv)	Maximum individual dose (mSv)	Average individual dose (mSv)
2020	0.13	6.31	0.16
2021	0.93	9.25	0.69
2022	1.14	14.03	0.83
2023	0.49	8.03	0.49

(b) Liquid and Gaseous Discharges

In accordance with the licence for operating the Krško NPP, the total dose constraints for a member of the public are as follows:

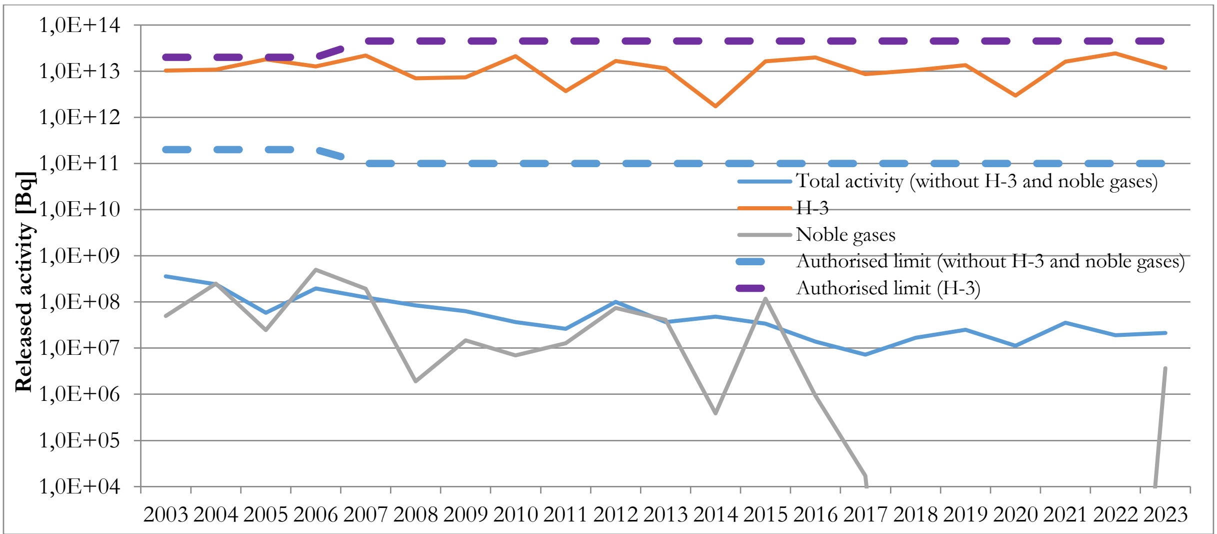
- The effective dose constraint at a distance of 500 m from the reactor and beyond – for doses due to liquid and gaseous radioactivity releases during normal operation – is less than or equal to 50 µSv/year.
- The radiation dose constraint from all sources is less than or equal to 200 µSv/year at the site fence.

The limits of radioactive discharges into the environment were initially authorised in the operating licence of the Krško NPP, issued on 6 February 1984. In 2007 the operating limits were revised and slightly modified in order to ensure compliance with the standard Radiological Effluent Controls for Pressurised Water Reactors (RETS). The modification was made in order to include the corresponding effective dose as an additional parameter for the control of plant operation performance.

The regular control of radioactive discharges was set out in the technical specifications (RETS) for plant operation and comprises the measurement of the concentrations and flow rates of gaseous and liquid discharges at the source. In addition, the dose rates of external radiation and the radioactivity in the air are measured on-site. The competent authorities are regularly informed by the Krško NPP of discharges of radioactive materials into the environment on a daily, weekly, monthly, quarterly and yearly basis.

Liquid radioactive discharges (Figure 10) are released into the Sava River via the Essential Service Water System outlet upstream of the dam. The dominant radionuclides in the liquid discharges are ^{3}H and ^{14}C. In the last four years, the nuclides ^{51}Cr, ^{54}Mn, ^{58}Co, ^{60}Co, ^{110m}Ag, ^{125}Sb, ^{137}Cs, ^{95}Nb, ^{133}Xe, ^{55}Fe, and ^{90}Sr have also been detected, but their activity was around 7 orders of magnitude lower. The main contribution to the dose originates from ^{3}H, ^{14}C and radioisotopes of caesium and cobalt. The dose to the reference group due to liquid discharges is assessed as being around 0.01 µSv per year.

Figure 10: **Radioactive liquid discharges from the Krško NPP, 2003-2023**

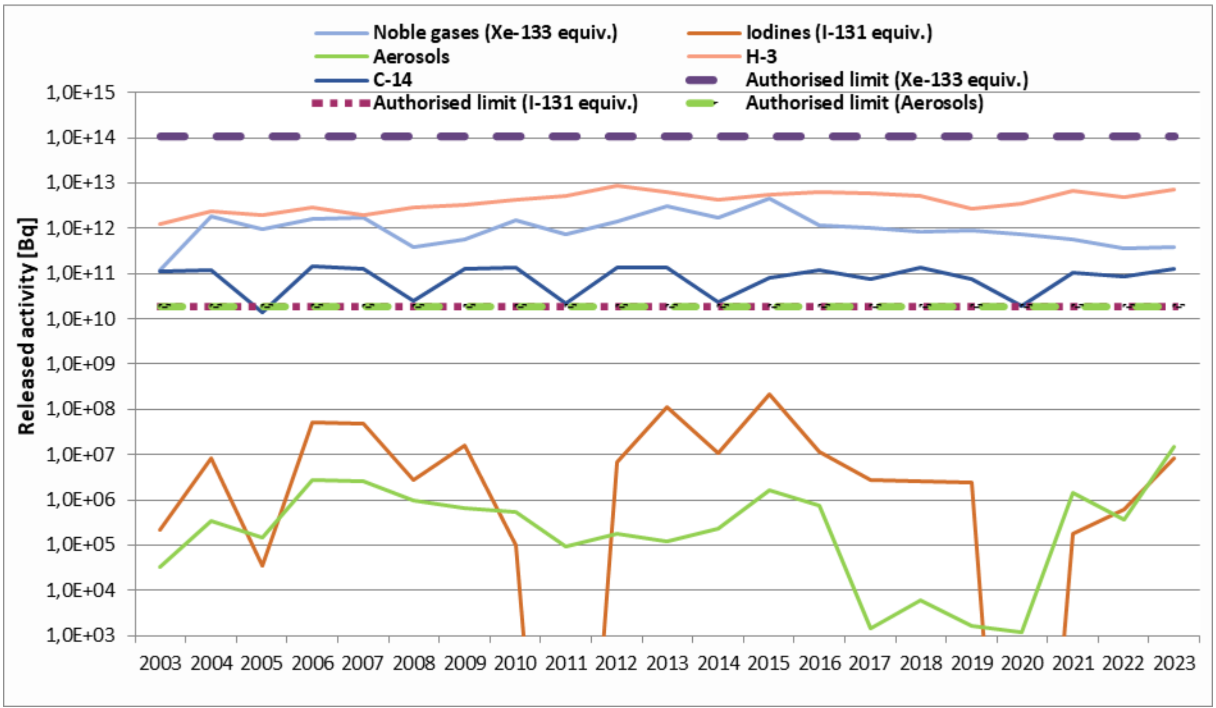


Notes:

- the limit for fission and activation products is 100 GBq (since 2007);
- the limit for ^{3}H is 45 TBq (since 2007);
- the radioactivity of noble gases was below the prescribed detection limit in the years from 2018 to 2022.

Radioactive gases (Figure 11) from the Krško NPP are released into the atmosphere mainly from the reactor building and fuel handling building ventilation system via the common plant vent. The radiation monitoring system continuously measures and monitors the concentrations of individual radioactive elements at both discharge points. The conservatively estimated gaseous ground release dose at a distance of 500 metres from the reactor were below 1 µSv in each of the last four years.

Figure 11: **Radioactive gaseous discharges from the Krško NPP, 2003–2023**



Notes:

- the limit for noble gasses was expressed in ^{133}Xe equivalent activity until 2006; since 2007 there has not been a specific limit, but the total annual dose limit of 50 µSv must be respected;
- the released activities of ^{131}I for 2011 and 2020 were under the limit of detection.

Conservatively estimated individual exposures of members of the public are based on directly measured discharge values, environmental sampling programme results and on model calculations. This amounts to the value of an effective dose usually around 0.1 µSv/year for an adult. The dose assessment showed that exposures to members of the reference groups are well below the regulatory limit of 50 µSv/year and less than 0.01% of exposure due to natural radiation.

Central Storage Facility for Radioactive Waste in Brinje

(a) Radiation Protection

Radiation protection in the CSF in Brinje includes occupational radiation protection (the protection of workers) and on-site and off-site monitoring of the storage facility (the protection of the public). Workplace radiation monitoring is performed regularly inside the CSF. The measurements include the gamma and neutron dose rate, the gamma and neutron radiation field, the radionuclide contamination of surfaces and the air, radon and radon equilibrium equivalent concentrations, and the concentration of gamma emitters in the wastewater coming from the CSF.

Radioactive waste management and other activities in the CSF are performed according to defined procedures, always also considering radiation protection. A radiation protection worker is present at all activities involving ionising radiation sources of higher activity or in non-routine activities. Personal dosimetry is provided for all radiation workers and annual doses are regularly reported to the competent regulatory body. The radiation exposure data for workers in the CSF due to radioactive waste management activities from 2005 to 2023 are given in Table 4.

Higher personal and collective doses correspond to intensified handling of stored radioactive waste due to the management of historical radioactive waste in 2005 and 2008 (sorting, dismantling, re-packaging, rearrangement inside the CSF), the introduction of self-supporting metal pallets for the storage of waste packages in 2015, and the dismantling of DSRS starting in 2017. These waste management measures substantially decreased the level of dose rates in the CSF and the emissions of radon from the CSF.

Table 4: **The radiation exposure of workers at the Central Storage Facility due to radioactive waste management, 2005–2023**

Year	Number of workers	Average [mSv]	Maximum individual dose [mSv]	Collective dose [man mSv]
2005*	20	0.199	1.68	4.07
2006*	15	0.045	0.35	0.9
2007*	27	0.046	0.38	1.23
2008*	21	0.175	1.420	3.68
2009	9	0.032	0.147	0.284
2010	10	0.011	0.040	0.105
2011	9	0.021	0.073	0.192
2012	9	0.014	0.065	0.127
2013	9	0.033	0.092	0.296
2014*	8	0.067	0.193	0.536
2015	8	0.136	0.345	1.084
2016	7	0.039	0.096	0.274
2017	6	0.072	0.268	0.429
2018	7	0.030	0.210	0.393
2019	6	0.056	0.106	0.333
2020	6	0.056	0.143	0.448
2021	6	0.020	0.043	0.159
2022	8	0.029	0.051	0.228
2023	7	0.057	0.149	0.453

Note: * staff of the ARAO and sub-contracting workers

(b) Liquid and Gaseous Discharges

The scope of monitoring includes emissions (measurements of gaseous and liquid discharges) and environmental concentrations of radioactivity near the CSF. Since 2008, when the 2nd phase of treatment and conditioning of the stored waste took place, the average emission rate of radon has been below 10 Bq/s (Figure 12). A trend of a slight increase in radon emissions can be seen in the last few years until 2023, when the above average of emissions of radon has been measured. The increased measurements could be due to resent collected and not yet conditioned radium sources and from ground transmission into the CSF.

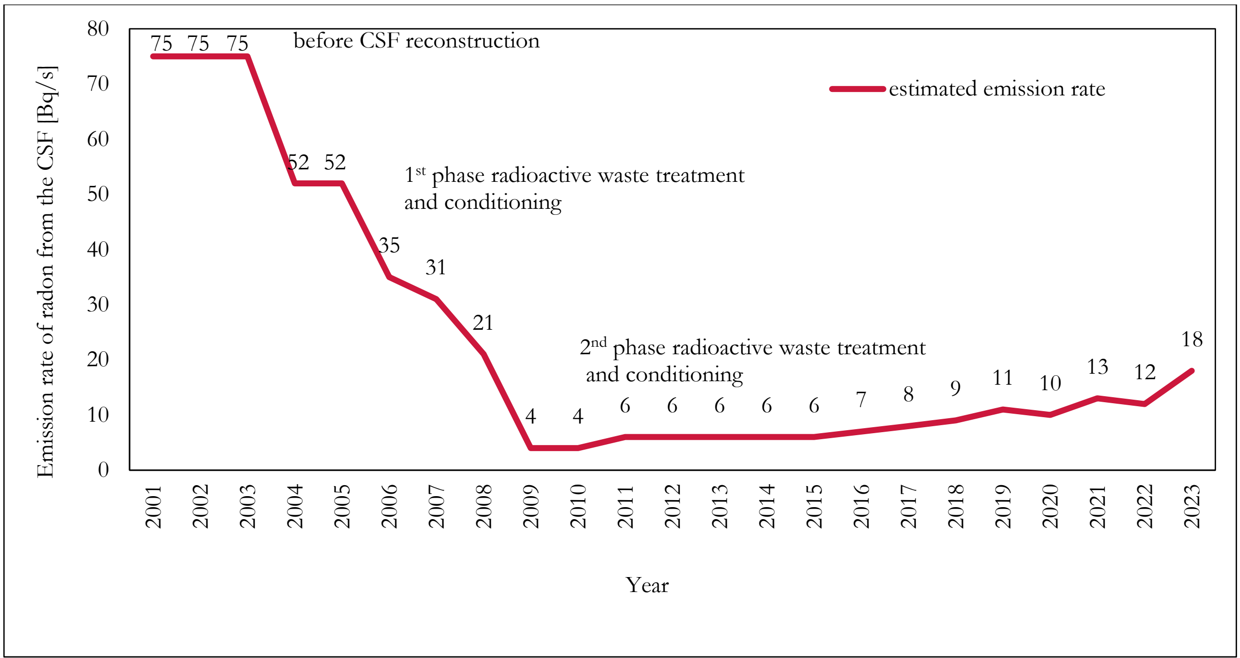
The sanitary water and condensate from the air-drying apparatus is collected in the container and checked for radioactive contamination before release. Thus far, no water contamination has been measured.

The assessment of the public dose considered two pathways of dose exposure: radon progeny inhalation and external exposure. The annual effective dose for the most exposed representative of the reference group remaining in the vicinity of the CSF site for a part of his or her routine work is estimated to be from 3 – 7 μSv in the last few years. The annual effective dose received by a farmer who occasionally works in a field near the site is estimated to be less than 0.2 μSv, and for employees from the JSI it is estimated to be less than 7 μSv. The assessment has taken into consideration the new dose factors for exposure to radon and its short-lived progenies as defined in the ICRP 137, which are higher than the previously used factors from the ICRP 65. Exposure to radon represents more than 98% of the assessed dose.

The conservatively estimated public exposure due to the operation of the CSF is far below the dose constraint of 100 μSv/year set in the operational licence for the CSF, which was issued by the SNSA in April 2008 and in the licence renewal in April 2018.

The emission rate of radon from the CSF in the period from 2001 to 2023 is shown in Figure 12.

Figure 12: **The emission rate of radon from the CSF in the period 2001–2023**



Jožef Stefan Institute Reactor Infrastructure Centre

(a) Radiation Protection

Radiation protection at the Jožef Stefan Institute Research Reactor Infrastructure Centre is implemented and performed by the Radiation Protection Service of the Institute. In total, 35 persons from the reactor department, the service, and the radiochemical laboratory were exposed to ionising radiation in 2023, with an average annual dose of 0.036 mSv (not taking into account the neutron dose). The collective annual dose in 2023 was 1.27 man mSv.

Table 5: **Radiation exposure of workers at the JSI Reactor Infrastructure Centre due to radiation practices and radioactive waste management, 2010-2023**

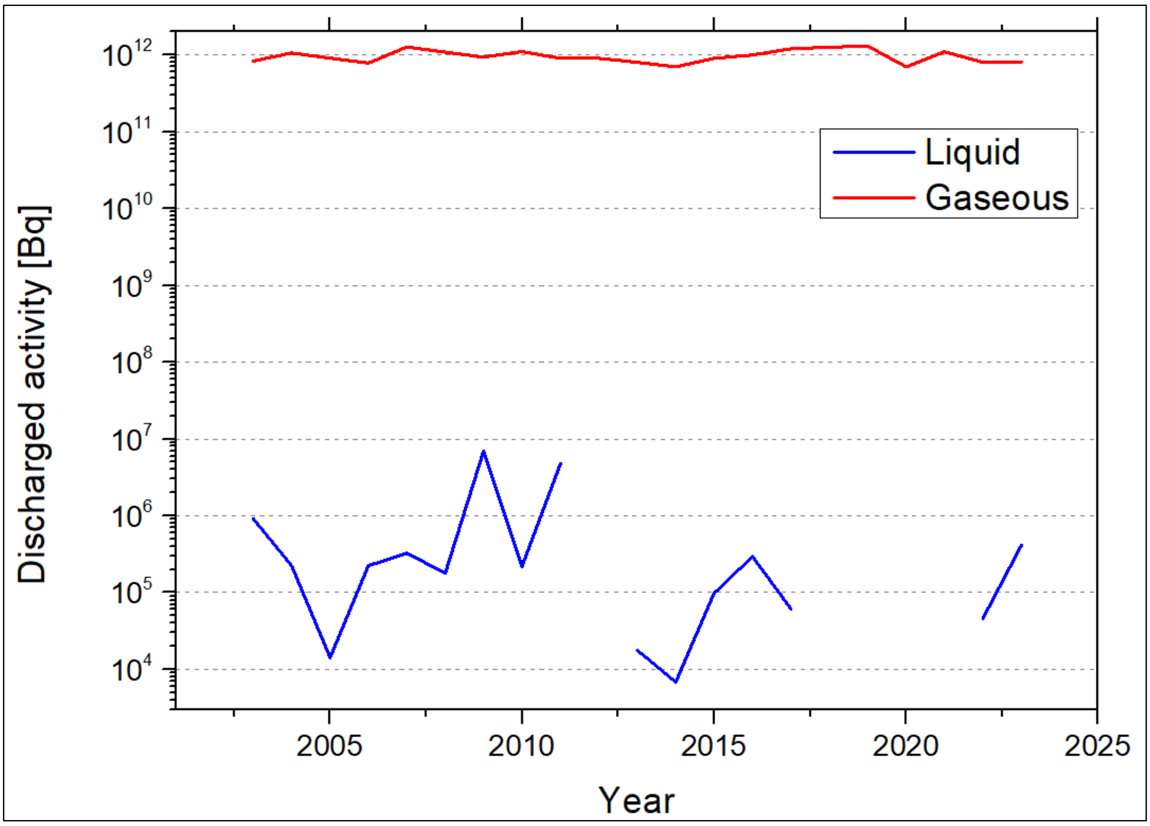
Year	Number of workers	Average [mSv]	Maximum individual dose [mSv]	Collective dose [man mSv]
2010	26	0.008	0.044	0.203
2011	28	0.004	0.032	0.101
2012	29	0.007	0.036	0.189
2013	27	0.019	0.118	0.512
2014	24	0.024	0.136	0.0567
2015	23	0.038	0.0242	0.0876
2016	30	0.035	0.0208	1.053
2017	26	0.044	0.20	1.15
2018	32	0.072	0.41	2.31
2019	31	0.093	0.36	2.87
2020	29	0.077	0.56	2.23
2021	31	0.108	0.52	3.34
2022	35	0.047	0.32	1.65
2023	35	0.036	0.23	1.27

(b) Liquid and Gaseous Discharges

The liquid discharges mainly originated from the radiochemical laboratory using reactor activation products. The annual reactor discharge of ^{41}Ar is proportional to the reactor operation time and is typically estimated at approximately 1 TBq (810 GBq in 2023).

Discharges from the JSI Reactor Infrastructure Centre in the period from 2014 to 2023 are shown in Figure 13.

Figure 13: **Discharges from the JSI Reactor Infrastructure Centre in the period 2003–2023**



Note: * Liquid discharges for 2012, 2018, 2020 and 2021 were less than the detection limit.

For the exposure of the public, only two exposure pathways were considered: external exposure due to ^{41}Ar immersion and the ingestion of contaminated released water. In 2023, the total dose received by a representative person was estimated to be 10 nSv/year for a farmer at a distance of 100 m and 0.14 µSv/year for a permanent resident living in a village at a distance of 0.5 km. The authorised dose limit for the operation of the research reactor is 50 µSv/year.

Žirovski Vrh Uranium Mine

(a) Radiation Protection

Within the scope of decommissioning, the Radiological Protection Unit of Žirovski Vrh Mine d.o.o. is responsible for tasks related to the radiation protection of workers and the general population.

Measuring occupational exposure to ionising radiation is based on the time records of an individual worker relating to his or her work at different workplaces and on the following workplace measurements:

- measurements of radon and the potential alpha energy of radon progeny in the air; and
- measurements of external radiation (measured with TLDs on a quarterly basis).

The main contribution to occupational exposure comes from radon and radon progeny.

Table 6: **The radiation exposure of workers at the Žirovski Vrh Uranium Mine due to radioactive waste management, 1996–2023**

Year	Number of workers**	Average [mSv]	Maximum individual dose [mSv]	Collective dose [man Sv]
1989*	350	5.0	18.00	1.75
1996	55	0.9	2.64	0.05
1997	70	1.3	3.40	0.09
1998	65	1.5	2.97	0.10
1999	60	1.0	1.89	0.06
2000	61	< 1.0	1.95	0.05
2001	64	< 1.3	2.95	0.08
2002	103	1.5	4.58	0.15
2003	133	1.8	5.39	0.24
2004	103	2.1	5.93	0.22
2005	87	0.99	4.60	0.09
2006	64	0.34	0.77	0.02
2007	95	0.17	0.40	0.02
2008	102	0.22	1.50	0.03
2009	38	0.34	0.47	0.008
2010	7	0.57	1.32	0.004
2011	7	0.52	1.47	0.0036
2012	8	0.12	0.28	0.0007
2013	9	0.05	0.10	0.0004
2014	8	0.08	0.26	0.0007
2015	8	0.07	0.23	0.0006
2016	8	0.08	0.27	0.0006
2017	8	0.22	1.71	0.0018
2018	8	0.12	0.45	0.0010
2019	8	0.06	0.24	0.0005
2020	8	0.07	0.26	0.0006
2021	8	0.08	0.25	0.0006
2022	8	0.06	0.21	0.0005
2023	7	0.16	0.50	0.0010

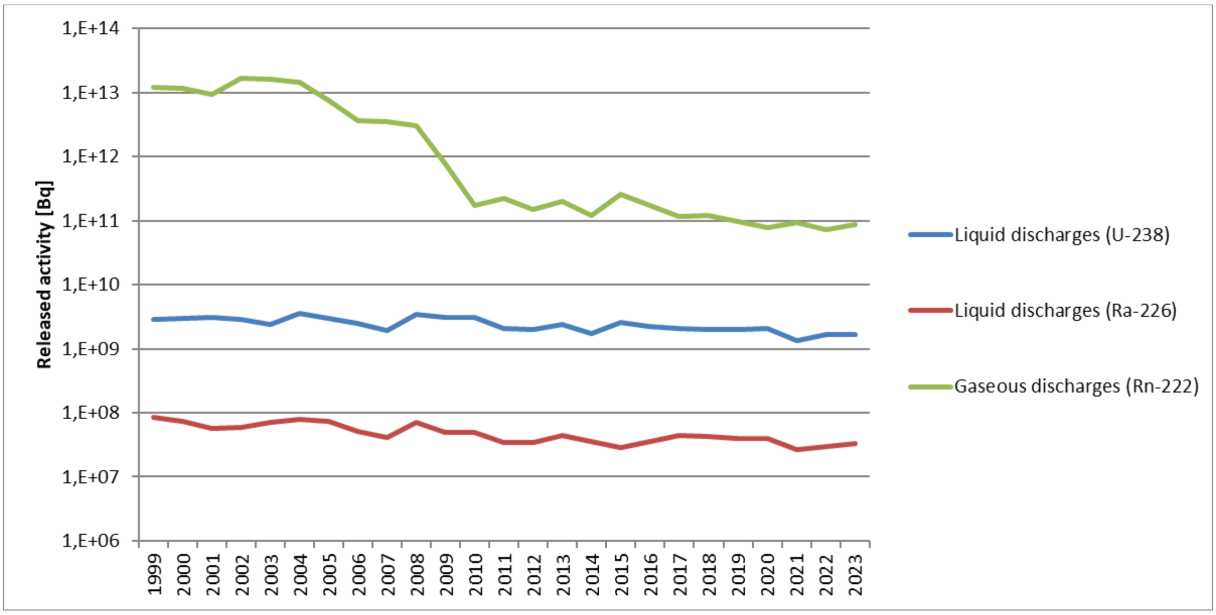
Notes:
* in the period of regular operation; 1989–2001 effective equivalent dose; 2002–2023 effective dose
** staff and contractors (outside workers)

(b) Liquid and Gaseous Discharges

Monitoring of radioactive discharges into the environment was performed regularly during all operational phases (1985–1990) and in the post-operational phase (from 1991 onwards).

The permanent discharges of dissolved long-lived radionuclides in percolating and run-off water from disposal sites and in mine water were reduced due to progressive remediation. It is expected that future fluctuations will mainly depend on weather conditions in the respective years. The radon release estimation is based on field measurements of the radon exhalation rate (Figure 14).

Figure 14: **Radioactive discharges at the Žirovski Vrh Uranium Mine in the period 1999–2023**



Note: For the year 2016, radon discharges were estimated based on partial measurements, past experience and extrapolation.

The impact of the mine discharges extends over an area inhabited by about 330 people. The dose assessment was made for a representative of each reference population group: a 1-year-old child, a 10-year-old child, and an adult resident older than 18 years of age. The inhalation of radon and its progeny is the main factor contributing to the public exposure caused by past mining activities. In 2023, the new dose factors for exposure to radon and its short-lived progenies, as defined in the ICRP 137, were taken into consideration. The new dose factors are higher than the previously used factors from the ICRP 65. Since exposure to radon represents more than 98% of assessed dose, the exposure of an adult member of the public in 2023 was estimated to be 0.249 ± 0.011 mSv, roughly double compared to past estimations. This value is still lower than the authorised limit for an adult of the population's reference group due to radiation exposure from the former uranium mine, i.e. 0.3 mSv/year.

Nuclear Medicine Departments

(a) Radiation Protection

Occupational exposure at the Institute of Oncology is monitored through regular individual monitoring of external exposure and workplace monitoring. The annual dose of the majority of workers at the Institute of Oncology did not exceed the value of 1 mSv in the period 2000–2023. Individual radiological engineers and radiopharmacists, mainly those handling the ^{18}F isotope, received a higher dose, but still below 5 mSv. The maximum annual dose in 2023 was 1.7 mSv. No worker has exceeded the annual limit of 20 mSv during the past 20 years. All of the above-mentioned values reflect the total exposures and include exposure during the handling of radioactive waste and its storage. No special tasks regarding radioactive waste are performed and no separate doses related to radioactive waste management are recorded. This is because the total collective dose is less than 25 man mSv per year. Only a few percent of this dose is due to work with waste.

Occupational exposure at the University Medical Centre's Division of Nuclear Medicine is monitored through regular individual monitoring and workplace monitoring. All staff are under dose control. In 2023, the effective dose of 84% of workers did not exceed 1 mSv and exposures between 1 and 2 mSv were measured for 14% of workers. The maximum annual dose was 2.0 mSv. The quoted values are the result of overall individual exposures, i.e. they are not related only to waste management. The total annual collective dose is below 50 man mSv.

Management of radioactive waste at nuclear medicine departments is performed according to the set procedures. Personal protection equipment is used where appropriate. Intermediate local storage for waste materials with short-lived contamination is in place elsewhere.

(b) Liquid and Gaseous Discharges

The Institute of Oncology has a system of decay storage tanks to control the radioactivity released. Faecal sludge is released into the hospital sewerage system only after the defined period (about four months) required for the activity of the radionuclides to decrease below the prescribed limit.

Liquid discharges from the University Medical Centre's Division of Nuclear Medicine are monitored from time to time (on average every 5–10 years) and are estimated from the administered activities.

Five other small departments of nuclear medicine in the country deal with radiopharmaceuticals with essentially lower activities. Patients are dismissed from hospitals after iodine ^{131}I therapy and no special decay tanks for radioactive discharges are in place, so such discharges are estimated in the same way as above.

In total, less than 0.3 TBq of ^{131}I is released into the environment annually.

Article 25: Emergency Preparedness

1. *Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive waste management facility there are appropriate on-site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency.*
2. *Each Contracting Party shall take the appropriate steps for the preparation and testing of emergency plans for its territory insofar as it is likely to be affected in the event of a radiological emergency at a spent fuel or radioactive waste management facility in the vicinity of its territory.*

Regulatory Requirements

The nuclear emergency preparedness and response in Slovenia is regulated in the latest consolidated version of the Protection against Natural and Other Disasters Act and the 2017 Act. There are two authorities with responsibilities and competences to regulate and supervise emergency preparedness at nuclear facilities. The Administration for Civil Protection and Disaster Relief is responsible for protecting the population during a nuclear accident and for the organisation of civil protection units at nuclear installations. The SNSA is responsible for regulatory control over on-site procedures and measures related to the on-site emergency plan. Their roles were described in more detail in the First National Report.

Concerning safety, the 2017 Act stipulates that every applicant shall submit, together with the application for a construction permit for a nuclear facility, an operator's emergency plan in the event of a nuclear accident. During trial operation and operation of the nuclear facility, the radiological emergency plan shall be updated, including all changes made during the construction and testing period. The on-site radiological emergency response plan is a constituent element of the safety analysis report.

The provisions of the 2017 Act mostly focus on intervention measures in the event of an emergency. According to these provisions, the operator needs to be capable of classifying accidents, assessing the consequences of such events, and proposing remedial measures. In the operator's emergency plan, intervention measures should be planned in accordance with the emergency class declared. The operator shall provide to emergency planners all the requested data it has available. The operator shall maintain emergency preparedness and provide responses as stipulated in the emergency plan. The prompt notification, without undue delay, of any such event is required, and the public needs to be informed of important facts in the emergency plans.

The Regulation on the Elaboration of Emergency Plans stipulates that the on-site nuclear emergency plan should be coordinated at the national and local levels and the nuclear emergency plans should be revised at least every five years. Emergency plans are public documents and should be presented to the public within 90 days of their adoption. The regulation also specifies the set of data relevant for the emergency that is to be supplied to the authorities by companies obliged to have an on-site emergency plan.

Overall National Emergency Preparedness Scheme and Off-Site Emergency Plans

The responsibilities and competences for emergency planning and maintaining emergency preparedness for an accident at a nuclear facility are specified at four levels: operator, local, regional and national. The State is responsible for the local and national radiological emergency response planning and maintenance of the radiological response plans.

The last update of the National Emergency Response Plan for Nuclear and Radiological Accidents (hereinafter: the National Plan) was in 2023, led by the Administration for Civil Protection and Disaster Relief, with close cooperation with the SNSA. Besides a possible accident at the Krško NPP, the plan also covers nuclear or radiological accidents abroad with a potential impact on Slovenia, and a radiological accident due to satellite re-entry.

Most revisions in the National Plan refer to the IAEA standard GSR Part 7 (General Safety Requirements – GSR) and include the post-Fukushima improvements and some of the requirements of the EU BSS directive[2]. In 2023, the SNSA also revised several other emergency preparedness documents: Threat Assessment for an Emergency at Nuclear Facilities or an Emergency involving Radioactive Materials, Risk Assessment for Nuclear and Radiological Accidents, and an Assessment of Risk Management Capabilities for Nuclear and Radiological Accidents. These documents, together with the new National Emergency Response Plan for Nuclear and Radiological Accidents and other plans, ensure that the country is prepared to manage and respond effectively to nuclear and radiological accidents.

In 2023, the Emergency Response Team of the SNSA and the Krško Nuclear Power Plant were activated once on August 4, when Slovenia was hit by the worst floods in the country's history. Due to the high flow and level of the Sava River, the Krško NPP declared a level 0 emergency, an unusual event. The next day, the flow and level of the Sava River decreased, and the situation slowly returned to normal, while the end of the emergency was declared. In addition, the SNSA continued to monitor the situation at all Ukrainian nuclear facilities and actively participated in meetings of international organisations as well as bilateral and multilateral meetings on this topic, relevant ever since 24 February 2022, when the war in Ukraine started.

The JSI has a standby Ecological Laboratory with a Mobile Unit (ELME), which is a special unit for radiological and emergency response at the national level. It is intended to assist in any radiological emergency. It also performs radiation measurements and interventions in the event of the loss or dispersion of radioactive materials. Since 2007, the mobile unit of the Institute of Occupational Health has also been actively participating in emergency drills in field measurements and the testing of radiation monitoring preparedness in the vicinity of the Krško NPP.

The On-site Radiological Emergency Response Plan

Krško NPP

The Krško NPP has competence and sole responsibility for on-site emergency preparedness and response and maintains its on-site radiological emergency response plan (RERP). The on-site RERP is harmonised with the National Plan and was last updated in May 2023 (rev. 40).

The Krško NPP's RERP takes into consideration the IAEA's recommendations, the US 10 CFR 47 NUREG-0654 requirements, and the post-Fukushima lessons learned. It also covers the spent fuel pool, spent fuel dry storage system, and on-site radwaste facilities.

The objectives of the Krško NPP's RERP are:

- to identify and evaluate the type and classification of an emergency, including extensive damage and beyond design-basis accidents;
- to take on-site emergency measures and procedures to ensure the protection of the health and safety of plant personnel and members of the public in the surrounding area;
- to identify the on-site emergency response organisation and responsibilities for the overall command and co-ordination between the particular on-site and off-site emergency measures;
- to identify additional plant support required in the event of an emergency from the off-site support organisation, the Civil Protection Headquarters of Slovenia, and other competent authorities;
- to identify emergency response facilities, equipment, communications, protective and other means of managing emergencies;
- to take on-site recovery measures to manage or mitigate the consequences of an emergency and to ensure conditions for recovery;
- to provide a basis for maintaining on-site emergency preparedness; and
- to provide co-ordination between the Krško NPP and off-site local, regional and state authorities to ensure effective emergency planning and preparedness, including public information about protective measures.

[2] Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom, OJ L 13 (17 January 2014).

The Jožef Stefan Institute Reactor Infrastructure Centre

The TRIGA Mark II research reactor has an on-site radiological emergency response plan, which was updated in May 2022. Off-site radiological emergencies are covered in the National Plan. Urgent protective actions for the off-site population are not expected. According to the safety analysis report, the most severe possible accident (total loss of all reactor coolant) would not cause a core meltdown, so no significant radioactive release into the environment is expected, even in the worst-case scenario.

The emergency procedures are subject to internal and external verification and approval. The emergency procedures include reactor status data, the identification of an emergency situation, a description of appropriate actions, raising the alarm, reporting, informing, and responsibilities for the following internal and external emergency events:

- radiological reactor accidents (loss of reactor shielding – primary water, release of radioactivity in the controlled area, release of radioactivity outside the controlled area, loss of water in the spent fuel pool);
- non-radiological accidents or events (a fire in the reactor building, an earthquake, sabotage and unauthorised access, riots and demonstrations, an off-site chemical emergency due to an accident in the chemical plant in the vicinity of the Reactor Infrastructure Centre).

The most severe operational accident (loss of coolant in the pool) would not significantly affect the spent fuel if it was stored in the reactor pool (since 1999 there has been no spent fuel). The off-site consequences of a gap release from damaged spent fuel elements are negligible.

Central Storage Facility for Radioactive Waste in Brinje

The ARAO is responsible for on-site emergency preparedness and response and maintains an on-site radiological emergency response plan. The emergency response plan for the CSF in Brinje is designed for events identified in the safety assessment as relevant emergency events related to the operation of the facility and the handling of radioactive waste. The plan defines the competences and responsibilities of the personnel responsible for emergency preparedness and the response to an emergency situation. The emergency response plan was updated and upgraded in 2021 in accordance with the results of practical exercises and with the aim of improving the plan.

Žirovski Vrh Uranium Mine

Radiological emergency situations are not expected at either the Jazbec or Boršt disposal sites. The Jazbec disposal site was closed in 2015; therefore, the area has become an object of national infrastructure, and public service and maintenance on the side has been provided by the ARAO since the end of 2015. In 2016 and 2017, additional rehabilitation work started at the Boršt disposal site, which is expected to slow down the sliding of the base (the drainage tunnel). In 2019, the monitoring network was renovated and upgraded with an additional nine deep piezometers. As part of the long-term surveillance and maintenance programme, the surfaces of the Jazbec mine waste disposal site and the Boršt hydro-metallurgical tailings disposal site are controlled regularly. In the event of heavy rain or an earthquake, additional site controls are conducted. The rate of sliding of the base of the Boršt hydro-metallurgical tailings disposal site is measured in real time, using a GPS system, at control points on the hydro-metallurgical tailings. In the period 2018–2020, geodetic surveillance was carried out twice a year. A geodetic network, entitled "*Vrtine-2*", has been added to the basic landslide surveillance network. From 2024, the geodetic survey of the checkpoints' status will take place once a year in a single "*Plaz-2*" geodetic network.

Slovenian Nuclear Safety Administration

The SNSA emergency plan is harmonised with the National Plan. It consists of organisational procedures for the SNSA emergency team.

The SNSA emergency team has three expert subgroups in addition to communicators and other supporting positions – one for analysing any nuclear accident, second for dose assessment and since 2021 a third one for cyber security. The full composition of the team comprises 20 members working in 12-hour shifts.

The SNSA's main role during a nuclear or radiation emergency is to recommend protective measures for the population to the Slovenian civil protection commander and to lead emergency monitoring. In addition, the SNSA issues first press releases to the public, responds to the media and public inquires and coordinates international assistance through the Response and Assistance Network (RANET) of the IAEA.

For primary communication between all organisations involved in the response to a radiation emergency in Slovenia, and also the Croatian Ministry of the Interior, the Civil Protection Directorate, and the Department for Radiological and Nuclear Emergency, a special on-line communication system provided by the SNSA, i.e. the KID, is used.

Exercises

In accordance with the Rules on Exercises in the Field of Protection against Natural and Other Disasters, one exercise must be organised every three years.

The SNSA emergency response is ensured by regular training of the members of emergency expert groups and verification response teams, and through exercises, regular testing of equipment and participation in international activities. Each year, the SNSA also actively participates in annual Krško NPP exercises, the ConvEx exercises organised by the IAEA, the ECUREX exercises organised by the EC, and it also conducts several internal exercises.

The emergency response training, drills and exercises are an integral part of the Krško NPP radiological emergency preparedness programme. It incorporates the human element with emergency response facilities, emergency equipment and emergency procedures to develop and maintain key emergency response skills and ensure the readiness and efficiency of its emergency preparedness and response team.

The programme is based on a routine annual schedule of the activities and includes the plant personnel, plant contractors, and off-site support organisations.

Emergency response training consists of initial, continuing (requalification) and specialised (proficiency) emergency response training.

The Krško NPP carries out the following emergency response drills:
- facilities and on-site emergency response organisation activation;
- implementation of severe accident strategies with mobile equipment;
- placing flood protection equipment;
- evacuation and accountability;
- post-accident sampling;
- off-site field monitoring, dose assessment and off-site protective measure recommendations;
- on-site radiation protection and radiological control;
- firefighting;
- first aid and medical response; and
- emergency notifications.

The objectives of the drills are verified in on-site integrated exercises, carried out twice a year. The exercises are prepared by the Exercise Organisation Group, which is also in charge of the preparation of the formal scenarios, including spent fuel and radioactive waste accidents. Within a five-year period, all emergency response segments are tested. The exercises are prepared and conducted regularly using the plant's full-scope simulator, which is also used for the Main Control Room (MCR) and Emergency Control Room (ECR) simulations. The Krško NPP emergency support organisations and local and governmental agencies also participate in the integrated exercises. The last on-site integrated exercise was conducted in December 2023.

Exercises for ensuring the safety of first responders in the event of a nuclear or radiological emergency have been carried out since 2019 in the framework of the ENRAS project. These are joint exercises of Slovenian and Croatian firefighting units, conducted to exercise procedures used in different scenarios. Their purpose is to improve the preparedness of firefighters in the event of a nuclear or radiological accident, and to ensure appropriate safety during such a response.

In March 2024, the SNSA participated in the Sixth International Nuclear Emergency Exercise (INEX-6), which was focused on long-term recovery from radiological and nuclear emergencies. Prepared by the OECD Nuclear Energy Agency, this table-top exercise focused on the long-term recovery phase, one year after the emergency. This phase of an emergency had never been tested before at the international level. Slovenia was actively engaged in all four modules, testing recovery areas including health impacts, food safety, remediation and decontamination and radioactive waste management. Over 15 organisations participated in the exercise. The overall assessment in Slovenia was that it a great success, with positive feedback from the participants. The exercise also led to the identification of areas for further improvement and proposed revisions to Slovenian legislation.

The ARAO regularly organises dedicated training programmes and practical exercises for employees of the Central Storage Facility. The ARAO maintains regular contacts with the Professional Fire Brigade of Ljubljana, the responsible police station, and the contractor responsible for physical protection services. The upgrading of theoretical training and the exchange of information is organised regularly. The ARAO also maintains the required equipment and is responsible for professional dosimetry.

International Agreements and International Projects

Slovenia is party to the Convention on Early Notification of a Nuclear Accident and to the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency. Slovenia has also signed bilateral agreements with Austria, Croatia, Hungary and Italy on the early exchange of information in the event of a radiological emergency.

In November 2017, an EPREV (Emergency Preparedness REView) Mission was carried out in Slovenia to review the implementation of international standards in the field of preparedness for nuclear accidents, with an emphasis on the requirements under GSR Part 7 (Preparedness and Response for a Nuclear or Radiological Emergency, General Safety Requirements). In Slovenia, this was a review of the activities of organisations that, according to the national (fundamental) Protection and Rescue Plan in the Event of a Nuclear or Radiological Accident, are involved in the response to a nuclear and radiological accident. After the mission, an action plan was adopted in April 2018, with 31 actions to eliminate identified deficiencies or to implement the necessary improvements. The SNSA reported on the implementation of the plan to the Government of the Republic of Slovenia twice, the first time in 2020 and the second time in early 2021, when 64% of all tasks according to the action plan were carried out. In the same year, Slovenia invited the IAEA to the so-called "EPREV follow-up mission", which was carried out between 3 and 7 October 2022, and during which, according to international experts, already 90% of the plan, or 28 of the 31 tasks of the action plan, had already been carried out.

The members of the EPREV follow-up mission reviewed the extensive self-assessment prepared by Slovenia, visited locations and conducted numerous interviews. The mission recognised Slovenia's general commitment to preparedness for nuclear and radiological accidents and highlighted the achievements, which were, among other findings, the result of following the recommendations and proposals of the EPREV 2017 Mission.

The EPREV follow-up mission made two new suggestions for improvement. The first proposal is to update the Protection and Rescue Plan in Case of Accidents at Sea with a scenario involving nuclear-powered vessels, and the other, to ensure a coordinated response in the event of an accident at the Krško NPP caused by a security event.

Slovenia is also very active in the HERCA working group. The SNSA is the editor of the "Country Fact Sheets", established in 2015, which include information on national emergency response arrangements, with the aim of enhancing knowledge and facilitating communication during a nuclear or radiological emergency.

Article 26: Decommissioning

Each Contracting Party shall take the appropriate steps to ensure the safety of decommissioning of a nuclear facility. Such steps shall ensure that:

(i) qualified staff and adequate financial resources are available,

(ii) the provisions of Article 24 with respect to operational radiation protection, discharges and unplanned and uncontrolled releases are applied,

(iii) the provisions of Article 25 with respect to emergency preparedness are applied,

(iv) records of information important to decommissioning are kept.

In the Republic of Slovenia, there are no nuclear facilities in the process of being decommissioned (there is ongoing remediation of the Boršt waste disposal site at the former uranium mine at Žirovski Vrh, but this is a radiation facility). In order to assess the financial contribution to the decommissioning fund, the Decommissioning Programme for the Krško NPP is being revised.

Krško NPP

The initial Krško NPP Decommissioning Programme was developed in 1996. The Agreement between Slovenia and Croatia on the Krško NPP of 2003 required the preparation of a Decommissioning Programme for the Krško NPP by the Slovenian and Croatian authorities for the management of radioactive waste. In accordance with the Agreement, a review of the Programme for the Decommissioning of the Krško NPP and the Disposal of Low- and Intermediate-Level Waste and Spent Fuel was prepared in April 2004. The Decommissioning Programme must be updated at least every five years. The aim of periodic revisions of the Decommissioning Programme is to revise it, implement new international standards, and use best practices through the period of plant operation. These revisions are needed to provide an estimation of the expenses of the future decommissioning and radioactive waste and spent fuel management and will represent the basis for decommissioning funds in Slovenia and Croatia.

A revision of the Decommissioning Programme was started in September 2008. The first version of the document was drawn up by June 2010 and the second version by February 2011. These two versions have been neither discussed nor approved by the Intergovernmental Commission for monitoring the implementation of the Bilateral Slovenian-Croatian Agreement on the Krško NPP. In July 2015, the Intergovernmental Commission held a session where it was briefed on progress concerning the revised Decommissioning Programme. The Commission decided to suspend all the activities in connection with the drawing up of this programme and identified the need to draft a new revision of the Krško NPP Decommissioning Programme and the Programme for the Disposal of the RW and SF from the Krško NPP. The Krško NPP was assigned the task of preparing the third revision of the Decommissioning Programme in cooperation with the ARAO and the Croatian Fund. In 2019 the third revision of the Decommissioning Programme was issued and in November 2019 it was approved by the SNSA.

At the 13th session of the Intergovernmental Commission in September 2019, the Intergovernmental Commission reviewed the final version of the third revision of the Krško NPP Decommissioning Programme and decided that the Programme was suitable for forwarding for further administrative procedures in the Republic of Slovenia and the Republic of Croatia. The Intergovernmental Commission gave final approval to the third revision of the Decommissioning Programme at its 14th session in July 2020.

The third revision of the Krško NPP Decommissioning Programme was prepared according to the decommissioning strategy "Immediate Dismantling" after final shutdown in 2043. It contains the operation of the spent fuel dry storage (SFDS) and its decommissioning as well as the successive conventional demolition of the other remaining buildings. Two cases are considered. The base case considers operation of the SFDS until 2103, and the sensitivity case until 2075.

The third revision starts with a description of the facility and a presentation of the revised physical inventory. The subsequent chapters present a description of the decommissioning and dismantling techniques as well as the planned decommissioning activities. The chapters that follow describe waste management, including the treatment of materials and the packaging of radioactive waste. For the purpose of revision preparation, it is considered that 50% of the LILW is disposed of in N2d containers (Slovenia), and the other 50% is disposed of in reinforced concrete containers (RCC, Croatia). The Attachments show the alternative results if 100% of the LILW is disposed of in N2d containers or RCC. The Attachments additionally provide different options for cementation (packaging). The option with the lowest costs for the disposal of 50% of the LILW in N2d containers and the other 50% in RCC is taken into account for the waste management strategy.

The planning and cost estimation use a so-called "work breakdown structure" (WBS).

The revision of the planning of the Krško decommissioning project results in the following main milestones, presented in Table 7.

Table 7: **Main milestones for the decommissioning project**

	Base case	Sensitivity case
Start of the project (Pre-decommissioning actions)	2040	
Final shutdown / D&D approval	2043	
Old steam generators dismantled and packed	2045	
Finalisation primary loop	2047	
Finalisation RPV internals	2049	
Finalisation RPV	2051	
Finalisation biological shield	2052	
Building structures cleared – brown field	2058	
End of operation SFDS	2103	2075
Status – green field	2107	2079

During the planning work for the third revision no critical technical problems were found, and they are not expected to arise. The state of the relevant technology attained by now is high enough to realise all present and future decommissioning projects. However, considering that during the coming decades the volume of the decommissioning of installations will reach levels never handled before, the advancement of several aspects of existing techniques would be entirely desirable with regard to, for example, dose reduction, the simplification of processes, increased efficiency, minimising waste, and cost reduction.

Waste treatment and disposal (e.g. the availability of a final repository and the corresponding repository requirements) have a huge impact on the entire decommissioning project and thus on the decommissioning costs. A decision on these aspects in due time is very important in order to ensure better planning reliability for the next revisions.

(i) Staff and Financial Resources

The Slovenian share of funds for the decommissioning of the Krško NPP is collected and managed by the Fund for the Decommissioning of the Krško NPP. Following the first revision of the Decommissioning Programme in 2004, the levy per kWhe was increased from approximately 0.2 to 0.3 euro cents. In 2012, the SNSA approved the Ageing Management Programme, which enables the operation of the Krško NPP beyond 2023. The operation of the Krško NPP was extended from 2023 to 2043 after the successful conclusion of the 3rd Periodic Safety Review and Environmental Protection Consent. The next periodic safety review needs to be successfully concluded in 2033. Extended operation has a significant impact on the Decommissioning Programme, the Decommissioning Fund and the National Programme for the Management of Radioactive Waste and Spent Nuclear Fuel. It is assumed that the Krško NPP staff will perform decommissioning together with external contractors. In July 2020, the third revision of the Krško NPP Radioactive Waste and Spent Fuel Disposal Programme and the third revision of the Krško NPP Decommissioning Programme were approved by the Intergovernmental Commission.

The total nominal costs without VAT for the Krško NPP decommissioning project (including the operation and decommissioning of the SFDS) for the base case have been assessed at EUR 417.6 million. For VAT an additional EUR 56.4 million is calculated. The total costs without VAT for the sensitivity case have been assessed at EUR 405.3 million. For VAT, an additional EUR 56.1 million is calculated.

In both cases, Slovenian VAT of 22% is taken into account, except in the case of Krško NPP personnel costs and the costs of compensation for the limited use of space, which are not subject to VAT.

By a decision of the Slovenian Government in July 2020, the Slovenian electrical power company GEN energija d.o.o. continued increased payments from the previous rate of 0.3 euro cents per kWhe to 0.48 euro cents per kWhe, starting 1 August 2020. By an additional decision of the Slovenian Government in April 2023, the payment rate was increased to 1.2 euro cents per kWhe.

Intergovernmental Commission adopted the Terms of Reference (ToR) for the preparation of the fourth revision of the Disposal Programme and the Decommissioning Programme at its meeting in April 2022. The deadline for the preparation of the programmes is April 2024 and approval by the Intergovernmental Commission in 2025.

(ii) Operational Radiation Protection, Discharges and Unplanned and Uncontrolled Releases

There are no specific regulations on the decommissioning of nuclear facilities. All legal requirements and limitations that are applicable to all operating facilities are also applicable to nuclear facilities in the decommissioning process.

(iii) Emergency Preparedness

As no decommissioning is being performed at the moment, there is no need for an emergency preparedness plan. However, one is required and shall be prepared as part of the application for the licence for decommissioning.

(iv) Records of Information

The Engineering Long-term Operation Support Department at the Krško NPP is in charge of record keeping and maintaining the database required by regulations, including regarding decommissioning.

Jožef Stefan Institute Reactor Infrastructure Centre

A research project estimating the quantity and composition of LILW resulting from dismantling was carried out. A Decommissioning Plan for the reactor was prepared in 2007 and 2016 and revised in 2020, 2021 and 2022. There are no plans to shut down this reactor in the near future. It has been estimated that not more than 60 tons of LILW would be produced in decommissioning.

Žirovski Vrh Uranium Mine

Properly qualified staff are available to accomplish all the remaining tasks and activities at the Boršt disposal site. Adequate financial resources are available to accomplish closure activities at the Boršt hydro-metallurgical tailings disposal site. For this purpose, the Ministry of Natural Resources and Spatial Planning provides financial means from the national budget.

Part of the funds necessary for monitoring and maintenance of the Jazbec mine waste disposal site for activities regarding the service of general economic interest are provided by the national budget.

The safety of the remediation of the Jazbec mine waste disposal site and the Boršt hydro-metallurgical tailings disposal site is ensured through licensing and regulatory supervision similarly as for the decommissioning of other nuclear or radiation facilities.

The Central Storage Facility for Radioactive Waste in Brinje

The operation of the CSF, serving as vital national infrastructure for the storage of institutional radioactive waste, ensures a secure storage area for radioactive waste throughout its production from various activities in the country. Following the cessation of operations, the decommissioning of the CSF is anticipated.

There are no nuclear reactions in the facility that could cause neutron activation, and no contamination of the facility or its immediate surroundings is expected during the life cycle of the CSF. Contamination control results indicate no expected contamination of partition walls, floors, ceilings, metal pallets, the surface of radioactive waste packages, movable and electro-mechanical equipment, as well as underground tank and piping wastewater. The 2021 Decommissioning Programme outlines that once national disposal of LILW becomes available, all LILW meeting acceptance criteria will be transported from the CSF to the LILW repository for disposal. The CSF will persist as the central storage facility for institutional RW during the dormancy period of the LILW repository, and at least until the planned cessation of LILW repository operations in 2058. Subsequently, the CSF facility will undergo decommissioning and be released for unrestricted use. Complete removal of the facility is not anticipated. Regular assessments of eligibility, adequacy, and timelines for facility operation are integral to periodic safety reviews, procedures for extending operational permits, and the development and approval of the national programme for RW and spent fuel management.

Two years before the initiation of decommissioning, applications must be submitted to obtain permits for the cessation of nuclear facility operations, approval for decommissioning, and permission to initiate the decommissioning of the nuclear facility. The CSF decommissioning works are expected to take approximately four months.

The financing for the decommissioning of the facility will be sourced from the national budget.

SECTIONS G AND H: SAFETY OF SPENT FUEL MANAGEMENT AND SAFETY OF RADIOACTIVE WASTE MANAGEMENT

The Republic of Slovenia has no separate legally binding documents on the safety of spent fuel management and the safety of radioactive waste management. The main legal pillar in this area is the 2017 Act. In this Act the general safety requirements are applicable to both the safety of spent fuel management and the safety of radioactive waste management. Some specific requirements regarding the type of activity are stipulated in separate articles of the 2017 Act. Thus, in order to avoid redundancy in the text, the requested information under Sections G and H is presented jointly.

Article 4: General Safety Requirements

Each Contracting Party shall take the appropriate steps to ensure that at all stages of spent fuel management, individuals, society and the environment are adequately protected against radiological hazards.

In so doing, each Contracting Party shall take the appropriate steps to:

(i) ensure that criticality and removal of residual heat generated during spent fuel management are adequately addressed,

(ii) ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted,

(iii) take into account interdependencies among the different steps in spent fuel management,

(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards,

(v) take into account the biological, chemical and other hazards that may be associated with spent fuel management,

(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation,

(vii) aim to avoid imposing undue burdens on future generations.

Article 11: General Safety Requirements

Each Contracting Party shall take the appropriate steps to ensure that at all stages of radioactive waste management individuals, society and the environment are adequately protected against radiological and other hazards.

In so doing, each Contracting Party shall take the appropriate steps to:

(i) ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed,

(ii) ensure that the generation of radioactive waste is kept to the minimum practicable,

(iii) take into account interdependencies among the different steps in radioactive waste management,

(iv) provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards,

(v) take into account the biological, chemical and other hazards that may be associated with radioactive waste management,

(vi) strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current generation,

(vii) aim to avoid imposing undue burdens on future generations.

The criticality and removal of residual heat generated during radioactive waste and spent fuel management are adequately addressed in the 2017 Act through the approval of the safety analysis report by the SNSA. The content of the safety analysis report is determined in the Rules on Radiation and Nuclear Safety Factors (JV5) and in non-binding guidance on the content of the safety case for a particular type of nuclear facility.

The requirement that the generation of radioactive waste associated with spent fuel management and the generation of other radioactive waste is kept to the minimum practicable, consistent with the type of fuel-cycle policy, is ensured through the 2017 Act. Paragraph (2) of Article 121 stipulates that any person responsible for the generation of radioactive waste and spent fuel shall ensure that radioactive substances occur in the smallest possible quantities.

The interdependencies among the different steps in spent fuel management and radioactive waste management are addressed through the 2023 Resolution. The producers of radioactive waste and spent fuel have to consider the interdependencies among different steps of their management in the safety analysis report and operating licences. The requirement to consider interdependencies among different steps in spent fuel and radioactive waste management is also provided in the Rules on Radioactive Waste Management.

The provisions ensuring the effective protection of individuals, society and the environment, by applying suitable protective methods at the national level as approved by the regulatory body, are included within the framework of national regulations.

The biological, chemical and other hazards that may be associated with spent fuel and radioactive waste management are taken into account through the environmental impact assessment report and safety analysis report for each particular nuclear and disposal facility. The content of the environmental impact assessment report is prescribed by the regulation issued by the Ministry of the Environment, Climate and Energy (2017 Act, Article 95), while the content of the safety analysis report for the disposal of spent fuel and radioactive waste (2017 Act, Article 101) and uranium mining and ore processing waste (2017 Act, Article 106) shall be prescribed by the SNSA, which also acts as the licensing authority for the approval of the safety analysis reports.

Article 121 of the 2017 Act contains a provision on avoiding actions that impose reasonably predictable impacts on future generations. There are no special provisions requiring that impacts should not be greater than those permitted for the current generation in the Republic of Slovenia. This subject is addressed implicitly throughout all legally binding documents in the area of nuclear and radiation safety.

As a consequence of the Fukushima accident in March 2011, the SNSA issued a decision to the Krško NPP stipulating that safety measures must be undertaken in order to prevent severe accidents and/or mitigate their consequences. The decision, *inter alia*, stipulates that the Krško NPP has to address all possibilities to decrease the risk associated with spent fuel management, having in mind also a change in the long-term strategy. In the second half of 2012, the Krško NPP prepared and submitted a document with an evaluation of spent nuclear fuel storage options. The recognised and confirmed optimal solution was the construction of a dry storage, which would consequently improve nuclear safety due to its passive nature and by reducing the number of fuel assemblies in the pool. The timeline for the construction of the dry storage is in line with the SNSA Safety Upgrade Programme decision. The Krško NPP activities started in 2016 while the dry storage was constructed in 2023 and has been in operation since then.

Article 5: Existing Facilities

Each Contracting Party shall take the appropriate steps to review the safety of any spent fuel management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility.

Article 12: Existing Facilities and Past Practices

Each Contracting Party shall in due course take the appropriate steps to review:

(i) the safety of any radioactive waste management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility,

(ii) the results of past practices in order to determine whether any intervention is needed for reasons of radiation protection bearing in mind that the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including the social costs, of the intervention.

The Republic of Slovenia has no spent fuel management facilities. The spent fuel that is generated by the operation of the Krško NPP and the JSI Reactor Infrastructure Centre (the TRIGA Mark II research reactor) is managed in storage sites that are integrated parts of these nuclear facilities. Similarly, the LILW generated at the Krško NPP is managed and stored in storage sites under the operating licence for the Krško NPP. The legislative provisions for nuclear facilities were applied for the siting, construction and operation of these storage sites.

The facilities that are subject to this paragraph are the Central Storage Facility for Radioactive Waste in Brinje, the Boršt hydro-metallurgical tailings disposal site and the Jazbec mine waste disposal site at the former Žirovski Vrh Uranium Mine.

The Central Storage Facility for Radioactive Waste (CSF) in Brinje was put into operation in 1986, when nuclear legislation was not yet fully implemented. The operation of the storage facility was initially not licensed on the basis of nuclear and radiation safety legislation. The operator (JSI) obtained a licence for the use of this facility on the basis of the Construction Act. In 1998, the SNSA required by a decree that the operator apply for an operating licence and prohibited further operation of this facility, except for emergency cases.

When the management and operation was transferred to the national waste management organisation, the ARAO, in 1999, the SNSA required that the new operator meet the requirements of the above decree. By the end of 2002, plans for the reconstruction and modernisation of the facility were prepared. In 2004, all activities regarding the modernisation and refurbishment of the facility were concluded.

The refurbishment of the CSF and the licensing were performed in compliance with the 2002 Act. The licence for trial operation of the CSF was issued in 2005 and the licence for operation was issued in April 2008. The first periodic safety review (PSR) of the CSF was concluded in 2018 and the new operating license of the CSF was granted for the next 10 years.

The remediation of the Žirovski Vrh Uranium Mine has been in progress since the cessation of its operation in 1990. Remediation actions at the Jazbec site were finished in 2008. The final remediation work on the Boršt disposal site has been delayed due to the activation of a landslide. From the legal perspective, the uranium mine, the ore processing facilities, and the disposal sites for mining and ore processing waste were not nuclear or radiation facilities at the time of their operation. The principal Act governing their operation and closure was the Mining Act. The key document is the safety analysis report. After finishing and checking the performance of environmental remediation activities at the Jazbec disposal site, the SNSA issued a decision to revoke the status of a radiation facility and decide on the facility of national infrastructure and issued a license for the facility's closure. Regular control and maintenance of the closed site is provided as a public service by the national waste management organisation ARAO. Although the facility does not have the status of a radiation facility, the provisions of nuclear legislation have to be followed when applicable.

Article 6: Siting of Proposed Facilities

1. *Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed spent fuel management facility:*

(i) *to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime,*

(ii) *to evaluate the likely safety impact of such a facility on individuals, society and the environment,*

(iii) *to make information on the safety of such a facility available to members of the public,*

(iv) *to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.*

2. *In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 4.*

Article 13: Siting of Proposed Facilities

1. *Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed radioactive waste management facility:*

(i) *to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime as well as that of a disposal facility after closure,*

(ii) *to evaluate the likely safety impact of such a facility on individuals, society and the environment, taking into account possible evolution of the site conditions of disposal facilities after closure,*

(iii) *to make information on the safety of such a facility available to members of the public,*

(iv) *to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.*

2. *In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 11.*

The course of the procedure in the process of licensing nuclear facilities such as repositories is stipulated in the 2017 Act, the Environmental Protection Act, the Spatial Planning Act, the Act on the Siting of Spatial Arrangements of National Significance in Physical Space, the Construction Act, the Rules JV5, the Decree on Categories of Projects for which an Environmental Impact Assessment is Mandatory, and the Decree on the method of drafting and on the content of the report on the effects of planned activities affecting the environment.

The above-mentioned legislation provides the framework for the preparation of the nuclear and radiation safety documentation and documentation for an environmental impact assessment. It stipulates which consents and licences are to be issued and the manner of public participation.

According to the 2017 Act and the Environmental Protection Act, the safety documentation concerning nuclear and radiation safety during the siting and licencing of a nuclear facility shall consist of three main documents: a comprehensive environmental impact assessment, an environmental impact assessment report and a safety report. The content of all three documents is similar, as they are prepared for the same facility, but they differ regarding the level of details presented.

Article 95 ("Location of a nuclear facility") of the 2017 Act determines that the selection of a site for the location of a nuclear facility shall be based on a safety report, which will be used to assess all the factors at the site of the nuclear facility that may affect the nuclear safety of the facility during its operating lifetime and the impacts of the operation of the facility on the population and the environment.

The Environmental Protection Act forms the basis for the environmental impact assessment. The Decree on Categories of Projects for which an Environmental Impact Assessment is Mandatory determines that an environmental impact assessment is mandatory for spent fuel management facilities and radioactive waste management facilities and for the disposal of mining tailings and hydro-metallurgical tailings.

Public participation in the siting process is ensured through prescribed public hearings, consultations and presentations and by making all the information available to the public. In the siting phase, public participation takes place in the framework of a strategic environmental assessment (SEA), and in the licensing phase in the framework of an environmental impact assessment (EIA).

Siting of the SF and HLW Disposal Facility

The decision on the siting and construction of the national facility for the management and disposal of spent fuel is part of the broader "dual tack" approach to a deep geological repository as described in the 2023 Resolution and the Programmes for the Decommissioning of the Krško NPP and the Disposal of RW and SF from the Krško NPP. In parallel with the national disposal programme, a multinational disposal option is possible. Both options go in parallel until the choice of one of the options is made.

It is assumed that the site selection process for HLW and SF disposal will be based on similar principles as were applied for the site selection of the LILW repository in Slovenia. The site selection process comprises all activities that are intended for the selection of a final geological repository site. It is a mixed mode process, which includes expert assessment, applications from local communities, and public participation. It consists of four stages: the concept and planning stage, the area survey stage, the site characterisation stage, and the site confirmation stage.

In 2022, the Slovenian waste management organisation ARAO and the Croatian Fund started preparing a joint Research, Development and Demonstration Programme (RD&D Program). The purpose of the RD&D Programme is to define criteria and all the necessary activities and research that will enable the selection of a site for the disposal of SF and HLW in a deep geological repository in the territory of the Republic of Croatia or the Republic of Slovenia. An additional objective of the project is to estimate the total costs for the implementation of the RD&D Programme and all planned activities.

Start of the main activities of the geological disposal siting programme according to the 2023 Resolution is shown in Table 8. There is a possibility of a different solution being agreed on within the Intergovernmental Commission (the commitment to seek a joint solution) and/or an international solution for the permanent disposal of SF and HLW.

Table 8: **The start of the main activities of the geological disposal siting programme**

Activity	Year
Comparative studies, preliminary designs and the preparation of qualified staff	Until 2045
Activation of the geological programme, site selection process, with a socially acceptable site to be approved in 2055	2045-2055
Repository construction	2055-2065
Repository operation	2065-2075
The closure of the repository and the start of the long-term monitoring and maintenance of the repository	2075-

Siting of the LILW Disposal Facility

Due to the growing need for the final disposal of LILW, the final solution for the short-lived LILW is the key issue of radioactive waste management in the Republic of Slovenia. The ARAO successfully accomplished the siting procedure for the LILW repository and the site was approved in December 2009.

The ARAO decided on a combined mode site selection process. This in practice means a combination of technical screening and volunteer siting. It is flexible, transparent and ensures strong public participation.

At the end of 2004, the official administrative procedure for the siting of the repository was announced. In accordance with the procedure, all Slovenian municipalities were invited to take part in the procedure of searching for a repository site. By the deadline for submitting applications, 4 May 2005, eight municipalities had announced their intention to participate.

The proposed locations were discussed by the municipalities in pre-comparative studies and evaluated from a safety, functional, technical, economic, environmental, spatial and social point of view. On the basis of the prepared pre-comparative study, in November 2005 the Government of the Republic of Slovenia confirmed three potential locations for more detailed consideration in the further process of selecting the location of a LILW repository, the location of Vrbina in the Municipality of Krško, Globoko in the Municipality of Brežice, and Čagoš in the Municipality of Sevnica.

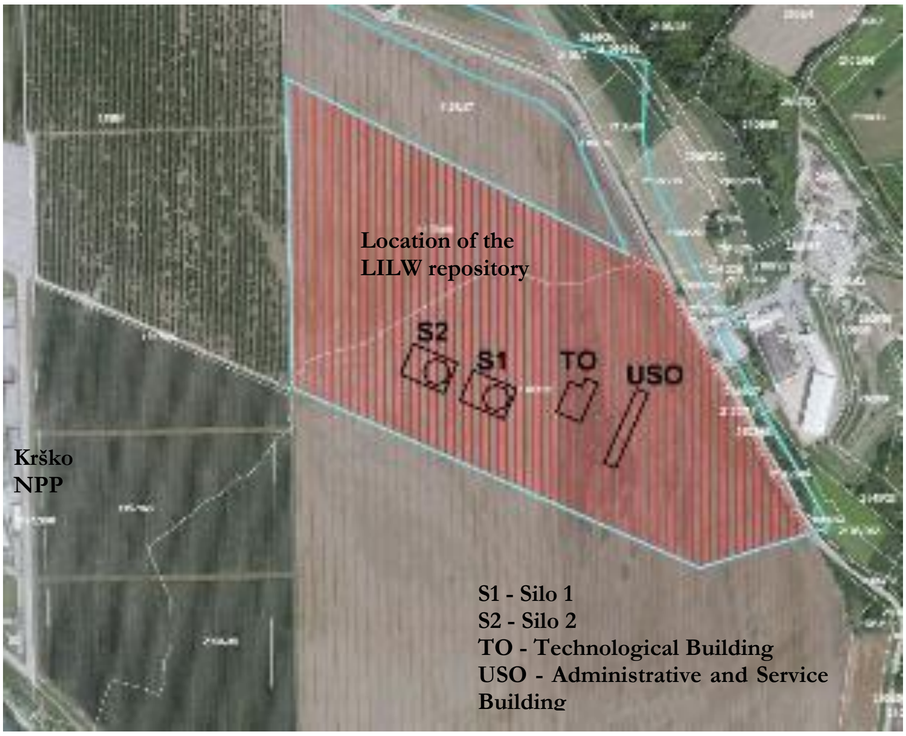
Activities in the area of the design concept of the repository began to be intensively implemented in May 2006 with the elaboration of the design bases as one of the basic starting points for design. During the formulation of the design bases, the Municipality of Brežice adopted a decision to withdraw the Globoko site from the procedure and to try to identify an alternative site to participate in the procedure. Since, after the call of the ministry responsible for preparation the national spatial plan for the submission of guidelines for LILW repository in March 2006, the Municipality of Sevnica had already withdrawn from the procedure, the formulation of the design bases proceeded only for the Vrbina site. At the same time, in July 2006 work began on the expert basis for studying variants only for the Vrbina site. As part of the formulation of the expert basis for the variant study, produced in August 2006, the technical adequacy was checked for the recorded alternative solutions regarding repository facilities at the Vrbina site, and it was concluded that it would be possible to construct various variants of a repository facility at the site. For the needs of the variant study, a multilateral assessment of the acceptability of the activity was made by comparing variants from five aspects – functional, safety, environmental, spatial and economic – as well as the aspect of its acceptability in the local environment.

The overall assessment of the evaluation showed that the solution with silo disposal units showed the highest degree of suitability for construction at the Vrbina site.

After years of intensive siting work, the Detailed Plan of National Importance for a Low- and Intermediate-Level Radioactive Waste Repository in Vrbina in the Municipality of Krško was prepared and adopted at the end of the 2009 by the Slovenian Government. With the 2009 adoption of the Decree on the Detailed Plan of National Importance for a LILW Repository, the location and type of repository were confirmed. The selected type of repository envisages the disposal of radioactive waste in near-surface silos. Disposal silos are built from the surface down in low permeability silt layers in a saturated zone under groundwater. The concept combines properties of surface type repositories (disposal from the surface) and properties of underground repositories (the placement of disposal units in low-permeable saturated geological formations).

The approved location of the LILW repository in Vrbina in the Municipality of Krško is shown in Figure 15.

Figure 15: **Approved location of the LILW repository in Vrbina in the Municipality of Krško**



Article 7: Design and Construction of Facilities

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a spent fuel management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases,

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a spent fuel management facility are taken into account,

(iii) the technologies incorporated in the design and construction of a spent fuel management facility are supported by the decommissioning of a spent fuel management facility.

Article 14: Design and Construction of Facilities

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a radioactive waste management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases,

(ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a radioactive waste management facility other than a disposal facility are taken into account,

(iii) at the design stage, technical provisions for the closure of a disposal facility are prepared,

(iv) the technologies incorporated in the design and construction of a radioactive waste management facility are supported by experience, testing or analysis.

The measures prescribed in Articles 7 and 14 of the Convention are ensured through the licensing process for the construction of nuclear facilities.

The permit for the construction of a nuclear facility is issued by the Ministry of Natural Resources and Spatial Planning on the basis of the Construction Act; the opinion issued by the SNSA (2017 Act, Article 97) is one of the conditions for such. In issuing an opinion, the SNSA evaluates the technologies incorporated into the design and construction of the spent fuel management or radioactive waste management facility from the point of view of nuclear and radiation safety and environmental protection.

According to Article 97 of the 2017 Act, an application for an opinion shall include project documentation, a safety analysis report, including relevant evaluations, and the opinion of an authorised expert for radiation and nuclear safety. The project shall be in compliance with the design bases according to the provisions of Chapter II of Rules JV5. The content of the project documentation and the methods of its preparation and revision are prescribed by the rules governing project and technical documentation and, in the case of mining works, by the provisions of the rules governing the method of the compilation, sequence, contents and revision of mining works project documentation. The key document governing the technical and safety measures for the construction and operation of a nuclear facility is the safety analysis report. The content of the safety analysis report for the disposal of uranium mining and ore processing tailings and mines is prescribed in detail by the SNSA. The main content of the safety analysis report is prescribed by the 2017 Act and Rules JV5. The detailed content of the safety analysis report for the LILW repository was prepared by the SNSA in the form of guidelines issued in 2012.

Chapter II of Rules JV5 sets the requirements for the design bases for radiation and nuclear facilities and the main principles that the design of radiation or nuclear facilities should adhere to. It includes general provisions for the design bases and specific provisions for, *inter alia*, safety functions, physical protection, site conditions, postulated initiating events, normal operation, events and accidents, facility states, capability for decommissioning and emergency preparedness.

Design of the LILW Repository

The silo 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, with a net area of about 10 ha, includes all structures, systems and components required for its operation as an independent nuclear facility. An area for additional silos is reserved for the future extension of its capacity, if needed.

The foreseen layout of structures, systems and components shall ensure the relevant conditions for the safe operation of the repository.

The area for connection to infrastructure consists of structures enabling access to the repository (an access road) and all connections necessary to meet the needs of the new repository (water, electricity, sewage systems, IT, etc.). Areas within the disposal area and a major part of the inner areas of the waste conditioning structure are classified as radiologically controlled areas and are protected by a fence.

The narrow 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 the area is approximately 6 ha, with the following structures:

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

In accordance with the level of protection against flooding, structures are situated on a flood protection embankment for protection against the probable maximum flooding. The dimensions and shape of the embankment are in accordance with the technological requirements. The repository is surrounded by an external service road.

In the Administrative Building there are facilities and systems for repository management activities, service and administrative activities, access control, personal and vehicle entrance control, as well as control of the repository area.

The Technological Building is located in the central part of the repository. It is designed for temporary storage and, if necessary, the repair of damaged waste containers, basic laboratory research, and the control of technological processes, and the other necessary technological and service functions of the repository, as well as activities for ensuring radiation safety. Functionally, the building is designed in such a manner that its construction can be performed in two stages. The technological building is also the entrance and exit point regarding the controlled area of the LILW repository.

The silo is designed as a reinforced concrete cylindrical structure with an inside diameter of 27.3 m and a height (depth) of 55 m. A vertical communication shaft runs inside the silo. The central part of the shaft consists of stairs and an elevator, with installation shafts on the side. The entrance to the communication shaft is provided from the hall or from the outside.

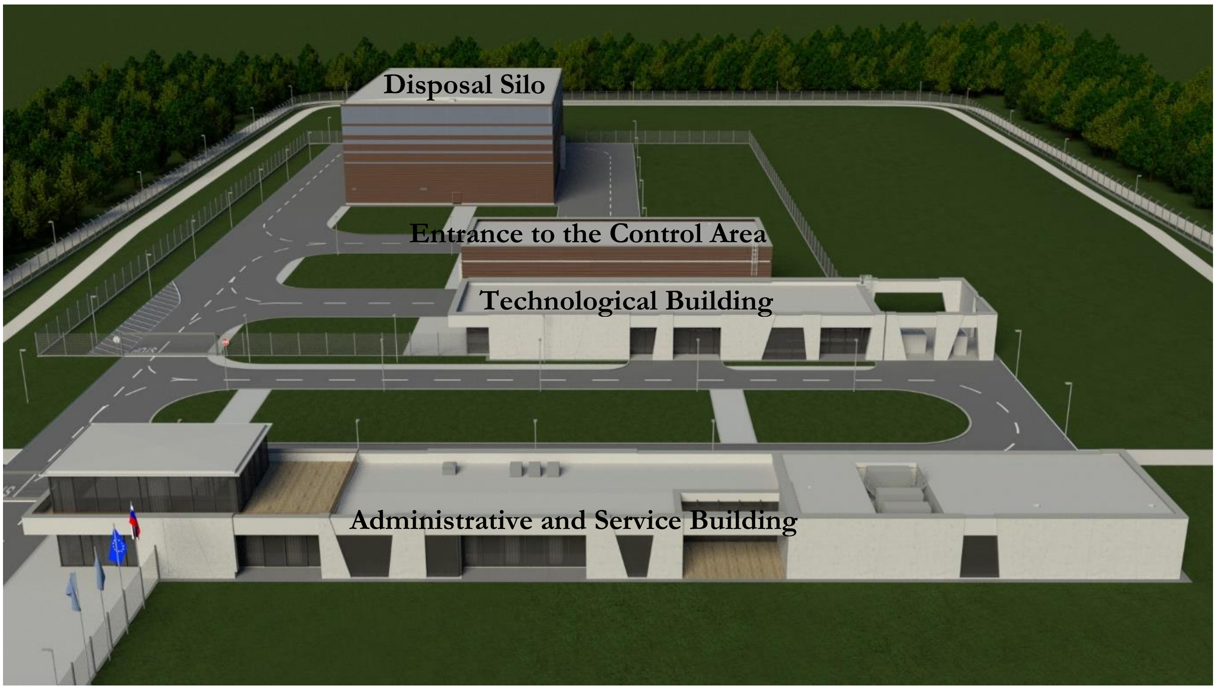
The net floor area of the silo enables the arrangement of 99 containers on one level. The height of the silo is designed to contain 10 levels of containers, including the closing structure, a reinforced concrete plate and a clay barrier. The closing barrier is below the level of the existing aquifer.

The hall above the silo is located in the central part of the repository in the radiologically controlled area and 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 the cleaning of the floor, and the decontamination of tools and equipment. The construction of the Control Pool is in line with the technological requirements.

Figure 16 shows the structures inside the LILW repository in Vrbina, Krško, as shown in the design for the construction permit.

Figure 16: **The LILW repository facilities based on the design for the construction permit**



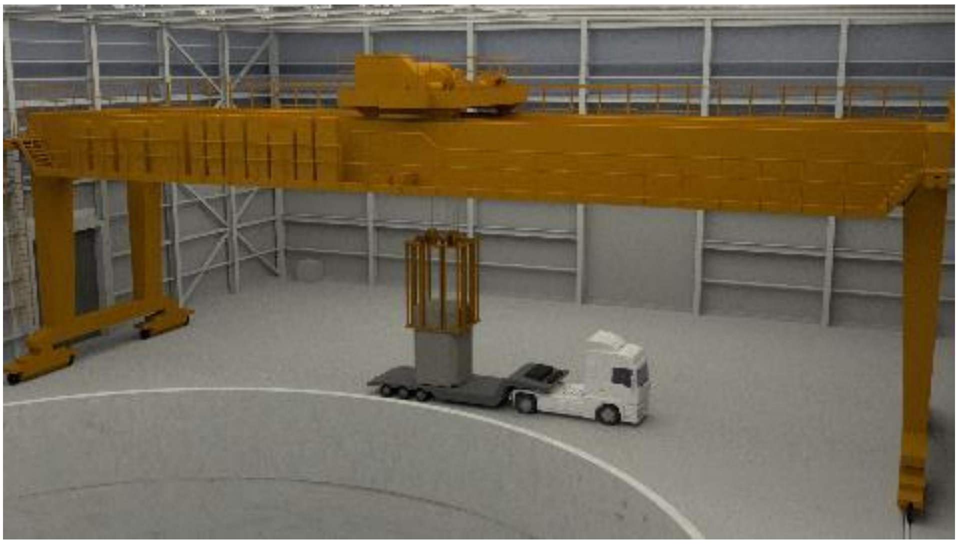
The reinforced concrete container is one of the engineering barriers that must comply with all required safety functions. The basic geometry of the container was determined on the basis of the 4 TTC overpacks, which are the most commonly used overpack at the Krško NPP. The chosen design in terms of both design and materials meets all the basic safety functions for concrete containers.

Figure 17 shows the reinforced concrete container as presented in the design for the construction permit.

Figure 17: **A reinforced concrete container for the disposal of LILW**

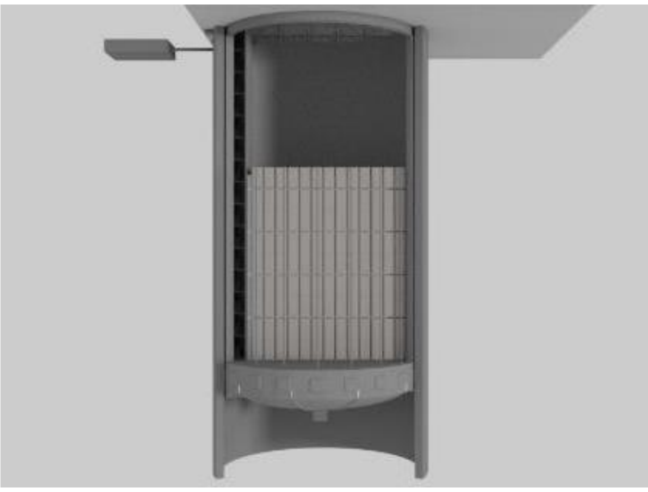
During its period of operation, the silo is protected by a hall, where a portal crane is located. All waste will be put in reinforced concrete containers prior to disposal. In total, 853 type N2d containers, with a maximum (design) weight of 40 t will be disposed of. The disposal containers will be transported to the handling area near the silo by vehicle and then disposed of using the portal crane and a special gripper. The empty spaces will then be backfilled with backfilling material. The last layer of the containers will be covered with a reinforced concrete plate and a layer of fairly impermeable material (e.g. clay).

Figure 18: **An N2d container being unloaded from a transport vehicle by a gantry crane and a special gripper**



The disposal concept is flexible and covers as many future developments in the programme as could reasonably be expected. It consists of a modular approach and an intermittent mode of operation. Each silo is an independent unit and the number of silos is expandable. The second silo will be constructed when the first one has been filled and the need for a second one arises. The repository can operate intermittently, i.e. it can be temporarily in standby mode for longer or shorter periods of time. The disposal facility also has the potential to accommodate all LILW from the Krško NPP. Figure 19 shows a cross section of the silo as presented in the design for the construction permit.

Figure 19: **The LILW disposal silo cross section as shown in the design for the construction permit**



Construction of the LILW disposal facility

The design documentation and safety assessment report had to be prepared for the construction permit. The SNSA approved the safety assessment report and issued consent for the construction in 2022. Environmental consent, which was gained in 2021, also had to be submitted for the construction permit application. A construction permit for a nuclear facility was gained in 2022 and for the infrastructure construction early in 2023.

The public procurement process for the construction was divided into three phases. The first phase was for the construction of the infrastructure and physical security, the second phase was for the nuclear facility construction, and the third will be for portal crane delivery. The public procurement process for the second phase was closed at the end of the year 2023 and the evaluation of the submitted offers started. The third phase has not yet been published.

The construction works on the infrastructure, i.e. road reconstruction, sewage, electricity, and water pipes, started in August 2023. By the end of the year 2023, the road reconstruction with all the necessary infrastructure had been finalised. The work on the construction of an external fence, which is part of the physical security system was finished in April 2024.

In 2023, a contractor for N2d concrete containers was selected. The contractor started with the preparation of the documentation needed for the process and with the development of the concrete mixtures for manufacturing the concrete containers.

Article 8: Assessment of the Safety of Facilities

Each Contracting Party shall take the appropriate steps to ensure that:

(i) before construction of a spent fuel management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out,

(ii) before the operation of a spent fuel management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

Article 15: Assessment of the Safety of Facilities

Each Contracting Party shall take the appropriate steps to ensure that:

(i) before construction of a radioactive waste management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out,

(ii) in addition, before construction of a disposal facility, a systematic safety assessment and an environmental assessment for the period following closure shall be carried out and the results evaluated against the criteria established by the regulatory body,

(iii) before the operation of a radioactive waste management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).

Assessment of Safety before Construction

The assessment of safety before the construction of a spent fuel management facility or a radioactive waste management facility is ensured by Article 101 of the 2017 Act. It is ensured through the provision requiring that an application for a licence shall contain project documentation, a safety analysis report and the opinion of an authorised expert for radiation and nuclear safety.

Article 43 of Rules JV5 lays down the general contents of the safety analysis report, which shall provide the following information:

- a site description, a general description of the facility and its normal operation, and a description of how the facility's safety is ensured;
- a description of the programme for trial operation;
- a description of the technical characteristics of the radiation or nuclear facility and a description of performance in all operational states of the facility;
- a description of the facility's design concept and the approach adopted to meet the fundamental safety objectives and a description of the design bases of the radiation or nuclear facility and of their methods of fulfilment;
- a detailed description of the safety functions, of all safety systems, and of safety-related structures, systems and components (SSCs), their design bases and the functioning of all safety-related SSCs in all operational states of the facility;
- a list of regulations and standards applied as the basis for descriptions and safety analyses covered in the safety analysis report;
- a description of the plant organisational set-up of the facility operator intended for ensuring nuclear safety;
- an assessment of the safety aspects relating to the facility site;
- a description of safety analyses performed to assess the safety of the radiation or nuclear facility in response to postulated design-basis events and a comparison with the technical acceptance criteria;
- a description of the probabilistic safety analyses;

- a description of the emergency operational procedures and of the severe accident management guidelines in the case of a nuclear facility;
- a description of the measures for protection against internal fires;
- a description of the emergency plan for the facility and of the facility operator's internal organisational set-up for emergency events and of its alignment with the national protection and rescue plan in the event of a nuclear accident;
- a description of the measures providing for SSC inspection, testing and surveillance; a description of the operational experiences feedback programme; and a description of the ageing management programme;
- a description of the training and education of the personnel;
- the operating limits and conditions of safe operation and technical bases explaining the expert bases for each operating condition or limit;
- a description of the strategy for protection against radiation – a description of the methods and measures for the protection of exposed personnel against ionising radiation, including an assessment of their protection against radiation and an assessment of the exposure of the general population and the environment;
- a description of any radioactive and nuclear materials and other sources of radiation;
- a description of the radioactive waste and spent fuel management programme;
- a description of all activities in the facility's operational phase planned to facilitate the termination of operation and decommissioning;
- a description of the management system;
- an outline of the physical protection of the facility and nuclear and radioactive substances;
- the anticipated and maximum allowable releases of radioactive substances into the environment;
- the programme of meteorological measurements and radioactivity monitoring during operation; and
- in the case of a radioactive waste repository, a spent fuel repository, a hydro-metallurgical tailings repository or a mining tailings repository, a plan for long-term surveillance.

The safety analysis report shall be amended when changes in the situation referred to therein arise during the construction or decommissioning of the facility or during the period of trial operation.

The SNSA shall issue consent for construction within 24 months after the submission of a complete application. Article 107 of the 2017 Act allows the SNSA to issue a special decision splitting the contents of the application into thematically related subjects to obtain partial opinions in order to shorten the time period for the issuance of consent for construction. In April 2017 and in June 2019, the SNSA issued a decision to split the contents of the application into content-based thematic sections in the case of approval of a LILW repository. This approach contributed to a more systematic review of the documentation and accelerated the overall licensing process.

Assessment of Safety before Operation

After construction work has been completed, every nuclear facility shall undergo a period of trial operation. Prior to the start of the trial operation of a nuclear facility, it is mandatory to obtain the consent of the SNSA. An application for consent for the start of trial operation shall contain a safety analysis report updated with any changes that have occurred during construction, the opinion of an authorised expert for radiation and nuclear safety, and other prescribed documentation.

Article 26 of Rules JV5 determines the contents of an application for consent for the start of the trial operation of a radiation or nuclear facility.

The SNSA shall issue consent for trial operation for a fixed period, which may not exceed two years. The consent for trial operation may be extended. There is no right to appeal against the refusal of consent for the start of trial operation.

The Safety Case and Safety Assessment for the LILW Repository

After the conclusion of the siting of the LILW repository, the preparation of the safety case for the licensing thereof was started. The main goal of this phase was to attain confidence that the combination of the repository site and the disposal concept is safe, especially regarding long-term safety. This information was used both in the licence application and to support the environmental impact assessment. As a part of the safety case, a new iteration of the safety assessment was prepared. The purpose of this was to develop reasonable assurance that the facility will remain within regulatory safety constraints for a long time into the future, as determined in legislation. The safety assessment was undertaken using the Improvement of Safety Assessment Methodologies (ISAM methodology) of the IAEA, which has become an internationally accepted standard for conducting safety assessments. At each stage of the process, the methodology is intended to focus attention on key issues that need to be addressed to develop confidence that the final decision is well supported, documented and fully coherent.

The selection and classification of postulated initiating events were placed into two sub-groups:

- initiating events for the operation, closure and decommissioning of the repository;
- the definition of the Features, Events, and Processes (FEPs) for the repository in the post-closure period.

The list of postulated initiating events was used for selecting initiating events during the operation, closure and decommissioning of the repository, and was supplemented by the anticipated operating occurrences as defined in the reference documentation for repository operation.

The FEPs for the repository in the post-closure period were reviewed and those with no relevance to the Vrbina LILW repository were excluded. Suitable scenarios were then developed from the FEPs that remained.

The scenario development process for the repository's long-term safety resulted in the identification of five main scenarios:

- a nominal scenario,
- the early failure of engineering barriers,
- river meander and surface erosion,
- inadvertent human intrusion, and
- changes in hydrological conditions,

for which analyses were conducted. For all of these scenarios, detailed models were prepared to calculate the impact of the facility on people and the environment. At the end of the process, all the results were evaluated. All dose assessments from scenarios on a representative person showed that doses are expected to be under the limits determined by the regulatory body. Limits were taken from the IAEA standard, international practice and Annex IV.6 of Rules JV5.

On the basis of the initiating event analysis and final design, the scenarios for the operational phase of the disposal facility were developed and analysed.

The post-closure safety assessment and operational safety assessment showed that the proposed concept and the design of the facility meet the regulatory safety criteria for post-closure and operational safety with a good margin for all the analyses conducted. This conclusion is contingent on a number of basic assumptions that form the foundation of the safety assessment analyses. On the basis of these studies, it is concluded that there is high confidence that the Vrbina repository meets the regulatory constraints with a sufficient margin.

Article 9: Operation of Facilities

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the license to operate a spent fuel management facility is based upon appropriate assessments as specified in Article 8 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements,

(ii) operational limits and conditions derived from tests, operational experience and the assessments, as specified in Article 8, are defined and revised as necessary,

(iii) operation, maintenance, monitoring, inspection and testing of a spent fuel management facility are conducted in accordance with established procedures,

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a spent fuel management facility,

(v) incidents significant to safety are reported in a timely manner by the holder of the license to the regulatory body,

(vi) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate,

(vii) decommissioning plans for a spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body.

Article 16: Operation of Facilities

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the license to operate a radioactive waste management facility is based upon appropriate assessments as specified in Article 15 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements,

(ii) operational limits and conditions, derived from tests, operational experience and the assessments as specified in Article 15 are defined and revised as necessary,

(iii) operation, maintenance, monitoring, inspection and testing of a radioactive waste management facility are conducted in accordance with established procedures. For a disposal facility, the results thus obtained shall be used to verify and to review the validity of assumptions made and to update the assessments as specified in Article 15 for the period after closure,

(iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a radioactive waste management facility,

(v) procedures for characterisation and segregation of radioactive waste are applied,

(vi) incidents significant to safety are reported in a timely manner by the holder of the license to the regulatory body,

(vii) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate,

(viii) decommissioning plans for a radioactive waste management facility other than a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body,

(ix) plans for the closure of a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility and are reviewed by the regulatory body.

Initial Authorisation for Operation

An operating licence is issued by the SNSA only after the Ministry of Natural Resources and Spatial Planning issues, in accordance with the Construction Act, a licence for the use of a facility.

An application for an operating licence shall contain an updated safety analysis report, an opinion from an authorised expert on radiation and nuclear safety, and other documentation prescribed by Article 27 of Rules JV5. The safety analysis report shall be updated with any changes that occur during the trial operation.

A licence shall be issued by the SNSA within 90 days of receiving a complete application and information on the trial operation indicating that all the conditions for radiation and nuclear safety have been fulfilled.

Operational Limits and Conditions

In accordance with Article 101 of the 2017 Act, the proposed operational limits and conditions (technical specifications as part of the safety analysis report) have to be submitted to the regulatory body as a part of the safety analysis report first already with the application for consent for construction, then with the application for consent for trial operation, and subsequently with the application for the operating licence.

Article 46 of Rules JV5 sets the basic requirements for operational limits and conditions and also defines that they shall be specified for all operational states of the facility.

Article 47 of Rules JV5 defines the contents of the operational limits and conditions, which should contain:

- a definition of terms;
- the safety limits;
- limits on the operating parameters for safety systems;
- limits on the operating parameters and a stipulation of the minimum amount of operable equipment, including the number of SSCs important for safety, which should be in operational or standby condition;
- necessary measures in cases of exceeded operating limits and conditions, and the time available for taking such measures;
- requirements for surveillance; and
- requirements for the minimum staffing levels to ensure safe operation in different operational states of the facility.

Article 3 of the Rules on the Operational Safety of Radiation or Nuclear Facilities (JV9) defines the application of operational limits and conditions. It is required that the personnel licensed to operate and monitor the technological process in a radiation or nuclear facility shall be highly knowledgeable as to the contents, purposes and technical bases of the operational limits and conditions. Information on the operational limits and conditions shall be accessible to all personnel involved in operating the facility. In facilities fitted with a control room, such information shall be available in the control room.

The operational limits and conditions shall be reviewed and kept updated as appropriate in accordance with operational experience and developments in science and technology and upon any modification to the facility that warrants or requires such updates.

Articles 116 and 117 of the 2017 Act outline the procedure for the approval of changes to the safety analysis report. The procedure defines 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 licence from the SNSA shall be obtained.

Rules JV9 define the methodology for the assessment and classification of modifications and the method and form of reporting and proposing modifications to radiation or nuclear facilities.

Operation, Maintenance, Monitoring, Inspection and Testing

In accordance with Article 27 of Rules JV5, the documentation submitted for the application for an operating licence shall also contain a list of prepared operating procedures, a report on trial operation, a radioactive waste or spent fuel management programme, management system documentation, a decommissioning programme, a programme for monitoring operational experiences, a programme for monitoring ageing, programmes for SSC maintenance, testing and inspection, the results of pre-operation monitoring, a safety analysis report, an opinion by an approved radiation and nuclear safety expert, and other prescribed documentation. At the request of the SNSA, the investor or the operator of a radiation or nuclear facility shall make licence application reference documentation available.

Periodic safety review

In accordance with Article 112 of the 2017 Act, the operator of a radiation or nuclear facility shall ensure regular, full and systematic assessment and inspection of the radiation or nuclear safety of the facility through periodic safety reviews.

The operator shall draw up a report on a periodic safety review and submit it to the SNSA for approval.

Where a report on a periodic safety review indicates the need to change the conditions of operation or the limitations from the safety analysis report with the aim of improving radiation or nuclear safety, the operator shall draw up a proposal for any such changes.

An approved report on the periodic safety review shall be a condition for the renewal of a licence for the operation of the nuclear facility.

The frequency, contents, scope, duration and method of performing periodic safety reviews and the methods of reporting such reviews are defined in Chapter V of Rules JV9.

Exceptional review of the safety analysis report

According to Article 119 of the 2017 Act, the operator shall evaluate and verify the safety of the facility and ensure a review of the concordance of the safety analysis report with the conclusions of the evaluation and verification of safety directly after any emergency at the facility or after the completion of work relating to the mitigation of the consequences thereof.

Engineering and Technical Support

In-house capabilities have been developed to perform engineering and technical support at the existing nuclear facilities. The Krško NPP, the Jožef Stefan Institute Reactor Infrastructure Centre, the ARAO and the Žirovski Vrh Mine d.o.o. are capable of processing minor design changes in-house. The capability to prepare purchase specifications, review bids and bidder selection, quality assurance, quality control and engineering follow-up of projects, and the review and/or acceptance testing of products are possible to a certain extent at all of the above facilities. Other engineering and technical support is provided through outsourcing to Slovenian research and engineering organisations or abroad. However, major projects require an open invitation to tender. The Ministry of Higher Education, Science and Innovation financially supports research and development projects in the field of nuclear safety in the Republic of Slovenia through a research fund, with the participation of the nuclear industry and the SNSA.

Characterisation and Segregation of Radioactive Waste

According to Article 121 of the 2017 Act and the Rules on Radioactive Waste and Spent Fuel Management, a licence holder shall collect radioactive waste, classify them with regard to the aggregation state and the level and type of radioactivity, report on radioactive waste and spent fuel generation, keep accounting records for the waste, label the waste, provide for the processing, transport and storage of waste, and perform activities in such a manner that the lowest possible quantities of radioactive waste are generated, taking into consideration safe working conditions, radiation protection and economic criteria.

Incidents Significant for Safety

Article 120 (“Reporting on the operation of facilities”) of the 2017 Act stipulates that an operator shall submit exceptional reports to the SNSA containing information on:

- equipment malfunctions that could cause an emergency, emergencies themselves, and measures taken for the mitigation of the consequences of the defects or emergencies;
- mistakes made by workers while handling or operating a facility that could cause an emergency;
- deviations from operational limitations and conditions; and
- all other events or operational circumstances that significantly affect the radiation or nuclear safety of the facility.

Chapter III of Rules JV9 prescribes detailed requirements for reporting and for the notification of the regulatory body by the operator of a nuclear facility. The regulations distinguish between routine reporting and notification and reporting in the event of an abnormal event. They specify the time period for each report. Reporting criteria are also provided and abnormal events are specified.

According to Article 135 of the 2017 Act, the licence holder is required to report to the regulatory body that issued the operating licence (the SNSA) and to other competent agencies on an emergency in the shortest possible time.

Programmes to Collect and Analyse Relevant Operating Experience

In accordance with Article 90 of the 2017 Act ("The use of experience gained during operational events"), the operator of a radiation or nuclear facility shall ensure that programmes for collecting and analysing operating experience at nuclear facilities are implemented.

The method and frequency of reporting on the implementation of programmes for collecting and analysing operating experience are defined in Chapter II.2 of Rules JV9.

In the assessment, examination and improvement of radiation and nuclear safety, the operator of a radiation or nuclear facility shall take into account the conclusions of the programmes for collecting and analysing operating experience.

Decommissioning plans

In accordance with Article 3 of the 2017 Act ("Definitions"), the decommissioning of a facility shall mean all measures leading to the cessation of control over a nuclear or radiation facility pursuant to the provisions of the 2017 Act. Decommissioning includes both decontamination and removal of the facility or dismantling procedures and the removal of radioactive waste and spent fuel from the facility.

The legal requirements for approval for decommissioning a nuclear facility comprise a two-step procedure and are defined in Articles 101 and 109 of the 2017 Act, which prescribe that an investor intending to decommission a radiation or nuclear facility shall attach to an application for consent for decommissioning and to the project documentation a safety analysis report and the opinion of an authorised expert for radiation and nuclear safety, and to an application for a permit for the commencement of decommissioning activities an updated safety analysis report, an opinion of an authorised expert for radiation and nuclear safety and other documentation. The detailed contents of these applications are defined in Articles 31 and 32 of Rules JV5.

In the case of the decommissioning of a facility, the content of the safety analysis report shall refer to the decommissioning of the facility and the related measures for radiation or nuclear safety.

Two special acts have been approved by the Slovenian National Assembly for the decommissioning of nuclear facilities, namely the Act Governing the Fund for Financing the Decommissioning of the Krško Nuclear Power Plant and the Disposal of Radioactive Waste from the Krško NPP and the Permanent Cessation of Exploitation of the Uranium Ore and Prevention of the Consequences of the Mining at the Uranium Mine at Žirovski Vrh Act. Through the legal provisions of these two Acts, the legal framework has been established for the financing and planning of decommissioning activities for the respective facilities.

Article 17: Institutional Measures after Closures

Each Contracting Party shall take the appropriate steps to ensure that after closure of a disposal facility:

(i) records of the location, design and inventory of that facility required by the regulatory body are preserved,

(ii) active or passive institutional controls such as monitoring or access restrictions are carried out, if required, and

(iii) if, during any period of active institutional control, an unplanned release of radioactive materials into the environment is detected, intervention measures are implemented, if necessary.

In the safety report of the repository facilities relating to the time period following the closure thereof, all the possible risks relating to the spent fuel or radioactive waste shall be assessed, as well as the exposure of the population after the closure and the exposure of the workers working at the repository during the maintenance thereof and the long-term supervision of the repository facility following closure (Article 103 of the 2017 Act).

The plan for the long-term post-closure supervision of a repository for radioactive waste or a disposal site for uranium mining and milling waste material shall include the following:

- the extent and content of the operational monitoring of radioactivity at the repository, the monitoring of natural phenomena affecting the long-term stability of the repository and the functioning of the individual parts of the repository; and
- the criteria on the basis of which decisions on carrying out maintenance work at the repository shall be made, dependent on the results of the operational monitoring referred to in the previous indent and on inspection (Article 106 of the 2017 Act).

The records on the location, design and inventory of a facility required by the regulatory body are preserved through the provision of Article 110 ("Application for a permit"), which stipulates that it is necessary to attach to the application for a closure permit a safety analysis report, an opinion from an authorised expert for radiation and nuclear safety, and other prescribed documentation.

Article 110 of the 2017 Act further stipulates that the owner or operator of a facility that has obtained a permit for the disposal of spent fuel, radioactive waste, or mine and hydro-metallurgical tailings shall ensure the maintenance and supervision of the disposal site in line with the conditions laid down in the safety analysis report.

Article 123 ("Long-term surveillance and maintenance of closed repositories") of the 2017 Act stipulates that the long-term surveillance and maintenance of repositories of mining and hydro-metallurgical tailings resulting from the extraction of nuclear mineral materials is provided as a service of general economic interest.

The contents of applications for a permit for the closure of a radioactive waste or spent fuel repository or for the closure of a repository for mining or hydro-metallurgical tailings are defined in Rules JV5 in Articles 36 and 37, respectively.

Žirovski Vrh Uranium Mine

The closure of the uranium mine, including the environmental remediation activities on disposal sites for mining and milling waste material, is carried out by the public company Žirovski Vrh Mine d.o.o., which was established by the Permanent Cessation of Uranium Ore Exploitation and Prevention of the Consequences of Uranium Mining Act. The environmental remediation at disposal sites was carried out under the control and with the approval of the regulatory body competent for nuclear and radiation safety (the SNSA). The radiological safety requirements were defined in the safety report, which also includes the post-closure period and defines the general programme of long-term surveillance and maintenance of the location. After closure, the disposal site became a facility within the state infrastructure and was thus excluded from legal transactions. The Government of Republic of Slovenia assigned the management of the Jazbec disposal site as national infrastructure to the ARAO in 2016.

The long-term surveillance and maintenance of the uranium mining waste disposal site is ensured as a permanent mandatory service of general economic interest performed by the ARAO with no time restrictions. Its scope is defined in the Decree on the method and conditions for providing the mandatory national public service of general economic interest of radioactive waste management. Fulfilling the requirements for record keeping, reporting and updating the safety report and the programme of long-term surveillance and maintenance of the disposal site is supervised by the SNSA, although the closed uranium mining waste disposal site is not considered to be a radiation facility and its environmental radiological impact cannot be distinguished from the natural background radiation. The monitoring results show that the disposal site Jazbec is in the same state as it was upon closure.

After the closure of the Boršt hydro-metallurgical tailings disposal site, which is expected to take place in the near future, the same long-term surveillance and maintenance measures will be implemented as in the case of the Jazbec disposal site.

Planned LILW repository in Vrbina, Krško

After the closure of the repository, it will enter a transitional period prior to post-closure institutional control and maintenance. During this period, the operator identifies and monitors the effectiveness of the performed activities for closure and carries out the necessary maintenance and corrective measures that bring the repository to a state appropriate for the repository to be submitted for post-closure institutional control and maintenance. Active long-term surveillance and maintenance is planned to commence at the beginning of 2063, once all preparatory activities have been performed for a transition to monitoring following the period of the transition of the repository to long-term surveillance and maintenance (2060–2062) and after the monitoring and maintenance provider has taken over the repository for long-term surveillance and maintenance. Active long-term surveillance and maintenance will last 50 years (2063–2113), unless another duration is determined in subsequent revisions of the project documentation, based on a safety analysis and operational experience.

The repository's technological facility following decommissioning and other non-technological facilities at the repository may also be used for requirements relating to active long-term institutional surveillance and maintenance or may be temporarily used for other activities.

Institutional control of the repository shall cover the area of the repository surrounded by the outer perimeter fence, the auxiliary structures, the plateau near the disposal facilities and any immediate surroundings that could have an impact on the repository or in which the impact of the repository can be detected by means of measurement procedures. The precise area for monitoring the environment outside of the repository fence will be determined in subsequent revisions of the project documentation.

Active long-term institutional control

In the period of active long-term institutional control, the provider of management, long-term surveillance and maintenance of the repository will provide, in accordance with the confirmed and valid safety analysis report, in particular the following:

- the technical monitoring of the closed repository, in order to monitor the provision of the safety functions;
- maintenance of the physical protection of the facility;
- regular maintenance works on and cleaning of systems that will still be functioning, including measuring equipment;
- any necessary repairs and maintenance of the covering, filling and service elements of the repository;
- monitoring the growth of vegetation at the repository and the prevention of forest growth on the grassy area.

Within the scope of monitoring radioactivity at the repository and monitoring the surrounding environment during the period of active institutional control, it will be necessary to conduct measurements of external (gamma) radiation, measurements of the groundwater characteristics and measurements of liquid discharges from the system for removing water from the disposal part of the repository.

Passive long-term institutional control

After the end of active long-term institutional control, the repository will pass into the phase of passive long-term institutional control. The above-ground facilities of the repository will be removed or transferred to unrestricted use. It is assumed that the earth-filled plateau of the repository will continue to remain at the site in the phase of passive long-term institutional control. The plateau can also be removed. The passive control phase is planned to last a maximum of 250 years after the end of active long-term institutional control of the repository (2114- 2363), unless another duration is determined in subsequent revisions of the project documentation, on the basis of a safety analysis and operational experience.

The repository shall be prepared for long-term passive institutional control when the long-term active control period comes to an end. The preparations will include in particular:

- the removal of all equipment for the performance of measurements and other forms of active control;
- the removal of the facilities that were required for active monitoring, or the transfer of the facilities to unrestricted use; and
- the removal of the fence or the discontinuation of fence maintenance.

Long-term passive monitoring of the repository will primarily be carried out for:

- the storage of information on the repository;
- maintenance of ownership of the repository land; and
- the presence of geodetic warning signs at the repository.

For the purposes of the storage of repository records, at least two types of information will be archived for as long a period as possible and for potential use:

- information, data, records and documents relating to activities during operation and decommissioning, data on disposed waste, data on emergencies, site data, site maps, photos of the repository and the surrounding environment, etc.;
- data obtained through monitoring of the repository and the surrounding environment (radiological, meteorological, etc.).

Article 10: Disposal of Spent Fuel

If, pursuant to its own legislative and regulatory framework, a Contracting Party has designated spent fuel for disposal, the disposal of such spent fuel shall be in accordance with the obligations of Chapter 3 relating to the disposal of radioactive waste.

Krško NPP

After the period of dry storage, spent fuel or high-level waste generated from decommissioning or from spent fuel processing is to be further treated, packaged and disposed of. For spent fuel and HLW, a deep geological repository should be built to ensure adequate temporal isolation of the waste from the environment.

For long-term spent fuel management, a dual-track strategy has been adopted as a reasonable solution in the present situation. In parallel with the national disposal programme, a multinational disposal option is possible.

The reference scenario for Slovenia's own repository in suitable hard rock was first developed in 2004 and revised 2019. The 2023 Resolution assumes the disposal of spent fuel in 2065, with an option to also consider the construction of a regional repository or use of disposal services provided by a disposal facility in a host country. Both options continue in parallel until the choice of constructing a national repository or participation in a multinational repository is made.

Slovenia is a member of the ERDO Association, which brings together a group of countries to consider a model for the development of joint disposal solutions for the benefit of its Member Countries. The main reason for cooperation and integration in this area is Slovenia's extremely small-scale nuclear programme and that by participating in joint programmes it can achieve significant positive economic effects.

The reference conceptual design is based on the best available current knowledge of future inventories and the operation of both nuclear facilities in Slovenia. The national concept scenario includes the overall geological disposal programme, including research, development, and implementation activities for the siting, construction, operation, and closure of a geological repository.

No site investigations for a deep geological repository have been carried out in Slovenia, and no specific data for geological disposal are available now. The reference scenario is made for a generic location in hard rock media. For some specific aspects, assumptions and estimates based on expert assessments were used.

Only the direct disposal of spent nuclear fuel (no reprocessing) is envisaged and the repository will be constructed in a hard rock environment at a depth of 500 m.

The following basic requirements are considered in the reference scenario from 2019:

- In total, 2,282 SF elements will be disposed of.
- In addition to SF, decommissioning HLW from the NPP, packed in 7 Holtec HI-SAFE containers with a disposal volume of 237 m^3, 650 m^3 of SF dry storage operational and decommissioning waste, 172 m^3 of encapsulation facility operational and decommissioning waste, and 3,000 m^3 of repository operational and decommissioning waste (5% of the waste is assessed to be long-lived HLW) will be disposed of in the geological repository. The disposal of this waste is anticipated to take place in the abandoned underground service compartments or, as an alternative, in a special underground compartment.
- An Underground Testing Facility (UTF) will be constructed as the first phase of the disposal facility.
- The generic site of the shared repository will be in a hard rock formation in Slovenia or Croatia.
- In the pre-activation stage before the adoption of a chosen repository concept, the reference design also includes monitoring of the status and development of all available SF disposal methods, including disposal in a sedimentary rock formation. In this stage, maintenance and periodic revision of the deep geological disposal programme, R&D, international cooperation and project administration will be carried out.
- The site of the repository is 200 km from the SF storage facility at the NPP site.
- Four assemblies of SF will be encapsulated into each copper canister for disposal. In all scenarios, the encapsulation plant is part of the above-ground repository facilities. As an alternative, encapsulation at a shared regional encapsulation plant 1,000 km away from the SF storage at the NPP site is considered.

- The disposal area is located at a depth of 500 m; an alternative depth of 800 m is also evaluated.
- The disposal area is accessed by way of an access ramp. Alternatively, access via an access shaft is also considered.
- Disposal boreholes are vertically oriented and lie 9 m apart. Distances of 8 and 10 m and space requirements for an additional 20% of boreholes are also considered.
- As an alternative to the basic scenarios that assume that SF disposal will be in a shared bilateral repository in Slovenia or Croatia, a multinational option for disposal is being considered. A multinational/shared regional repository, including an encapsulation plant, 1,000 km from the SF storage at the NPP site is being considered.
- Regarding the spatial planning, construction, public investments and nuclear safety requirements, relevant Slovenian legislation and corresponding procedures are being considered.

The disposal concept follows the Swedish SKB KBS-3V model of disposal and includes at the repository site all structures, systems and components needed for the repository to operate as an independent nuclear facility. Due to operating requirements and necessary physical protection measures, the entire repository area will be divided into four areas: an unfenced area with support buildings and systems, an industrial area with fences due to industrial security (including offices, production buildings and workshops), a technological above-ground area with fences due to radiological and nuclear safety (with an encapsulation plant, service buildings and auxiliary systems) and underground facilities (an access ramp and tunnels, a service area and disposal tunnels with disposal boreholes).

Construction of the geological repository will start 10 years prior to the start of regular operation in 2065. It will begin with the construction of auxiliary above-ground structures. Then, construction of the encapsulation plant and of the underground structures will begin.

The encapsulation plant is part of the disposal concept and is located at the repository site. The plant will contain units for the acceptance of transport containers with SF, for the encapsulation of SF in copper canisters including the handling area, for dispatching and transporting canisters to underground disposal facilities, a unit for the treatment and packaging of LILW, an office building, a storage and auxiliary facilities and systems. In the proposed concept, the encapsulation plant has an annual production capacity of 60 copper canisters per year, which allows sufficient capacities for all SF during the operational period. After the encapsulation is completed, the plant will be decommissioned, and radioactive decommissioning waste will be transported to the repository. The operational period for the encapsulation plant is 10 years and will close simultaneously with the cessation of repository operation.

Spent fuel will be encapsulated according to the Swedish concept. Fuel assemblies will be inserted and sealed into massive copper canisters. A canister is an approximately 1 m-diameter and 4.7 m-high cylinder with a 5 cm-thick anticorrosion overpack of copper. From the inside, it is reinforced by a cast iron insert, which can accept four PWR fuel assemblies. The insert also serves as a pressure-bearing component. After inserting the spent fuel assemblies into the canister, the lid of the canister is sealed by an electron beam welding machine.

The underground part of the repository is situated at a depth of 500 m below the ground surface. Alternatively, a depth of 800 m is also being considered. It consists of two areas: a central service area and a disposal area. The underground level can be reached in several ways: for personnel through a service shaft, for waste and other cargo through a spiral ramp (with at least a 15 m-curved radius to enable access by long vehicles, and a 10% slope), or alternatively through a vertical access shaft with an 8.0 m-clear diameter. The ramp is 5 km (alternatively 8 km) long, 7 m wide and 7 m high. The service shaft has 5 m of clear diameter. It contains two elevators (cages). The main cage will be used for the transportation of personnel and light equipment. The small cage will be used in the event of an emergency for personnel. Both cages may be used for shaft inspection. The service shaft is also used as part of the ventilation system (air intake). The repository is supplied with a 3 m wide ventilation shaft, which can serve as an emergency exit as well.

Out of the 571 disposal boreholes required to accommodate all the fuel canisters, only a few dozen are required to start operation. The rest will be drilled as required for waste emplacement activities.

Long-lived institutional LILW, decommissioning HLW and long-lived LILW from the Krško NPP, HLW and other RW from SFDS decommissioning, long-lived LILW and eventually HLW from the operation and decommissioning of the geological disposal facility and encapsulation plant will be disposed of in one of the abandoned vaults of the service area. Alternatively, a special repository room will be excavated approximately 70 m above transverse drift.

Decommissioning and closing activities will start after all spent fuel has been disposed of.

However, a part of the decommissioning and closure activities, i.e. the backfilling and sealing of the disposal vaults, will begin already during the operation of the repository. Decommissioning activities will last for 5 years, while closure activities will last for 2 years.

Active institutional control and maintenance of the repository is anticipated by the 2017 Act and the 2023 Resolution.

Active institutional control and maintenance will start after the closure of the repository, when all activities for transfer into institutional control have been completed and when the competent organisation takes over the repository for institutional control. It is presently assumed that active institutional control will last for 50 years after repository closure, but the duration of this phase will be determined subsequently on the basis of a safety analysis. Passive institutional control of the repository is planned as a type of surveillance primarily including activities regarding keeping the data on the repository and retaining the repository land ownership. The duration of passive institutional control is not yet defined; the actual duration will be determined on the basis of a safety analysis.

In 2023, a new revision of the HLW and SF Disposal Programme was begun. In this regard, two supporting studies are being prepared as part of the fourth revision of the Disposal Programme. The objectives of the revision regarding SF disposal are as follows:

- to update the overall cost estimate taking account of recent and current international developments in deep geological repositories and radioactive waste management costing methodologies;
- to extend the reference deep geological repository concepts by adding a repository in an argillaceous (clay) sedimentary formation;
- to update and adapt as necessary the work breakdown structure and engineering build-up itemisation used in the 2019 revision and revise the cost estimates for disposal in a deep geological repository using current data on the costs of activities, materials, etc;
- to explore the sensitivity of total costs and the times at which costs arise to varying certain key milestone dates;
- to provide more detailed costings for the whole SF-HLW programme when use is made of a multinational deep geological repository option for the whole Krško NPP inventory; and
- to provide more detailed costings for the whole SF-HLW programme when use is made of a deep borehole disposal solution (a complementary solution to a mined deep geological repository) for spent nuclear fuel.

Jožef Stefan Institute Reactor Infrastructure Centre

At present, no spent fuel from the TRIGA Mark II research reactor is planned for disposal. The future quantities of spent fuel depend on a decision to be made by the operator and owner of the research reactor concerning the operation of the reactor after 2026.

In 2021, a preliminary feasibility study on the disposal of TRIGA II research reactor SNF using a deep borehole disposal was prepared for the purpose of providing an initial assessment of deep borehole disposal and to carry out an assessment of the suitability and costs of this option. A detailed screening of Slovenian communities applying the geological site screening criteria has not been undertaken. Geological requirements were identified through existing high-level data reviews for palaeohydrological, geothermal heat flux and volcanism, climate change and seismicity factors.

Three disposal options were analysed:

- a vertical borehole drilled to a safe depth of 1.5 kilometres (assumed for generic costing purposes), with a very short vertical disposal section and using a standard canister with a diameter of 34 cm;
- developing a bespoke canister specially for the TRIGA II fuel elements, enabling the use of a significantly lower diameter borehole; and

- disposing of a standard canister with SF from the TRIGA Mark II research reactor as a marginal addition to a larger deep borehole repository that also disposes of the spent fuel from the Krško NPP.

Based on this preliminary assessment, the initial conclusion is that TRIGA II SF is suitable for deep borehole disposal, and that potentially suitable disposal areas exist in Slovenia. The optimum approach would involve disposing of the TRIGA II spent nuclear fuel in a larger deep borehole repository also capable of disposing of SNF from the Krško Nuclear Power Plant.

In the future, TRIGA Mark II research reactor spent nuclear fuel management will be arranged jointly with the spent fuel disposal of the Krško NPP unless the Government finds another solution.

SECTION I: TRANSBOUNDARY MOVEMENT

Article 27: Transboundary Movement

1. Each Contracting Party involved in transboundary movement shall take the appropriate steps to ensure that such movement is undertaken in a manner consistent with the provisions of this Convention and relevant binding international instruments.

In so doing:

(i) a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary movement is authorised and takes place only with the prior notification and consent of the State of destination,

(ii) transboundary movement through States of transit shall be subject to those international obligations which are relevant to the particular modes of transport utilised,

(iii) 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 spent fuel or the radioactive waste in a manner consistent with this Convention,

(iv) a Contracting Party which is a State of origin shall authorise a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement,

(v) a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made.

2. A Contracting Party shall not license the shipment of its spent fuel or radioactive waste to a destination south of latitude 60 degrees South for storage or disposal.

3. Nothing in this Convention prejudices or affects:

(i) the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law,

(ii) rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin,

(iii) the right of a Contracting Party to export its spent fuel for reprocessing,

(iv) rights of a Contracting Party to which spent fuel is exported for reprocessing to return, or provide for the return of, radioactive waste and other products resulting from reprocessing operations to the State of origin.

The Slovenian legislation (the 2017 Act and the Rules on Transboundary Shipments of Radioactive Waste and Spent Fuel) regarding the transboundary movement of radioactive waste and spent fuel is harmonised with Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel and with the Commission Decision of 5 March 2008 establishing the standard document for the supervision and control of shipments of radioactive waste and spent fuel referred to in Council Directive 2006/117/EURATOM.

Transboundary movement is covered in Articles 126–128 of the 2017 Act, Subparagraph 4.9, "Shipments into and out of EU Member States – The import, export and transit of nuclear and radioactive substances and radioactive waste."

The SNSA issues permits for the import from, export to, and shipment into and out of other EU Member States and the transit of certain radioactive and nuclear materials. Detailed provisions defining for which shipments a permit is necessary are stipulated in the 2017 Act and in the Rules on Transboundary Shipment of Nuclear and Other Radioactive Substances. It is necessary to obtain the SNSA's consent for shipments from and into other EU Member States and for licences for the import, export or transit of radioactive waste and spent fuel. Before issuing consent or a licence, the SNSA evaluates the measures relating to radiation and nuclear safety throughout the duration of the transport of radioactive waste and spent fuel from the place of origin to the final destination.

The SNSA may refuse to issue an approval for the import, export or transit of radioactive waste and spent fuel if it has concluded that the country of export or the country receiving the consignment does not have the technical, legal or administrative resources necessary for the safe handling of radioactive waste or spent fuel, such as for shipments to a destination south of latitude 60 degrees south.

The established legislation implements all obligations under Article 27 of the Convention.

Experiences

In the past, there were several transits performed on the territory of the Republic of Slovenia under the framework of the US and Russian research reactor spent fuel return programmes.

The last transits of nuclear material took place in October and November 2012, which was reported in the 5th Slovenian report under the Joint Convention. All those shipments were accomplished professionally and successfully within strong international cooperation, and by such Slovenia contributed to nuclear non-proliferation.

Besides these occasional transits, approximately every two years there is a shipment of radioactive waste from the Krško NPP that is sent for incineration and melting to another EU Member State. Signing the take back guarantee is one of the preconditions for acceptance of the waste by a foreign country. The last shipment was sent to Sweden in April 2024.

In 2023 there was also a shipment of dried blowdown ion exchange resins from Slovenia to the USA via Austria, Germany, the Netherlands and Canada. Due to noncompliance with the acceptance criteria for incineration in Sweden, the waste was exported to the USA. The SNSA issued an authorisation on the basis of Council Directive 2006/117/EURATOM after obtaining all the consents of the transit countries and the USA as the country of destination. To obtain confirmation from the country of destination, a diplomatic dialog between both countries was introduced and confirmation of the acceptance of secondary waste by the Slovenian authorities was given. The shipment was sent to the USA in November 2023. The company PermaFix will incinerate the waste and the secondary waste will be returned to Slovenia.

SECTION J: DISUSED SEALED SOURCES

Article 28: Disused Sealed Sources

1. *Each Contracting Party shall, in the framework of its national Act, take the appropriate steps to ensure that the possession, re-manufacturing or disposal of disused sealed sources takes place in a safe manner.*
2. *A Contracting Party shall allow for re-entry into its territory of disused sealed sources if, in the framework of its national Act, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources.*

In the Republic of Slovenia, radioactive sealed sources are used in medicine, industry and research applications. Minor quantities are also used by certain state institutions (e.g. customs, the police and the army).

Licensing is required for all activities dealing with sealed sources: for shipments from and to other EU Member States (endorsement of special forms, based on Council Regulation (Euratom) No. 1493/93, for import or export, for carrying out a radiation practice, for use, or for transport or transit – the last two based mainly on the activity of the sealed sources. The competent authorities (the SNSA and the SRPA) keep records on sealed sources (and other sources, too) in use.

In accordance with Article 170 of the 2017 Act, a register of radiation practices and a register of radiation sources shall be maintained. The registers shall be maintained as public registers by the SNSA, except for the register of radiation practices and of radiation sources in health and veterinary care, which shall be maintained as a public register by the SRPA. The contents of the registers are prescribed in Article 171 of the 2017 Act and in Chapter VI of the Rules on the Use of Radiation Sources.

The aforementioned Rules also set a basis for the termination of the use of radioactive sources. A person carrying out a radiation practice who terminates the use of a radioactive source shall report this, within 15 days, to the SNSA or the SRPA, as appropriate. Where radioactive sources are involved, a person carrying out a practice involving radiation shall hand them over, within three months, to the ARAO or to another holder of a licence to carry out a radiation practice, or return them to the manufacturer or supplier. A person carrying out a radiation practice shall, within eight days of the transfer of a radioactive source, send a notification, i.e. a document on the transfer of the radioactive source that records the transfer of the radioactive source to another person, to the SNSA or the SRPA, as appropriate.

When sealed sources are no longer in use, they become disused. Since 1986, disused and spent sealed radioactive sources from small producers have been stored at the Central Storage Facility for Radioactive Waste in Brinje. In 1999, the national public service for managing waste from small producers was established by a governmental decree. The ARAO, being assigned to perform this public service, became responsible for operating the storage and management of waste and disused sealed sources from small producers.

Until 2000, the acceptance of waste for storage was free of charge. Since then, according to the "polluter pays" principle, each waste producer or holder has had to pay a fee for the acceptance of a radioactive waste/disused radioactive source. If the waste producer or holder is not known, the expenses are covered from the national budget. When accepted into the Central Storage Facility for Radioactive Waste in Brinje, the liabilities for the disused radioactive source are transferred to the ARAO, which becomes responsible for the further management of the disused and spent sealed radioactive source, including future disposal. Under certain conditions, sources transferred to this storage could be returned to the interested Slovenian users (e.g. devices for industrial radiography or powdered U-substances used for e-microscopy) or even sent abroad (e.g. ionisation smoke detectors or empty devices for industrial radiography, encompassing depleted uranium).

The Republic of Slovenia is not a significant producer of sealed sources. The JSI has practically ceased the production of sealed radioactive sources for the domestic market (no such sources have been produced since the First Report under the Convention in 2003), so the return of exported sources is essentially a hypothetical issue. The JSI, from time to time, has sent (back) to some other European Union or other countries different activated, still radioactive, "products" which are, on the other hand, not typical sealed sources (e.g. activated teeth (^{32}P), irradiated e-components (^{182}Ta), etc.).

However, already back in 2003 the SNSA started an action to promote the transfer of disused sealed radioactive sources that remain with their former users to the ARAO. As a result, several hundred sealed radioactive sources of various activities have been transferred since then, including calibration sources and "historical sources". In addition, many radioactive sources and items with added radionuclides once used in defence (e.g. compasses) have been transferred, appropriately treated and safely stored at the Central Storage Facility for Radioactive Waste in Brinje since then. Disused sealed sources from industrial radiography (^{192}Ir and ^{75}Se; also one case with ^{60}Co) or brachytherapy (^{192}Ir) of high-activity (i.e. Category 2 at the time of manufacturing) have been returned to the foreign suppliers. Those companies that predominantly use ^{192}Ir in industrial radiography replace decayed sources with new ones almost annually. ^{192}Ir, used in brachytherapy, is replaced several times per year. There are up to 20 transfers of such sources per year. In addition, the number of disused ionisation smoke detectors, with mainly ^{241}Am transferred to the Central Storage Facility, amounted to more than 30,200 pieces in the period 2010-2023. The SNSA's inspectors have conducted over 100 different inspections with regard to such smoke detectors – and the pertinent supervision was intensified in particular after 2010. In 2020, a summary (analytical) report on the status of ionisation smoke detectors in Slovenia was issued (prepared by the SNSA's staff).

Disused sealed sources are one of the regular themes in Radiation News (*Sevalne novice* in Slovenian), which is distributed quarterly to users of radiation sources and other stakeholders in the country. The SNSA, as the main author and distributor of Radiation News, assesses that in nearly 20 years this flagship outreach activity has proved itself to be a positive approach with added value.

A noteworthy shipment of a high-activity sealed radioactive source took place in 2023. In June, disused ^{137}Cs (around 30 TBq) was properly packed and shipped (one-way) to neighbouring Hungary. It was the most radioactive domestic source outside nuclear facilities. All the licensing and inspection control was conducted by the SRPA. The SNSA followed the loading and start of transport (observer, expert support, together with the ARAO). By removing this source with alternative technology, domestic risk(s) may be slightly lower, having in mind unauthorised misuse or malicious purposes.

Figure 20: **Outgoing shipment of ^{137}Cs in a type B(U) package, accomplished in 2023**

Disused sealed sources (and other contaminated items) can also enter into the scrap metal recycling stream. This happens practically everywhere in the world. The Slovenian experience shows that most cases of orphan sources are related to the import of scrap metal into Slovenia and to the transit of such material through the country. In order to minimise the number of sources outside regulatory control, several regulatory and law enforcement measures have been implemented. Customs and police officers are equipped with various radiation detection devices in order to prevent illicit trafficking and other unauthorised activities. Since 2002, the SNSA has had an officer on duty 24 hours a day to give advice in the event of the discovery of orphan sources or elevated radiation levels. Major scrap metal dealers and recyclers are equipped with portal monitors and various hand-held radiation detection equipment. The current Decree on Checking the Radioactivity of Consignments that Could Contain Orphan Sources (in force since 2020) stipulates a set of measures for particular organisations measuring scrap metal and other goods (including at some major nodal points). When drafting this decree, Council Directive 2013/59/Euratom was also considered as one of the starting points. The broader scope includes different organisations (e.g. national airports and ports) to set up appropriate detection capabilities. Such measurements shall be performed only by certified organisations (there are approximately 35 of them at the time of writing this report), and the number is significantly higher than previously. The experiences gained throughout several years is fairly positive and the awareness thereof, including an adequate response, has improved in this regard. All the authorised organisations have to provide annual reports. The number of orphan sources that end up in the CSF is on the order of three per year. In addition, each year a handful of cases may occur that encompass the return of shipments with orphan sources (spent radioactive sources) transiting through Slovenia and being detected and denied by the neighbouring countries or discovered in Slovenia and denied and subsequently returned to the country of origin ("originator/polluter").

SECTION K: GENERAL EFFORTS TO IMPROVE SAFETY

This section addresses the challenges and planned actions to improve safety that were listed in the rapporteur's report on Slovenia at the end of the last (7th) Joint Convention review meeting.

Retaining the technical capabilities of nuclear institutions, including the regulatory body, recruiting and retaining staff for nuclear back-end related entities

Retaining the technical capabilities of nuclear institutions, including the regulatory body, is a constant challenge for countries with small nuclear programmes. Knowledge and competency management is becoming increasingly important with the ageing of the existing regulatory and other institutional staff.

In recent years, the SNSA increased and improved the training programme by the implementation of a systematic approach to training. The SNSA devotes attention to education and training by monitoring and developing the careers of its employees and continuously offering them possibilities for improving their professional skills. In particular, each employee has to attend a two-month course entitled Fundamentals of Nuclear Technology. In addition, employees spend on average two to three weeks annually attending international workshops or technical meetings from their area of expertise.

The financial situation in Slovenia has improved in the last few years; budgetary funds provided to the SNSA are again at the normal level and stable; extra budgetary financial resources of the SNSA obtained on the basis of its cooperation and work on various projects to assist third countries, as tendered by the IAEA and the European Commission, represent an important share of the total amount of funding. For this reason, since 2017 the SNSA has been able to again finance some research and development necessary for the administrative control of radioactive waste and spent fuel management.

Since June 2023, the Government of the Republic of Slovenia has been actively involved in the new nuclear power plant project. A dedicated State Secretary to the Prime Minister's cabinet is leading a working group comprising ministries, the investor, the regulatory body (the SNSA), the operator of Slovenia's electric power transmission network (ELES) and the Krško NPP. In addition, the Prime Minister's cabinet together with the Ministry of the Environment, Climate and Energy prepared a national strategic document, namely the Resolution on the Long-Term Peaceful Use of Nuclear Energy in Slovenia. The resolution has been approved by the Government and sent to the Parliament for adoption. Notably, the resolution underscores a commitment to a high level of nuclear and radiation safety.

In February 2024, the SNSA organised an all-day working meeting on the challenges of nuclear and radiation safety on the topic "*Preparedness for the Development and Use of Nuclear Energy in Slovenia*". The aim of the meeting was to determine the readiness of Slovenia (state authorities, educational and research organisations and industry) for the development and use of nuclear energy, with a focus on the implementation of the new nuclear power plant project. The meeting was attended by approximately 90 experts from all prominent Slovenian organisations dealing with nuclear and radiation safety. Experts presented their activities and vision of their work on the new nuclear power plant project, with particular emphasis on the number and competency of experts in these fields. All stakeholders agreed that the field of nuclear and radiation technologies is currently understaffed and that the development of the necessary human resources and the timely empowerment of all stakeholders is one of the main activities needed in relation to the new nuclear power plant project. Constructive cooperation between governmental authorities, educational and research organisations and industry is one of the main messages of this meeting.

The SNSA started to prepare a research and development strategy in the field of nuclear and radiation safety in Slovenia. A research and development strategy in the field of nuclear and radiation safety in Slovenia would determine where the country stands as regards research and which research areas in Slovenia need to be developed in the future. A common strategy for such research and development would help reduce the dispersion of areas and help secure adequate funding.

In past years, the SNSA investigated the possibility of establishing a special fund for financing appropriate research and development in the area of nuclear technologies, including radioactive and spent fuel management. During the collection of data to support such a project, it became evident that the nuclear industry and the national budget annually conclude contracts with research, development and engineering organisations and companies in Slovenia with a total value sufficient to support approximately 100 man/year of work. Such a level of financing of domestic institutions, which has also been stable over the years, ensures the reasonable stability of the nuclear expertise inside the country.

In 2020, the SNSA adopted a *Research and Development Strategy at the SNSA*, which was prepared with the aim of defining a multi-annual orientation towards research on and the development of nuclear and radiation safety to support the administrative control of nuclear and radiation safety, including radioactive waste and spent fuel management. On the basis of this document, the SNSA prepares annual operational research and development plans. In 2023, the SNSA carried out a project to assess all its duties and needed competencies and staff to perform adequately these duties and compare the SNSA organisation (the fields of expertise and number of experts) with foreign regulatory authorities that have a similar workload. Together with the needs (competences and staff) analysis for the new nuclear power plant, this shows two things. Firstly, the needs regarding where to supplement the competencies of SNSA employees to ensure that they have the necessary competencies to perform their tasks were identified. On this basis, an annual training and development plan was drawn up. The second question was whether the SNSA has enough employees to perform all the necessary tasks. The needs analysis showed that there are not enough employees; therefore, the SNSA must either adapt processes or hire new employees taking into the account the limits of the higher-level governmental and ministry's personnel plan.

In addition to the needs analysis, the SNSA has systematic training and other human resources processes in place to support the recruitment and induction of new staff, as well as to ensure the career development of staff and their retention at the SNSA.

The SNSA has a system for ensuring competencies and optimising the internal organisation, called SAT-URSJV. It systematically defines the competencies required for each position. The competencies are based on the work tasks, which are also defined for each position based on years of experience. This is based on the SNSA management manual, which defines the processes based on which the work tasks are then defined in more detail. The success of the training is reviewed in annual interviews (appraisals), in which the employees' skills are also tested. On this basis, the SNSA training plan is drawn up and approved for each process and the specifics of each workplace. Particular attention is devoted to newly recruited employees, for whom a special training plan is drawn up. Monitoring the professional development of employees is also an important component. In addition to the necessary training for the continuous development of competencies, the career plan also includes a development plan and a promotion system tailored to the skills of the staff and the needs of the SNSA.

The main elements of retaining staff are, in addition to numerous training possibilities, the development of professional competencies and international networking, and also work at home and plenty of vacations, which in practise employees can take more or less when it suits them. These are the elements where the SNSA has a big advantage over other companies in Slovenia, and partly also over foreign companies, because not many companies can offer all this in such a package. This can somewhat cover the disadvantages, which is mainly a lower salary than the competition.

In December 2022, the Slovenian Government approved the ARAO long-term work programme for the period 2023–2027. An important part of the long-term programme is the personnel plan, which is crucial for the implementation of the planned activities. In accordance with the reorganisation and planned needs for professional staff, the ARAO is preparing a new systematisation of jobs. Due to the greater volume of work in the period 2023-2027, new jobs are planned, which are necessary for the implementation of ARAO tasks in the field of the construction and operation of the Vrbina LILW repository and the implementation of the long-term institution control and maintenance of the closed disposal sites Jazbec and Boršt. Additional requirements for new jobs were also included due to 2023 Resolution measures for its implementation. The need for additional personnel to perform public service tasks was also recognised within the 2022 ARTEMIS mission review of the national programme for RW management. In the final report of the mission, the expert review group made an expert proposal that the Government of the Republic of Slovenia ensure adequate staffing of the ARAO in fulfilling its obligations for the safe management of RW and SF.

When planning ARAO staffing, it is largely considered that these are very specific jobs, for which additional training is necessary, which takes place over a long period of time, usually also abroad at similar facilities. In accordance with the personnel plan, it is planned that a total of 40 people will be employed at the ARAO on 1 January 2027. At the end of 2023, 24 people were employed, and an additional 4 will start working in April 2024. With the approval of the ARAO long-term work programme, financial resources for employing the planned 40 people were also secured.

The SRPA is continuing the development and implementation of the safety-oriented regulatory system at all levels of its activities. In this regard, the SRPA will follow the action plan according to IRRS and EPREV findings and further develop its management system.

The Krško NPP has established systematic training and human resource processes to support the recruitment of new staff and the transfer of knowledge to the younger generation. Acquiring new and additional knowledge and developing competencies is one of the priorities and is supported by the management. Regardless of this, for the next period, the development of personnel potential is one of the Krško NPP's focus areas.

Operating the TRIGA reactor, which was commissioned in 1966, is a challenge in itself. It is true that most of the components were replaced or modified through the years. However, ensuring safe operation for future years requires constant upgrading and modernisation. In the following years, the major challenge will be replacing the I&C system. The current one is over 30 years old and spare parts are no longer available. The next challenge is the fuel, which is over 50 years old and the need to carefully monitor its performance. Lastly, the major challenge is constantly changing legislation, which is getting stricter each year. This means more paperwork for a small team responsible for reactor operation and, in some cases, installing new systems or components which are not easy to embed in the current site configuration.

The Agreement with Croatia on the decommissioning of the NPP, the disposal of RW, and the management of SF

Since 2003, joint ownership of the Krško NPP has been regulated by the Intergovernmental Agreement, which, *inter alia*, states that management of RW and SF are the joint responsibility of the contracting parties, who must ensure an effective joint solution to the management of RW and SF from economic and environmental protection perspectives.

Pursuant to this Agreement, both parties are equally responsible for ensuring all material conditions, and the Republic of Slovenia is solely responsible for the control of nuclear and radiation safety. The parties agree on the common obligation to provide an effective joint solution to Krško NPP decommissioning and the disposal of RW and SF from an economic and environmental protection standpoint. The agreement stipulates that the decommissioning and disposal of RW and SF from the operation and decommissioning of the Krško NPP will be carried out in accordance with a disposal programme and a decommissioning programme, which should be revised at least every five years. The decommissioning programme should also be approved by the SNSA.

The programmes should be confirmed by the Intergovernmental Commission, which is formed by the contracting parties in order to monitor the implementation of the Intergovernmental Agreement and initiate other businesses in accordance with the Intergovernmental Agreement. An equal number of Intergovernmental Commission members are appointed by both sides. The Krško NPP Decommissioning Programme and the Programme for the Disposal of the RW and SF from the Krško NPP are the key enforcement mechanisms of the Agreement regarding decommissioning as well as RW and SF management.

The second revision of the Decommissioning Programme of the Krško NPP and the Disposal of LILW and HLW, which was prepared in 2011, has not been discussed or approved by the Intergovernmental Commission for monitoring the implementation of the Bilateral Slovenian-Croatian Agreement on the Krško NPP. In 2015, the Commission decided to suspend all activities in connection with the drawing up of this Programme and identified the need to draft a new revision of the Krško NPP Decommissioning Programme and the Programme for the Disposal of the RW and SF from the Krško NPP.

In 2016, a new revision of the Krško NPP Decommissioning Programme of the Krško NPP Radioactive Waste and Spent Fuel Disposal Programme started. The ARAO and the Croatian Fund were appointed to prepare the new Programme for the Disposal of the RW and SF from the Krško NPP and the Krško NPP was appointed to prepare the Krško NPP Decommissioning Programme. The Intergovernmental Commission also appointed a Project Implementation Coordination Committee, with four members from each side, to monitor the preparation of both Programmes and search for possibilities for the joint disposal of Slovenian and Croatian radioactive waste from the Krško NPP.

After searching for possibilities for the joint disposal of Slovenian and Croatian radioactive waste from the Krško NPP in 2018 and 2019, it was determined by the Intergovernmental Commission in September 2019 that a joint solution to the disposal of LILW was not possible and consequently such waste will be divided in half and each country will proceed to develop its own disposal capabilities.

In 2019, the third revision of the Krško NPP Decommissioning Programme and the third revision of the Programme for the Disposal of the RW and SF from the Krško NPP were completed. The third revision of the Krško NPP decommissioning Programme was prepared according to the "immediate dismantling" decommissioning strategy after final shutdown in 2043. After administrative procedures in both countries, the Intergovernmental Commission approved the third revision of the Decommissioning Programme and Disposal Programme in July 2020.

In these documents, annuities for each country are calculated and presented with respect to the internal rate of return.

By a decision of the Slovenian Government, the Slovenian electrical power company GEN energija d.o.o. should continue to contribute to the Slovenian fund for financing one half of the decommissioning and spent fuel and radioactive waste disposal with payments increased from the previous rate of 0.30 euro cents per kWhe to 0.48 euro cents per kWhe starting 1 August 2020 and since 1 January 2022 the payment was additional increased to 1.2 euro cents per kWhe until the next revisions of the Programmes are approved.

The fourth revision of the programme is currently under preparation.

Based on the existing Slovenian-Croatian Intergovernmental Agreement and conclusions from the meeting of the Intergovernmental Commission held in July 2015, the construction of a dry storage facility at the Krško NPP site is part of a joint solution to spent fuel management disposal until 2043. The construction and operation of the dry storage facility until 2043 should be financed from the Krško NPP's operational costs. Regarding the storage of HLW and SF after the cessation of the operations of the Krško NPP in 2043, negotiations will be ongoing, with the current plan being to develop a joint solution that involves either a repository in one of the countries, or joint participation in regional or multinational repository initiatives.

In October 2023, the Intergovernmental Commission decided that the division and takeover of LILW from the Krško NPP by the ARAO and the Croatian Fund will start in 2028, instead of at the end of 2023, as the previously scheduled deadline. The Intergovernmental Commission has therefore tasked this the ARAO and the Croatian Fund.

This is due to the delay in the construction of the repository in Vrbina near Krško and the long-term storage facility in Čerkezovac, Croatia, which will not be realised by 2025. The Intergovernmental Commission therefore instructs the Croatian Fund and the ARAO to start as soon as possible the construction of the long-term storage facility in Čerkezovac and the LILW repository in Vrbina, and to start the takeover of the LILW from the Krško NPP by the beginning of 2028 at the latest. The Intergovernmental Commission also instructs the Krško NPP to continue with the implementation of all activities and, if necessary, to initiate new activities that are necessary and feasible to ensure sufficient LILW storage capacity, with the aim of bridging the start of the takeover of LILW from 2023 to the beginning of 2028. In accordance with the signed contracts with the Croatian Fund and the ARAO, the Krško NPP will ensure the preparation of the takeover packages.

Timely Commissioning and Operation of the National LILW Repository

The timely construction of the LILW repository and LILW takeover by the ARAO and the Croatian Fund is essential for the normal operation of the NPP. The Waste Manipulation Building (WMB) for handling waste was constructed and put into operation in 2018. With its construction, the plant is provided with new premises for radwaste operations. Moving equipment out of the Solid Radwaste Storage Facility into the WMB and packages with solid noncompressible radwaste into the DB will release an additional storage space for the period until the repository is operational.

In a process that had taken place since November 2004 and in which the public had also been intensively involved, the location of the LILW repository was selected in December 2009, with the adoption of the Decree on the National Spatial Plan for the LILW repository at the Vrbina site in the Municipality of Krško.

The conceptual design of the LILW repository was drawn up in 2016 on the basis of the design of the project for the acquisition of a construction permit and as an appendix to the application for obtaining an environmental permit. The process of cross-border environmental impact assessment and the process of environmental approval in Slovenia took place between 2019 and 2021 and the environmental permit was issued in July 2021.

For the construction permit, a Safety Report was prepared, which was approved by the SNSA in 2022. Together with the documentation for the construction and environmental permit, the procedure for gaining the permit lasted from 2020 to 2022/23. The construction permit for the nuclear facility was issued in 2022, while the construction permit for the infrastructure was gained early in 2023.

The contractors for the construction of the infrastructure for the LILW repository and concrete containers were selected in 2023. The contractors for the nuclear facility were also selected in 2024. The repository operator will be the ARAO, as the provider of radioactive waste management as a mandatory service of general economic interest.

The construction of the infrastructure part of the repository started in August 2023. The repository is planned to be built in three and a half years. During this period, one disposal silo, all technological and other facilities, and the associated infrastructure will be built. After that, trial operation is planned. According to Rules JV5, for a radioactive waste repository, consent for the facility's trial operation shall be construed to be a permit for the disposal of radioactive waste, while the possibility of removing waste from the disposal facility and recovery of the facility's original state has to be ensured. During trial operation, tests and experiments on the constructed and operation-ready repository will be carried out in order to verify and determine the compliance of the repository operation and system structure and components with the approved design solutions and the required design conditions.

Regular operation is planned for the beginning of 2028 after the successful completion of the trial operation period and an operating permit has been obtained. On the basis of this permit, the repository will be put into regular operation. It is assumed that in the first phase of operation, LILW that was generated before the start of the repository standby phase will be disposed of. In this phase around 80% of Slovenia's share of operational waste from the Krško NPP and 57% of Slovenian institutional waste will be disposed of.

In 2030, the repository will enter into the standby phase, when the existing storage facility at the Krško NPP is used for the temporary storage of operational waste.

The repository is planned to re-start operation in 2050, when disposal will take place for the remaining Slovenian share of operating waste generated by the Krško NPP, the remaining Slovenian institutional waste, as well as the waste generated during the decommissioning of the Krško NPP until 2058.

After the adoption of the decision on the final closure of the repository after the decommissioning of the Krško NPP, the decommissioning and closing of the repository will be initiated. Decommissioning of the repository is provisionally planned for 2058. It will be carried out only for the technological facilities. The closure of the disposal silo is planned for 2059. After closure, the repository will enter the period of post-closure institutional control and maintenance (see Article 17).

See also Sections G and H.

The long-term management of the Boršt former uranium milling site, including the achievement of an acceptable closure licence

The uranium mine ceased operation in the summer of 1990. The environmental remediation project, which ensures conditions for the closure of mining facilities, is carried out by the public company Žirovski Vrh Mine d.o.o. The long-term surveillance and maintenance of the mine waste disposal site and hydro-metallurgical tailings disposal site after their closure is ensured by the ARAO, the provider of the mandatory service of general economic interest. Environmental remediation and long-term management activities are financed from the national budget.

All surfaces in the mining area affected by uranium production have been decontaminated and have been returned to unrestricted land use. The contaminated material produced by mining, uranium ore processing and decontamination has been disposed of at two disposal sites nearby the mine: the Jazbec mine waste disposal site and the Boršt hydro-metallurgical tailings disposal site.

Closure works at the Jazbec disposal site have been completed and the ARAO started the long-term surveillance and maintenance of the site in 2015.

The Boršt hydro-metallurgical tailings disposal site is situated on a hillside and the closure of this facility has been delayed due to the activation of a landslide and the required additional remediation works. The rate of sliding of the base of the Boršt hydro-metallurgical tailings disposal site is measured in real time, using a GPS system and geodetic networks.

Two studies were carried out in 2015 and 2016. In the first study, the distribution of tailings in the case of an extraordinary event (e.g. intensive rain or an earthquake) was assessed. On the basis of the study, the Ministry of the Environment and Spatial Planning ordered an additional study on the radiation exposure of residents and the workers who would carry out remediation of the deposited material on the riverbeds of the Todraščica, Brebovščica and Poljanska Sora Rivers.

In the meantime, additional intervention measures for reducing the velocity of the landslide's movements were performed in 2016 and 2017. The new drainage holes, in the passageway of the tunnel under the hydro-metallurgical tailings of the Boršt site were added to the existing drainage system. In 2019, the monitoring network of the Boršt hydro-metallurgical tailings disposal site was renovated and upgraded with nine additional deep piezometers.

In 2021, an additional study was carried out in order to assess the consequences of the worst-case scenario of an extraordinary event (extreme rainfall combined with an earthquake) in terms of radiation protection and an assessment of the additional radiation exposure of the residents and workers carrying out remediation. The authors of the study concluded that only a fraction of the landslide material would travel to the valley, and the damming of the stream in terms of total damming would not occur.

The safety report on the Boršt hydro-metallurgical tailings disposal site is under revision. The results of all the studies were included in the revised safety report. The safety report provides measures to remedy such a very unlikely event. This document is the basic document for the closure of the disposal site and the transition to long-term surveillance and maintenance, which will be carried out by the ARAO as part of the mandatory service of general economic interest.

Resolution on the National Programme

A new revision of the Resolution on the National Programme was published in January 2023.

In September 2021, the ARAO prepared expert bases for updating the national programme for radioactive waste and spent fuel management for the period 2023-2032. After the coordination process with key stakeholders, the expert bases were submitted as a draft of the 2023 Resolution in a one-month public consultation procedure, which ended in March 2022. The draft of the 2023 Resolution has been in line with the scope of the ARTEMIS terms of the reference part of the ARTEMIS advanced reference materials and subject to expert review. The comments and suggestions collected through the public consultation procedure and through the recommendations and findings of the ARTEMIS expert review team have been used to amend the draft of the 2023 Resolution for the adoption by the Slovenian Government in October 2022 and final approval by the National Assembly in January 2023.

The 2023 Resolution has been drafted as a continuation and update of the 2016 Resolution to remedy a few instances of non-compliance with EU Directive 2011/70/Euratom, pursuant to the 2017 Act and all the regulations adopted on its basis. The 2023 Resolution has been adopted primarily due to the improved estimates of radioactive waste and spent fuel inventories for all facilities and practices throughout the period of validity. Since the adoption of the 2016 Resolution, the majority of key input documents estimating the quantities of radioactive waste and spent fuel during operation and decommissioning have been supplemented and key milestones for particular activities have changed.

The management of radioactive waste and spent fuel is based on the current concept, as applied in the 2016 Resolution. No new or different facilities for managing radioactive waste and spent fuel are planned. In accordance with the requirements of the applicable legislation, the assessments of environmental impact in Slovenia and transboundary environmental impact have been carried out and, based on these assessments, relevant environmental approvals have been issued for the facilities discussed in the 2023 Resolution. Key performance indicators for achieving the main objectives and 2023 Resolution strategies have been added to enable more effective monitoring of the progress and implementation of the planned measures.

The development of Key Performance Indicators (KPIs) was driven by the intention that they are simple enough and easy to monitor and as precise as possible. On the other hand, KPIs were developed as a tool for quantitatively measuring progress towards reaching the goals and objectives of the strategies, and to evaluate the need to initiate further steering actions. In the 2023 Resolution, altogether 53 KPIs were identified.

Once a year, the SNSA collects information from individual organisations responsible for the implementation of measures. Reports of all measures and achieving KPIs are a part of the SNSA's Annual Report on Radiation and Nuclear Safety adopted by the Slovenian Government and submitted to the National Assembly of the Republic of Slovenia. The report must effectively describe the progress of the implementation of the measures and identify why the KPIs may not have been achieved and indicate possibilities to improve the measures and the KPIs, with a view to preparing the update of the ReNPROIG-23-32.

Completion for 3rd Periodic Safety Review of the Krško NPP

The Periodic Safety Review (PSR) is a systematic safety reassessment, with a primary means to assess the cumulative effects of plant aging and plant modifications, operating experience, technical developments and siting aspects. In the current, internationally accepted, safety philosophy, periodic safety reviews (PSRs) are comprehensive reviews aimed at the verification that an operating NPP remains safe when judged against current safety objectives and practices and that adequate arrangements are in place to maintain an acceptable level of safety. In practice, PSRs are required by law and conducted every ten years. The 3rd PSR project (PSR3) for the Krško NPP was initiated per the requirements of the 2017 Act. The PSR3 for the Krško NPP started in 2020 and was finished in December 2023. The global safety assessment showed significant improvement of the Krško NPP's safety since the previous PSR2 and that is a result of safety improvements made within the Krško NPP's safety upgrade programme. The implementation of a periodic safety review was the last condition for the long-term operation of the Krško NPP, as required by the SNSA. Under the PSR3, Safety Factor 16 (Radioactive Waste and Spent Fuel) was reviewed in order to address all relevant aspects relating to the Krško NPP radioactive waste and spent fuel management. Under this review, seven issues were identified that are included in the implementation action plan and are to be resolved by the end of 2028.

Completing the Licensing Process for Building and the Operation for the LILW Disposal Facility

In July 2019, an application was submitted to the SNSA for the issuance of the consent for the construction permit. In 2020 and 2021, the documentation was intensively reviewed and updated. All safety-related documentation was independently reviewed by a technical support organisation. Additionally, an expert in the area of the application of concrete, appointed by the SNSA, actively monitored the study of the production, suitability, and characteristics of the final concrete mixtures for the implementation of the secondary reinforced concrete lining of the LILW repository silo and participated in the review of the documentation for the issuance of construction consent, which related to concrete structures, the properties thereof, and processes affecting the long-term safety of the repository. The expert concluded its review in August 2021, when a final opinion was delivered.

In November 2021, the ARAO submitted the final version of the safety report for obtaining a construction permit and the SNSA's opinion regarding the construction of the LILW repository. The consent was issued by the SNSA in February 2022. At the same time, the decision on the designation of the status of nuclear facility and the decision on the status of the state infrastructure facility were also issued. The construction permit for the repository facilities of the LILW repository was issued in July 2022, but due to the filing of a lawsuit it was final only in 2023. The construction permit for the infrastructure facilities of the LILW repository was issued in 2023.

Implementation of the Outcomes of the IRRS/ARTEMIS mission in 2022

The IRRS mission took place on the premises of the SNSA from 4 to 14 April 2022 to review the Slovenian governmental, legal and regulatory framework for nuclear and radiation safety against the relevant IAEA safety standards including an overview of the organisation and functioning of both of the two relevant regulatory authorities in this area, the SNSA and the SRPA (full scope mission). The mission was organised back-to-back with an ARTEMIS mission.

The mission verified the performance of regulatory procedures in the national nuclear and radiation facilities and for this purpose the reviewers also participated in inspections at the Krško NPP, the JSI, the Institute of Oncology Ljubljana and the Central Storage for Radwaste in Brinje. They also visited the Minister of the Environment and the Minister of Health; both confirmed the obligation of the Government and of both ministries to ensure the independent work of the SNSA and the SRPA and agreed the necessary reinforcement of the staff thereof.

The basis for the review was a comprehensive self-assessment of the SNSA and the SRPA on the status in all areas of the mission review. The mission consisted of fourteen experts from twelve countries: Romania, Switzerland, France, Malta, Ireland, Sweden, Brazil, Slovakia, Finland, Pakistan, Hungary, and Lithuania, as well as one observer and three members of the IAEA Secretariat.

The mission summed up its findings in 20 Recommendations, which expressed inconsistencies or significant deviations from international standards, whereas the so-called Suggestions (the reviewers issued 21 thereof) represented minor discrepancies from international standards and were intended to improve the existing situation. The mission report also stated one example of Good Practice and three examples of Good Performance.

Besides the strong commitment and dedication of both the SNSA and SRPA staff, the importance of the Government ensuring that sufficient funding and human resources are provided to both authorities to enable them to fulfil their responsibilities was recognised by the IRRS mission. Some of the recommendations and suggestions were in light of a possible decision to build a new nuclear power plant in Slovenia, i.e. on licensing processes, the development of regulations, NPP design requirements and commissioning. The IRRS mission included policy issues on the implications of the Covid-19 pandemic and regulatory challenges in the context of a possible new build. A good practice in the SNSA's activities related to emergency exercises with cyber security scenarios was identified as well as several areas of good performance. The mission also commended the good working environment. The mission report is available to the public on the SNSA webpage.

The SNSA and the SRPA prepared Action Plans for the fulfilment of the recommendations and suggestions received by the IRRS mission. After all the actions are implemented, the Government of the Republic of Slovenia will invite the IRRS Follow-Up Mission to review the progress of the implementation thereof.

The SNSA and the SRPA started to implement the Action Plan intensively after the mission. The independence of the two regulatory bodies has already been emphasised in the new Resolution on Nuclear and Radiation Safety in the Republic of Slovenia for the Period 2024–2033, adopted in 2023. The requirement that authorised expert organisations inform the SNSA and the SRPA in advance of subcontracting activities or personnel changes is addressed in the new Rules on authorised radiation and nuclear safety experts (JV3). The Decree on Radiation Activities (UV1) has been revised so that similar activities no longer require more licences from the SNSA and the SRPA. A new revision of the Rules on Operational Safety of Radiation or Nuclear Facilities (JV9) has been finalised and includes a provision on non-radiological risks and also the Rules on radiation and nuclear safety factors (JV5) with provisions on human factors and human-machine interfaces and the preparation of the commissioning programme for a new nuclear installation. Guidance on the treatment of human intrusion scenarios for the ARAO has also been added such that it is taken into account before the next update of the safety analysis for the LILW repository. A few more actions have been completed following additional proposals from the mission.

There was a short time interval between the missions to make use of synergies between the two missions (back-to-back missions). The IRRS mission dealt with the ARTEMIS mission topics in terms of the role and responsibilities of the regulatory authority, the legal framework in the subject area, as well as the governmental responsibilities (i.e. how the competences were delegated to the regulatory body). Thus, ARTEMIS need not duplicate discussion on these topics, and Requirement 10 of GSR Part 1 was comprehensively covered in the ARTEMIS mission. IAEA Guidance on back-to-back missions was clear in terms of the preparation of materials (ARM).

The Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) team concluded a nine-day mission to Slovenia in May 2022. The ARTEMIS review has provided an independent international evaluation of Slovenia's radioactive waste and spent fuel management programme. The mission, carried out at the request of the Government of Slovenia, was hosted by the ARAO. It was the first time that the IAEA organised the ARTEMIS mission back-to-back with an IRRS mission, which was conducted in April 2022, which offered the expert team the opportunity to take into account the IRRS findings on the legal and regulatory oversight of activities, facilities and exposure situations in the field of radioactive waste and spent fuel management. From the Slovenian perspective, the most positive experience was the optimisation of the time allocated. A part of the planned content which refers to the administrative framework for dealing with radioactive waste and spent fuel was discussed and reviewed as part of the IRRS Mission. The remaining part was then addressed as part of the ARTEMIS mission. For this purpose, the SNSA and the ARAO participated in the organisation of both missions and the preparation of materials. Continuity between the missions was assured by the common reviewer. The IRRS reviewer of the radioactive waste management area was the ARTEMIS Team Leader, which turned out to be very efficient.

The ARTEMIS team of experts said that Slovenia has a comprehensive, robust and well-functioning system for spent fuel and radioactive waste management, while also noting areas where it could be further enhanced. The ARTEMIS team acknowledged that Slovenia will need to meet a number of critical milestones and objectives within the next years and needs to address the challenges in managing the operational and decommissioning waste from the Krško NPP by planning and developing the required infrastructure that is needed as its programme for the management of radioactive waste and spent fuel expands. The experts found Slovenia to have an exemplary commitment to the proactive pursuit of a wide range of opportunities for waste minimisation across all forms of radioactive waste.

The team also made a few recommendations and suggestions, including:

- the Government should coordinate all stakeholders in the National Programme to find mutually acceptable waste management solutions addressing legal agreements and physical constraints on continued waste storage that do not jeopardise the final disposal arrangements at the Vrbina repository;
- with regard to human resources, the review team suggested to the Government that consideration should be given to the particular human resources needs of both the SNSA and the ARAO in meeting their responsibilities for safe waste management; and
- the ARAO should consider further developing decision criteria to facilitate the selection of a preferred disposal strategy for HLW and spent fuel.

Based on the mission's final report, an action plan was prepared in 2022 with measures to mitigate the identified discrepancies. Subsequently in 2022 and in 2023, measures from the action plan were implemented: the 2023 Resolution was amended and approved (see more under the topic Resolution on the National Programme – new revision), a new tender for the selection of a contractor for the construction of the Vrbina LILW repository was published, contracts for the construction of the infrastructure part of the repository and for the production of the disposal containers were signed and further activities in this regard were carried out, the construction works of the LILW repository infrastructure part began in mid-2023, for the Vrbina repository, a novelation to the investment and feasibility programme that serves as the basis for project financing was prepared, updated draft studies were prepared to ensure the disposal of HLW and SNF, the long-term work programme of the ARAO for the period 2023-2027 was approved, which, together with the ARAO two-year Business Plans, foresees the adequate financing and provision of adequate staff for the implementation of the planned activities for RW management and on which basis new jobs were realised.

SECTION L: ANNEXES

(a) List of Spent Fuel Management Facilities

There are no off-site spent fuel management facilities in the Republic of Slovenia.

(b) List of Radioactive Waste Management Facilities

The Central Storage Facility for Radioactive Waste in Brinje, the Boršt hydro-metallurgical tailings disposal site and the Jazbec mine waste disposal site at the former Žirovski Vrh Uranium Mine are the only radioactive waste management facilities in the Republic of Slovenia.

Figure 21: **The Jazbec mine waste disposal site**

Figure 22: **The Boršt hydro-metallurgical tailings disposal site**

(c) List of Nuclear Facilities in the Process of Being Decommissioned

There are no nuclear facilities being decommissioned. The remediation works at the Boršt hydro-metallurgical tailings disposal site are in the final phase and the Boršt disposal site still holds the status of a radiation facility.

(d) Inventory of Spent Fuel

Spent Fuel Pool at the Krško NPP

Table 9: **The number, average burn-up, and total mass of the heavy metal of the fuel assemblies in each fuel batch as of 31 December 2023, stored in the Spent Fuel Pool**

Fuel batch	No. of fuel assemblies	Burn-up [GWd/MTU]	Heavy metal [kg]
1	18	18.6	7,165.2
2	14	24.1	5,529.1
3	29	31.1	11,324.9
4A	16	30.6	6,253.0
4B	11	34.1	4,299.4
5A	28	32.0	10,966.8
5B	2	30.2	780.1
6A	2	38.7	781.5
6B	0		
6C	14	37.0	5,479.8
6D	12	41.6	4,667.0
7A	15	36.2	5,920.3
7B	1	36.2	393.3
7C	14	32.0	5,553.4
KWU	27	35.0	10,106.6
8A	10	44.5	3,901.4
8B	5	43.5	1,956.2
9	6	42.2	2,346.6
10A	7	40.5	2,729.5
10B	6	42.7	2,332.4
10C	2	47.0	772.2
11	21	40.5	8,208.2
11B	12	41.3	4,692.6
12	17	44.2	6,600.6
12B	4	36.0	1,571.9
13	25	43.1	9,747.4
14	20	39.8	7,816.6
14B	3	44.5	1,166.0
15	4	43.3	1,553.6
15B	6	37.1	2,351.2
16	6	44.9	2,336.0
16B	0		
17	4	45.4	1,555.9
17B	0		
18	2	43.2	3,455.7
19	12	44.6	4,618.4
20	7	41.0	2,719.4
21	7	46.1	2,700.3
22A	6	41.7	2,327.1
22B	1	50.8	384.3
23A	0		
23B	8	50.4	3,077.3
24A	0		
24B	7	52.1	2,685.3
25A	0		

Fuel batch	No. of fuel assemblies	Burn-up [GWd/MTU]	Heavy metal [kg]
25B	4	50.8	1,539.2
26A	2	53.1	766,0
26B	3	52.7	1,149.4
27A	4	35.7	1,563.6
27B	8	52.4	3,071.6
28A	1	35.7	389.6
28B	5	51.9	1,919.3
29A	0		
29B	12	52.4	4,605.7
30A	0		
30B	8	52.4	3,066.1
31A	0		
31B	9	52.9	3.445.6
FRSB1	1	27.8	60.4
SBFR1	1	35.8	0.2

Dry Storage Building at the Krško NPP

Table 10: **The number, average burn-up, and total mass of the heavy metal of the spent fuel assemblies in each fuel batch as of 31 December 2023, stored in the Dry Storage Building**

Fuel batch	No. of fuel assemblies	Burn-up [GWd/MTU]	Heavy metal [kg]
MP001	37	35.3	14,463.7
MP002	37	39.3	14,358.7
MP003	37	42.6	14,386.1
MP004	37	42.2	14,383.4
MP005	37	34.3	14,484.5
MP006	37	44.9	14,345.4
MP007	37	43.7	14,347.2
MP008	37	45.6	14,292.9
MP009	37	39.7	14,365.7
MP010	37	45.4	14,343.0
MP011	37	43.6	14,351.4
MP012	37	42.5	14,318.4
MP013	37	37.6	14,382.0
MP014	37	33.7	14,467.4
MP015	37	41.1	14,379.0
MP016	37	42.8	14,373.7

Spent Fuel Pools at the JSI Reactor Infrastructure Centre

There are no spent fuel elements stored in the spent fuel pools at the JSI Reactor Infrastructure Centre.

(e) Inventory of radioactive waste

Radioactive Waste Storage Facilities at the Krško NPP

Table 11: **The radioactive waste inventory in the Krško NPP Solid Radwaste Storage Facility as of 31 December 2023**

Type of waste	No. of drums	Volume [m³]	Total beta/gamma activity [Bq]	Specific activity beta/gamma [Bq/m³]
Incineration products (A)	155	32.3	6.27E+09	1.94E+08
Blowdown Resins (BR)	1	0.2	8.06E+08	4.03E+09
Compressible Waste (CW)	4	0.8	1.10E+08	1.37E+08
Evaporator Bottom (EB)	2	0.4	2.12E+08	5.30E+08
Filters (F)	105	21.8	8.15E+10	3.74E+09
Other (O)	5	1.0	2.32E+08	2.32E+08
Supercompacted Waste (SC)	617	197.4	1.18E+10	5.98E+07
Spent Resins (SR)	689	143.3	1.72E+12	1.20E+10
Supercompacted Waste (ST)	1,858	1,605.5	4.93E+11	3.07E+08
Primary (PR) and Blowdown (BR) Resins, Incineration Products (A) and Dry Concentrate (DC) in Tube-Type Containers (TI)	426	370.1	1. 72E+13	4.65E+10
TOTAL	**3,862**	**2,372.8**	**1.95E+13**	**8.22E+9**

Table 12: **Radioactive waste inventory in the Krško NPP Waste Manipulation Building as of 31 December 2023**

Type of waste	No. of drums	Volume [m³]	Total beta/gamma activity [Bq]	Specific activity beta/gamma [Bq/m³]
Compressible Waste (CW)	73	15.2	7.63E+08	5.02E+07
Other (O)	440	91.5	1.29E+10	1.41E+08
TOTAL	**513**	**106.7**	**1.37E+10**	**2.67E+07**

Table 13: **Radioactive waste inventory in the Krško NPP Decontamination Building as of 31 December 2023**

Type of waste	No. of drums	Volume [m³]	Total beta/gamma activity [Bq]	Specific activity beta/gamma [Bq/m³]
Compressible Waste (CW)	144	30.0	3.35E+08	1.12E+07
TOTAL	**144**	**30.0**	**3.35E+08**	**1.12E+07**

The specific radionuclides (beta, gamma) are ^{58}Co, ^{60}Co, ^{134}Cs and ^{137}Cs.

A description of the waste types and acronyms used is as follows:

- Evaporator Bottom (EB) – the residue from evaporating wastewater, containing boric acid, solidified in vermiculite cement packed in 208 l drums.
- Filters (F) – spent filters from the primary water purification and liquid waste processing system, packaged in standard 208 l steel drums with an inner concrete biological shield.
- Spent Resins (SR) – spent ion exchange resins from purification systems, embedded in 208 l drums with vermiculite cement.
- Compressible Waste (CW) – waste arising mostly from using personal protective clothes, coveralls, shoe covers, plastics, etc., packed into 208 l drums.
- Other (O) – miscellaneous waste arising during operation and maintenance activities, such as contaminated used parts, cables, hoses, valves, concrete, wood, etc., packed in 208 l drums.

- Supercompacted waste (SC) – radioactive waste of a compressible waste type, supercompacted and packed in 320 l carbon steel overpacks (campaign conducted in 1988 and 1989).
- Supercompacted waste (ST) – radioactive waste of compressible waste and evaporator bottom types, supercompacted, spent resins inserted and packed in a tube-type container.
- Incineration products (A) – ash, dust and other residues from the incineration of combustible waste.
- Primary Resins (PR) – spent ion exchange resins from primary water purification systems dried and packed in stainless steel drums with 3-cm-thick walls as a biological shield.
- Blowdown Resins (BR) – resins arising from the purification system of a secondary system, packed in stainless steel drums.
- TI package- Primary Resins (PR), Blowdown Resins (BR), Incineration Products (A) and Dry Concentrate (DC) additionally inserted in tube-type containers (3 drums of PR/BR/A/DC in 1 tube-type container).

The types of packages in the Solid Radwaste Storage Facility are as follows:

- 208 l standard drum – designed in accordance with the ANSI DOT-17H standard; appropriate for the following solid waste: compressible waste, other, filters, spent resins and evaporator bottoms.
- 320 l overpack – used solely for the packaging of compressed standard 208 l drums from the first supercompaction campaign.
- 200 l stainless steel heavy drum with a biological shield (150 l of usable volume) – used for dried primary spent resins (Primary Resins) tested as a Type A Package in accordance with IAEA Safety Standards.
- 200 l stainless steel heavy drum without a biological shield – used for secondary spent resins (Blowdown Resins) and Dried Concentrate (DC) tested as a Type A Package. The use of stainless steel drums with biological shields started after the in-drum drying system for volume reduction was introduced.
- 200 l heavy carbon steel drum with coating – a limited number of this type of drum were filled with secondary spent resins (Blowdown Resins) and Dried Concentrate (DC). Periodic inspection of these drums is required to confirm corrosion resistance.
- 100 l drums containing ash from incineration – these drums are immobilised with concrete in 208 l drums.
- tube-type container, usable volume 869 l with a welded lid – an overpack, used in the second supercompaction campaign. Tested as an IP 2 container according to IAEA Safety Standards.
- tube-type container, usable volume 864 l with a flanged lid – used for in-drum drying system products and other types of radioactive waste as a preferred final package for interim storage in a solid radwaste storage facility, awaiting transport to an off-site disposal area. Tested as an IP 2 container in accordance with IAEA Safety Standards.

Table 14: **Contaminated/activated material inventory in the Decontamination Building – decontamination area, as of 31 December 2023**

Type of contaminated/activated material	Number of pieces	Volume [m³]	Mass [kg]	Contamination [Bq/dm²]	Packaging
Rx old head – CRDM	4	3	1,200	500	PE foil
Rx old head – DRPI	4	3	600	400	PE foil
Reactor screw tensioners	5	5	5,200	100	PE foil
VA cooler	8	50	24,000	100	PE foil
PAR board	880	1	880	< 200	PE foil
Concrete blocks RCP1	4	10	19,000	100	PE foil

Table 15: **Contaminated/activated material inventory in the Decontamination Building – old steam generators area, as of 31 December 2023**

Type of contaminated/activated material	Number of pieces	Volume [m³]	Mass [kg]	Activity/ Contamination/ Dose Rate	Packaging
Steam generators	2	600	646,000	< 3.00E+12 Bq	N/A
Regenerative and refuelling water heat exchanger	2	4	4,500	3.5 mSv/h	Metal container
Maintenance department equipment	2	2	1,900	1 mSv/h	Metal container
Tools for pressure monitoring of the reactor vessel temporary sealing lid	1	2	1,300	100 Bq/dm²	Metal container
Temporary lid seal of old steam generators	4	4	1,300	6,000 Bq/dm²	Metal container
Temporary reactor vessel lid	1	1.4	1,300	1,600 Bq/dm²	Metal container
Framatome steam generators equipment	4	1	1,300	4,000 Bq/dm²	Metal container
Rotor supports of the reactor coolant pumps	1	3	800	3,000 Bq/dm²	Metal container
Reactor coolant pumps equipment	2	4	1,000	4,000 Bq/dm²	Metal container
Support plates of the steam generators from container No. 6	10	1	2,000	400 Bq/dm²	PE foil
Old Rx seal ring	1	1	500	2 mSv/h	PE foil
New Rx seal cover	1	1	500	400 Bq/dm²	Stainless steel container
Diving equipment	2	2	300	500 Bq/dm²	Container
Temporary Rx seal ring	1	16	1,500	500 Bq/dm²	Metal container
Reactor coolant pumps elevator	1	2	500	300 Bq/dm²	Metal container
Reactor coolant pumps convenient elevator	3	2	200	100 Bq/dm²	Metal container
INETEC equipment	2	5	2,500	5,000 Bq/dm²	Metal container
Lead shields	15	15	20,000	100 Bq/dm²	Metal containers
Reactor coolant pump motor base	2	2	700	4,000 Bq/dm²	Metal containers
Rod position digital system cables	4	4	1,000	500 Bq/dm²	Wooden containers
Spare winch for fuel handling	1	0.5	300	500 Bq/dm²	PE foil
Steam generators drying equipment	1	1.5	200	-	Metal container
Reactor coolant pump motor equipment	4	1	300	400 Bq/dm²	Metal container
SEG for WP equipment	2	6	4,000	5,000 Bq/dm²	Metal container
Ingots	80	8.8	49,700	< 50 µSv/h/pc	Steel and Al ingots

Type of contaminated/activated material	Number of pieces	Volume [m³]	Mass [kg]	Activity/ Contamination/ Dose Rate	Packaging
RCP motor oil cooler	1	1	1,000	100 Bq/ dm²	
RCP01 motor stator	1	4	8,200	500 Bq/dm²	Metal stand
VA pump motor (RB-126)	3	3	3,000	100 Bq/dm²	PE foil
SS heat exchanger	2	0.5	200	100 Bq/dm²	Metal containers
Rx head – old	1	21	70,000	2 mS/h	Container
Old RTD valves and insulation	7	7	3,400	10 mS/h	Metal containers
Filter housing from RB126	35	5	700	Activated	
VAC-PAC vacuum cleaner	2	2	500	200 Bq/dm²	
Fission cell drives	3	6	4,000	5,00 Bq/dm²	IP2 container
Testing electric cables	3	3	900	100 Bq/dm²	Metal container
Old hydrogen recombiners from RB	2	4	1,200	500 Bq/dm²	PE foil

Central Storage Facility for Radioactive Waste in Brinje

Table 16: **Inventory of RW and disused radioactive sources stored at the CSF as of the end 2023**

Group	Subgroup and Type	Number of packages	Volume (m³)	Main radionuclides	Activity (Bq)
Group I – Solid RW	T1 (solid, compressible, combustible)	106	21	^{226}Ra, ^{60}Co, ^{241}Am, ^{109}Cd, ^{108}Ag, ^{238}U, ^{57}Co, ^{232}Th, ^{3}H	6.4E+08
	T2 (solid, compressible, non-combustible)	122	23	^{226}Ra, ^{60}Co, ^{241}Am, ^{109}Cd, ^{108}Ag, ^{238}U, ^{3}H, ^{238}U, ^{14}C, ^{228}Th, ^{106}Ru, ^{210}Pb	1.5E+10
	T3 (solid, non-compressible, combustible)	30	6	^{226}Ra, ^{60}Co, ^{232}Th	3.1E+09
	T4 (solid, non-compressible, non-combustible)	181	30	^{226}Ra, ^{60}Co, ^{109}Cd, ^{137}Cs, ^{108}Ag, ^{238}U, ^{14}C, ^{232}Th, ^{133}Ba	1.0E+11
Group II – DSRS	ZV0 (ionisation smoke detectors)	105	4	^{241}Am, ^{226}Ra	1,7E+10
	DSRS (other disused sealed radioactive sources)	196	5	^{226}Ra, ^{60}Co, ^{241}Am/Be, ^{238}U, ^{232}Th, ^{63}Ni, ^{55}Fe, ^{90}Sr, ^{106}Ru, ^{3}H, ^{152}Eu, ^{137}Cs, ^{85}Kr, ^{133}Ba, ^{241}Am	2.9E+12
Group III – other RW	L – liquid waste	0	0	/	0
	M – mixed waste	0	0	/	0
	TOTAL	740	89		3.0E+12
	Total mass	50 tons			

Jazbec mine waste disposal site at the Žirovski Vrh Uranium Mine

Table 17: **Mine waste and other debris at the Jazbec mine waste disposal site, situation as of the end of 2023**

Deposited	Mine waste and red mud 1982-1990 (mine ore production), contaminated material, technological equipment 1991-2007 (decontamination, demolition)
Final arrangement	2008
Closed	2015
Surface, total	67,325 m^2 (the drainage area of the mine waste disposal site) 74,239 m^2 (the area inside the safety fence)
Altitude	Bottom: 427 m; top: 509 m (above sea level)
Volume of disposed waste	Total volume of the disposed material: 1,198,900 $m^{3:}$ 854,500 m^3 of mine waste, 126,000 m^3 of low-grade uranium ore, 34,000 m^3 of red mud, 2,600 m^3 of filter cake from the mine water treatment station, 181,000 m^3 of contaminated soil and rubble from uranium ore processing facilities and crash station demolition, 800 m^3 of technological equipment from uranium ore processing facilities and the crash station.
Amount of disposed waste	Total amount of disposed material: 1,910,425 t: 1,366,589 t of mine waste, 200,684 t of low-grade uranium ore, 48,000 t of red mud, 4,220 t of filter cake from the mine water treatment station, 289,723 t of contaminated soil and rubble from uranium ore processing facilities and crash station demolition, 1,209 t of technological equipment from uranium ore processing facilities and the crash station.
Average specific activity of disposed material	7.7 kBq/kg mine waste (53 g U_3O_8/t), 65 kBq/kg red mud (^{230}Th 97%), 34.4 kBq/kg filter cake (236 g U_3O_8/t), 29.2 kBq/kg low-grade uranium ore (200 g U_3O_8/t), < 2 kBq/kg contaminated soil and rubble
Total activity of disposed material	21.7 TBq
Dose rate, average	0.10 – 0.11 µSv/h

Note: most of the ^{230}Th was not contained in the hydro-metallurgical tailings which remained in the so-called red mud as a neutralisation by-product.

Boršt hydro-metallurgical tailings disposal site at the Žirovski Vrh Uranium Mine

Table 18: **Boršt hydro-metallurgical tailings disposal site with basic data, situation as of the end of 2023**

Deposited	Hydro-metallurgical tailings 1984-1990 and mine waste 1984-2004, contaminated material 2008-2009
Final arrangement	2010 arrangement of the hydro-metallurgical tailings, until 2019, remediation of the hydro-metallurgical tailings base rock sliding
Surface, total	42,000 m^2 (hydro-metallurgical tailings surface), 67,923 m^2 (surface inside the safety fence of the hydro-metallurgical tailings)
Altitude	Bottom: 535 m; top: 565 m (above sea level)
Volume of disposed waste	339,000 m^3 of hydro-metallurgical tailings, 70,000 m^3 of mine waste, 6,543 m^3 of contaminated materials total volume of disposed material: 415,543 m^3
Amount of disposed waste	610,000 t of hydro-metallurgical tailings, 111,000 t of mine waste, 9,450 t of contaminated materials, total amount of disposed material: 730,450 t
Average specific activity of disposed material	78.2 kBq/kg hydro-metallurgical tailings 10.2 kBq/kg mine waste
Total activity of disposed material	48.8 TBq
Dose rate, average	0.14 μGy/h (covered with a final layer)

Note: The specific activity of the contaminated materials from the procedure for the decontamination of the disposal's surroundings was not measured; however, it was low.

In the summer of 2023, two metal drums containing samples of uranium ore and hydro-metallurgical tailings with a total volume of 0.4 m^3 were deposited over the sealing clay layer of a multilayer soil cover of the Boršt hydro-metallurgical tailings disposal site.

(f) References to National Acts, Regulations, Requirements, Guidelines, Etc.

- Ionising Radiation Protection and Nuclear Safety Act (Official Gazette RS, Nos. 76/17, 26/19, 172/21 and 18/23 – ZDU-1O)

In addition to the 2017 Act, two resolutions:

- Resolution on the National Programme on Radioactive Waste and Spent Fuel Management for the Period 2023–2032 (Official Gazette RS, No. 14/23),
- Resolution on Nuclear and Radiation Safety in the Republic of Slovenia for the Period 2024–2033 (Official Gazette RS, No. 122/23),

and the Acts and regulations stated below should also be mentioned.

Nuclear and Radiation Safety, Physical Protection, Safeguards, Quality Assurance

Based on the 2017 Act, the following decrees and regulations for implementing radiation protection and nuclear safety provisions were issued:

- Decree on Radiation Activities (Official Gazette RS, Nos. 19/18 and 6/24),
- Decree on Dose Limits, Reference Levels and Radioactive Contamination (Official Gazette RS, No. 18/18),
- Decree on the Areas of Limited Use of Land due to a Nuclear Facility and the Conditions of Facility Construction in These Areas (Official Gazette RS, No. 78/19),
- Decree on the National Radon Programme (Official Gazette RS, Nos. 18/18, 86/18 and 152/20),
- Decree on the Reduction of Exposure due to Natural Radionuclides and Past or Existing Activities or Events (Official Gazette, No. 38/18),
- Decree on the Safeguarding of Nuclear Materials (Official Gazette RS, Nos. 34/08 and 76/17 – ZVISJV-1),
- Decree on the Criteria for Determining the Compensation Rate due to the Restricted Use of Areas and Intervention Measures in Nuclear Facility Areas (Official Gazette RS, Nos. 92/14, 46/15, 76/17 – ZVISJV-1 and 8/20),
- Decree on Checking the Radioactivity of Consignments that Could Contain Orphan Sources (Official Gazette RS, Nos. 10/19 and 44/22 – ZVO-2),
- Decree on the Implementation of Council Regulations (EC) and Commission Regulations (EC) on the Radioactive Contamination of Foodstuffs and Feedstuffs (Official Gazette RS, Nos. 52/06, 38/10 and 76/17 – ZVISJV-1),
- Decree on the Method and Subject of and Conditions for Performing the Public Utility Service of Radioactive Waste Management (Official Gazette RS, No. 8/22),
- Rules on the Expert Council on Radiation and Nuclear Safety (Official Gazette RS, Nos. 35/03 and 76/17 – ZVISJV-1),
- Rules on the Use of Radiation Sources and on Activities Involving Radiation (Official Gazette RS, No. 27/18),
- Rules on Authorised Experts on Radiation and Nuclear Safety (Official Gazette RS, No. 126/23),
- Rules on Providing Qualifications for Workers in Radiation and Nuclear Facilities (Official Gazette RS, No. 162/20),
- Rules on Radiation and Nuclear Safety Factors (Official Gazette RS, Nos. 74/16 and 76/17 – ZVISJV-1),
- Rules on Radioactive Waste and Spent Fuel Management (Official Gazette RS, No. 125/21),
- Rules on the Safety Assurance of Radiation and Nuclear Facilities (Official Gazette RS, Nos. 81/2016 and 76/17 – ZVISJV-1),
- Rules on Radioactivity Monitoring (Official Gazette RS, No. 27/18),
- Rules on Transboundary Shipments of Radioactive Waste and Spent Fuel (Official Gazette RS, Nos. 22/09 and 76/17 – ZVISJV-1),

- Rules on the Transboundary Shipment of Nuclear and Radioactive Substances (Official Gazette RS, Nos. 75/08, 41/14 and 76/17 – ZVISJV-1),
- Rules on Requirements for New Construction and Interventions in Existing Buildings in order to Protect Human Health from the Harmful Effects of Radon (Official Gazette RS, Nos. 14/22, 55/23 – corr. and 76/23),
- Rules on the Functioning of the Expert Council for the Issues of Ionising Radiation Protection, Radiological Activities, and the Use of Radiation Sources in Human and Veterinary Medicine (Official Gazette RS, Nos. 62/03 and 76/17 – ZVISJV-1),
- Rules on the Criteria for Using Ionising Radiation Sources for Medical Purposes and for the Deliberate Exposure of Individuals for Non-Medical Purposes (Official Gazette RS, No. 33/18),
- Rules on Special Radiation Protection Requirements and the Method of Dose Assessment (Official Gazette RS, Nos. 47/18 and 30/21),
- Rules on the Health Surveillance of Exposed Workers (Official Gazette RS, Nos. 2/04 and 76/17 – ZVISJV-1),
- Rules on Authorising Ionising Radiation Practitioners (Official Gazette RS, No. 39/18),
- Rules on Authorising Radiation Protection Experts (Official Gazette RS, No. 47/18),
- Rules on the Obligations of Persons Carrying Out a Radiation Practice and Persons Possessing an Ionising Radiation Source (Official Gazette RS, No. 43/18),
- Rules on Radiation Protection Measures in Controlled and Monitored Areas (Official Gazette, No. 47/18),
- Rules on the Use of Potassium Iodine (Official Gazette RS, Nos. 59/10 and 17/14 – ZZdr-2),
- Rules on the Implementation of National Screening Programmes for the Early Detection of Precancerous Changes and Cancer (Official Gazette RS, Nos. 57/18 and 68/19),
- Rules on the Monitoring of Radioactivity in Drinking Water (Official Gazette RS, Nos. 74/15, 76/17 – ZVISJV-1 and 104/20),
- Rules on the Physical Protection of Nuclear Facilities, Nuclear and Radioactive Materials, and the Transport of Nuclear Material (Official Gazette RS, No 100/23),
- Order on Establishing Basic Training and Periodic In-Service Training Programmes of Security Personnel Performing the Physical Protection of Nuclear Facilities, Nuclear or Radioactive Materials and the Transport of Nuclear Materials (Official Gazette RS, No. 100/23),
- Rules on the Equipment of Inspectors Carrying Out Inspection on the Physical Protection of Nuclear and Radioactive Materials and Facilities (Official Gazette RS, Nos. 42/12 and 76/17 – ZVISJV-1).

Third Party Nuclear Liability

- Act on Liability for Nuclear Damage (Official Gazette RS, No. 77/10),
- Ordinance on Determining Persons for Whom the Conclusion of Insurance for Liability for Nuclear Damage Is Not Obligatory (Official Gazette RS, No. 110/10),

Civil Protection and Disaster Relief

- Protection against Natural and Other Disasters Act (Official Gazette RS, Nos. 51/06 and 97/10 – official consolidated text, 21/18 – ZNOrg and 117/22),
- Decree on the Contents and Drawing Up of Protection and Rescue Plans (Official Gazette RS, Nos. 24/12, 78/2016 and 26/19),
- National Emergency Response Plan for Nuclear and Radiological Accidents, Version 4.0, 2023.

Administrative

- Public Administration Act (Official Gazette RS, Nos. 113/05 – official consolidated text, 89/07, 126/07 – ZUP-E, 48/09, 8/10 – ZUP-G, 8/15 – ZVRS-F, 21/12, 47/13, 12/14, 90/14, 51/16, 36/21, 82/21, 189/21, 153/22 and 18/23),
- Inspection Act (Official Gazette RS, Nos. 43/07 – consolidated text and 40/14),
- General Administrative Procedure Act (Official Gazette RS, Nos. 24/06 – official consolidated text, 105/06 – ZUS-1, 126/07, 65/08, 8/10, 82/13, 175/20 – ZIUOPDVE and 3/22 – ZDeb).

Energy and Environmental Matters

- Energy Act (Official Gazette RS, Nos. 60/19 – consolidated text, 65/20, 158/20 – ZURE, 121/21 – ZSROVE, 172/21 – ZOEE, 204/21 – ZOP and 44/22 – ZOTDS),
- Decree on the Transformation of the Krško NPP, p.o., into the Public Company NEK d.o.o. (Official Gazette RS, Nos. 54/98, 57/98, 106/01, 59/02 and 10/03),
- Environmental Protection Act (Official Gazette RS, Nos. 44/22, 18/23 – ZDU-1O and 78/23 – ZUNPEOVE),
- Decree on Environmental Encroachments that Require Environmental Impact Assessments (Official Gazette RS, Nos. 51/14, 57/2015, 26/17, 105/20 and 44/22 – ZVO-2),
- Decree on the Method of Drafting and on the Content of the Report on the Effects of Planned Activities Affecting the Environment (Official Gazette RS, Nos. 36/09, 40/17 and 44/22 – ZVO-2),
- Decree on the Criteria for Determining the Likely Significance of Environmental Effects of Certain Plans, Programmes or Other Acts and Its Modifications in the Environmental Assessment Procedure (Official Gazette RS, Nos. 9/09 and 44/22 – ZVO-2),
- Decree Laying Down the Content of Environmental Report and on the Detailed Procedure for the Assessment of the Effects on Certain Plans and Programmes on the Environment (Official Gazette RS, Nos. 73/05 and 44/22 – ZVO-2),
- Permanent Cessation of Exploitation of Uranium Ore and Prevention of the Consequences of Mining in the Uranium Mine at Žirovski Vrh Act (Official Gazette, RS, No. 22/2006 – official consolidated text),
- Decree Determining the Area and of the Compensatory Amount due to the Limited Use of the Environment in the Area of the Žirovski Vrh Uranium Mine (Official Gazette RS, Nos. 22/08 and 50/09),
- Decree on the Method, Subject and Conditions for the Provision of the Obligatory Public Utility Service of the Long-Term Surveillance and Maintenance of Landfills of Mining and Hydro-Metallurgical Tailings from the Extraction and Exploitation of Nuclear Minerals (Official Gazette RS, No. 76/15),
- Fund for Financing the Decommissioning of the Krško Nuclear Power Plant and the Disposal of Radioactive Waste from the Krško NPP Act (Official Gazette RS, No. 120/22).

Transport

- Act on the Transport of Dangerous Goods (Official Gazette RS, Nos. 33/06 – official consolidated text, 41/09, 97/10 and 56/15),
- Decision on the Publication of Amendments to Annexes A and B of the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR; Official Gazette RS, No. 9/23).

Export of dual-use items

- Act Regulating Control of the Export of Dual-use Items (Official Gazette RS, Nos. 37/04, 8/10 and 29/23),
- Decree on Procedures for Export Control of Dual-Use Items (Official Gazette RS, No. 132/23),
- Ordinance of the Establishment of the Commission for the Dual-Use Items Export Control (Official Gazette RS, No. 6/24).

General

- Decree on Administrative Authorities within Ministries (Official Gazette RS, Nos. 35/15, 62/15, 84/16, 41/17, 53/17, 52/18, 84/18, 10/19, 64/19, 64/21, 90/21, 101/21, 117/21, 78/22, 91/22, 25/53 and 127/23),
- Maritime Code (Official Gazette RS, Nos. 62/16 – official consolidated text, 41/17, 21/18 – ZNOrg, 31/18 – ZPVZRZECEP, 18/21, 21/21 – corr. and 76/23),
- The Criminal Code (Official Gazette RS, Nos. 50/12 – official consolidated text, 6/16 – corr., 54/15, 38/16, 27/17, 23/20, 91/20, 95/21, 186/21, 105/22 – ZZNŠPP and 5/21),

- Minor Offences Act (Official Gazette RS, Nos. 29/11 – official consolidated text, 43/11, 21/13, 111/13, 74/14, 92/14, 32/16, 15/17, 73/19, 175/20 – ZIUOPDVE and 5/21),
- Spatial Planning Act (Official Gazette RS, Nos. 33/07, 70/08 – ZVO-1B, 108/09, 80/10 – ZUPUDPP, 43/11 – ZKZ-C, 57/12, 57/10- ZUPUDPP-A, 109/12, 76/14, 14/15 – ZUUJFO and 61/17 – ZUrep-2),
- Spatial Management Act (Official Gazette RS, Nos. 199/21, 18/23 – ZDU-1O, 78/23 – ZUNPEOVE and 95/23 – ZIUOPZP),
- Construction Act (Official Gazette RS, Nos. 199/21, 105/22 – ZZNŠPP and 133/23),
- Decree on the Detailed Plan of National Importance for the Low- and Intermediate-Level Waste Repository at Vrbina in the Municipality of Krško (Official Gazette of Republic of Slovenia, Nos. 114/09 and 50/12),
- Ordinance establishing the Public Service for Radioactive Waste Management – Agencija za radioaktivne odpadke (Official Gazette RS, No. 8/22),
- Decree on the Method and Subject of and Conditions for Performing the Public Utility Service of Radioactive Waste Management (Official Gazette RS, Nos. 8/22 and 19/24),
- Price List of the Public Service of Radioactive Waste Management (Official Gazette RS, No. 153/22),
- Standardisation Act (Official Gazette RS, No. 59/99).

Multilateral and Bilateral Treaties, Conventions, Agreements/Arrangements

In accordance with Article 8 of the Constitution of the Republic of Slovenia, all announced and ratified international treaties also constitute an integral part of the Slovenian legal system and can be applied directly. The following international instruments, to which the Republic of Slovenia is party, should be mentioned:

Multilateral Agreements

- Statute of the International Atomic Energy Agency (including the Amendment of Articles VI and XIV),
- Agreement on the Privileges and Immunities of the International Atomic Energy Agency,
- Convention on the Physical Protection of Nuclear Material (including the Amendment from 2005),
- Convention on Early Notification of a Nuclear Accident,
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency,
- The IAEA Incident Reporting System (IAEA-IRS),
- Convention on Nuclear Safety,
- Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water,
- Treaty on the Non-proliferation of Nuclear Weapons,
- Treaty on the Prohibition of the Emplacement of Nuclear Weapons and other Weapons of Mass Destruction in the Sea-Bed and the Ocean Floor,
- European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR),
- Convention on International Railway Carriage (COTIF), including Appendix B (RID),
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management,
- Comprehensive Nuclear-Test-Ban Treaty,
- Convention on Third Party Liability in the Field of Nuclear Energy of 29 July 1960, as Amended by the Additional Protocol of 28 January 1964 and by the Protocol of 16 November 1982,
- Convention of 31 January 1963 Supplementary to the Paris Convention of 29 July 1960, as Amended by the Additional Protocol of 28 January 1964 and by the Protocol of 16 November 1982,
- Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention,
- Agreement between the Kingdom of Belgium, the Kingdom of Denmark, the Federal Republic of Germany, Ireland, the Italian Republic, the Grand Duchy of Luxembourg, the Kingdom of the Netherlands, the European Atomic Energy Community and the International Atomic Energy Agency

in Implementation of Article III, (1) and (4) of the Treaty on the Non-Proliferation of Nuclear Weapons,

- Protocol Additional to the Agreement between the Republic of Austria, the Kingdom of Belgium, the Kingdom of Denmark, the Republic of Finland, the Federal Republic of Germany, the Hellenic Republic, Ireland, the Italian Republic, the Grand Duchy of Luxembourg, the Kingdom of the Netherlands, the Portuguese Republic, the Kingdom of Spain, the Kingdom of Sweden, the European Atomic Energy Community and the International Atomic Energy Agency in implementation of Article III, (1) and (4) of the Treaty on the Non-Proliferation of Nuclear Weapons.

Bilateral Agreements

- Arrangement between the SNSA and the US NRC for the Exchange of Technical Information and Co-operation in Nuclear Safety Matters,
- Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Hungary on the Early Exchange of Information in the Event of a Radiological Emergency,
- Agreement between the Republic of Slovenia and the Republic of Austria on the Early Exchange of Information in the Event of a Radiological Emergency and on Common Interests in the Field of Nuclear Safety and Radiation Protection,
- Arrangement between the Nuclear Safety Administration of the Republic of Slovenia and the Federal Ministry of Agriculture and Forestry, Environment and Water Management of the Republic of Austria regarding Co-operation in the Field of Radiation Protection and Strengthening of the Mutual Exchange of Data of the Aerosol Monitoring Systems,
- Arrangement between the Nuclear Safety Administration (the SNSA) of the Republic of Slovenia and the Institute for Environmental Protection and Research (the ISPRA) of the Republic of Italy for the Early Exchange of Information in the Event of a Radiological Emergency and Co-operation in Nuclear Safety Matters,
- Agreement between the Republic of Slovenia and the Republic of Croatia for the Early Exchange of Information in the Event of a Radiological Emergency,
- Agreement between the Government of the Republic of Slovenia and the Government of the Slovak Republic for the Exchange of Information in the Field of Nuclear Safety,
- Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on the Regulation of the Status and Other Legal Relations Regarding the Investment, Exploitation and Decommissioning of the Krško NPP,
- Agreement between the Government of the Republic of Slovenia and the Government of Canada for Co-operation in the Peaceful Uses of Nuclear Energy,
- Administrative Arrangement between the Slovenian Nuclear Safety Administration and the Atomic Energy Control Board of Canada pursuant to the Agreement between the Government of the Republic of Slovenia and the Government of Canada for Cooperation in Peaceful Uses of Nuclear Energy,
- Revised Supplementary Agreement between the International Atomic Energy Agency and the Government of the Republic of Slovenia concerning the Provision of Technical Assistance by the International Atomic Energy Agency to the Government of the Republic of Slovenia.

International Acts that are not International Treaties

- Memorandum of Understanding between the Slovenian Nuclear Safety Administration and the State Office for Nuclear Safety of the Czech Republic on the Exchange of Information on Nuclear and Radiation Safety Matters,
- Memorandum of Understanding between the Slovenian Nuclear Safety Administration and the Macedonian Radiation Safety Directorate on the Exchange of Information on Nuclear and Radiation Safety Matters,
- Memorandum of Understanding between the European Nuclear Safety Regulators Group and the International Atomic Energy Agency for International Peer Review Missions to the EU Member States,

- Memorandum of Understanding between the Slovenian Nuclear Safety Administration and the State Regulatory Agency for Radiation and Nuclear Safety of Bosnia and Herzegovina on the Exchange of Information on Nuclear and Radiation Safety Matters,
- Memorandum of Understanding between the Slovenian Nuclear Safety Administration and the National Nuclear Agency of the Republic of Albania on the Exchange of Information on Nuclear and Radiation Safety Matters,
- Memorandum of Understanding between the Slovenian Nuclear Safety Administration and the Ministry for Emergency Situations of the Republic of Belarus on the Exchange of Information on Nuclear and Radiation Safety Matters,
- Memorandum of Understanding for cooperation and the exchange of information on administrative matters in the nuclear field between the Administration of the Republic of Slovenia for Nuclear Safety and the President of the State Agency of the Republic of Poland for Nuclear Energy,
- Memorandum of Understanding between the Slovenian Nuclear Safety Administration and the Agency of the Kingdom of Morocco for Nuclear and Radiation Safety and Security on the exchange of technical data and cooperation in the field of nuclear and radiation safety.

(g) References to Official National and International Reports Related to Safety

- Angus, M. J., Moreton, A. D., Wells, D. A.: Management of Spent Sealed Radioactive Sources in Central and Eastern Europe, Contract B/-5350/99/6161/MAR/C2. March 2001.
- WAMAP Mission to the Socialist Federal Republic of Yugoslavia: Travel Report, IAEA, April 1991.
- EUR 19154, Radioactive Waste Management in the Central and Eastern European Countries. [prepared by the] European Commission; Nuclear Safety and the Environment. Brussels; Luxembourg: Office for Official Publications of the European Communities, 1999.
- WENRA Report: Radioactive Waste Disposal Facilities Safety Reference Levels, 22 December 2014.

(h) References to Reports on International Review Missions Performed at the Request of a Contracting Party

- End of Mission Report on "Decommissioning of the Žirovski Vrh Mine Complex (RUŽV)": Radiation Safety during the Decommissioning of Uranium Mines, (SLO/9/003-3&4). IAEA, February 1996.
- Feasby, D. G.: End of Mission Report on "Remediation of Žirovski Vrh, Uranium Mine and Milling Site": Assessment of the Remediation Programme and the Planned Remediation of the Žirovski Vrh Mine, (SLO/3/002-02). IAEA, 17-22 March 1997.
- Glendon W. Gee.: End of Mission Report on "Geotechnical Engineering/Soil Science Assessment": Remediation of the Žirovski Vrh Uranium Mine and Milling Site, (SLO/3/002-03). IAEA, 7-13 July 1997.
- Report of the International Regulatory Review Team (IRRT) to Slovenia, IAEA/NSNI/IIIT/99/5, TC Project RER/9/052. December 1999.
- WISMUT. Evaluation of the Technical and Economic Measures Planned in Relation to the Closeout of the Uranium Ore Mine. June 2001.
- ZETTWOOG, P.: Final Report of the Mission on "The Decommissioning of the Žirovski Vrh Mine Complex (RUŽV)", IAEA/TCA, (SLO/3/002-01). 10-15 February 1997.
- OSART Mission (IAEA), 17 October – 20 November 2003 and Follow-up Visit, 7-11 November 2005.
- WANO Peer Review Mission, 20 October – 3 November 2014.
- WATRP IAEA Mission, Review of the ARAO's Documentation and Technical Programme for the Development of the Slovenian National Repository for Low- and Intermediate-Level Radioactive Waste, 21-25 January 2008.
- INSARR (Integrated Safety Assessment for Research Reactors) performed a safety review of the TRIGA Reactor, 12-16 November 2012.
- IAEA Expert Mission, 27-28 August 2009, (Alain Van Cotthem, František Fiedler).

- IAEA Expert Mission, 8-10 March 2010, (M. Garamszeghy, J-M. Potier and L. Valencia).
- IAEA Expert Mission, 18-20 January 2011, (J. Pacovsky, R. Chaplow).

Furthermore, there were two additional international reviews of the LILW repository preliminary design:

- Peer Review of LILW Repository Preliminary Design, Vrbina, Krško; Technum – Tractebel Engineering; Technical Note N° P.001189.050-001.A; June 2010.
- Review of the Preliminary Design of the Vrbina LILW Repository, URS, May 2010.
- End of Mission Report on the Expert Mission to provide comments and discuss the third revision of the Krško NPP RW and SF Disposal Programme, 26-29 May 2019, (Neil Chapman, Peter Ormai, John Mathieson).

(i) Other Relevant Material

General Description of the Krško NPP

The Krško NPP is the only nuclear power plant in the Republic of Slovenia. The Krško NPP commenced operations in autumn 1981. It has been operating commercially since 1983. It is equipped with a Westinghouse pressurised light water reactor. At present, the gross electrical output is 727 MWe and the net output is 696 MWe. The previously installed capacity of 676 MWe net electrical output was updated due to the replacement of the low-pressure turbines in 2006. In 2004, the Krško NPP started operating with an eighteen-month fuel cycle.

Figure 23: **The Krško NPP**

The Krško NPP is designed and operates in accordance with Slovenian safety regulations and its operating license. In addition, the Krško NPP systematically observes the regulations and industrial standards of the USA, which is the supplying country.

The regulations followed in the design, construction and operation of the Krško NPP are divided into the following categories:

- the Acts and standards of the former SFRY (during construction and the first years of operation) and the Republic of Slovenia;
- WENRA SRL for existing NPPs (2020), as these were incorporated into nuclear safety regulations of the Republic of Slovenia;
- the US 10 CFR Code of Federal Regulations as applicable to the design of the Krško NPP;
- regulatory guidelines issued by the US regulatory authority;
- the US ANS/ANSI, ASME, and IEEE industrial standards;
- IAEA standards and guidelines.

Table 19: **Some technical data on the Krško NPP**

Reactor Thermal Power	MW	1,994
Gross Electrical Output	MW	727
Net Electrical Output	MW	696
Thermal Efficiency Factor	%	36
CONTAINMENT		
Height	m	71
Inside Diameter	m	32
Outside Diameter	m	38
Steel Shell Test Pressure	MPa	0.357
REACTOR COOLING SYSTEM		
Chemical Composition		H_2O
Additives		H_3BO_3, LiOH
Number of Cooling Loops		2
Total Mass Flow	kg/s	9,220
Pressure	MPa	15.41
Total Volume	m^3	197
Temperature at Reactor (Vessel) Inlet	°C	287
Temperature at reactor (Vessel) Outlet	°C	324
Number of Pumps		2
Pump Capacity	m^3/s	6.3
Pump Driving Power	MW	5.22
NUCLEAR FUEL		
Number of Fuel Assemblies		121
Number of Fuel Rods per Assembly		235
Fuel Rod Array in a Fuel Assembly		16 x 16
Fuel Rod Length	m	3.658
Clad Thickness	cm	0.0572
Clad Material		Zircaloy-4, ZIRLO
Fuel Chemical Composition		UO_2
Pellet Diameter	mm	8.191
Natural Pellet Length	cm	1.346
Enriched Pellet Length	cm	0.983
Annular Pellet Length	cm	1.173
Standardised Pellet Length	cm	1.27
Total Weight of Nuclear Fuel	t	48.7
CONTROL RODS		
Number of Control Rod Assemblies		33
Number of Absorber Rods per Assembly		20
Total Weight of a Control Rod Assembly	kg	53.07
Neutron Absorber		Ag-In-Cd
Percentage Composition	%	80-15-5
Diameter	mm	8.36
Density	g/cm^3	10.16
Clad Thickness	mm	0.445
Clad Material		SS 304

Krško NPP Structures

Nuclear island structures of the Krško NPP are located on a solid reinforced concrete platform situated on the Pliocene sandy-clay sediments of the Krško basin. The structures are designed and constructed to resist the hazard of earthquakes.

The Reactor Building, where the reactor, the reactor coolant system and the safety containment are installed, consists of an inner cylindrical steel shell and an outer reinforced concrete shield building. The containment airlock is equipped with a sealed passage chamber with double doors. Numerous piping and cable penetrations are double sealed. The Auxiliary Building, the Intermediate Building the Component Cooling Building, the Fuel Handling Building, the Diesel Generator Building and the Turbine Building are located adjacent to the Reactor Building.

Additional structures were constructed as part of the Safety upgrade programme after the Fukushima accident and the EU Stress tests. These are Bunkered Building 1 (housing the third diesel generator and the emergency control room), Bunkered Building 2 (housing the alternative cooling systems) and the Operations Support Centre. All these building were designed according to DEC requirements.

The cooling water and essential service water intake structures are located on the bank of the Sava River above the Sava River dam, which provides an adequate volume of the ultimate heat sink. The cooling water discharge structure is below the Sava River dam. The level of the Sava River is set by the operation of the Brežice hydropower plant that has a dam on the Sava River downstream of the Krško NPP. In addition, cooling towers are provided for cooling circulating waters in case of low water flow or an elevated temperature of the Sava River and in case of flooding conditions with floating debris in the river water.

Reactor Coolant System

The Westinghouse pressurised light water reactor with two cooling loops consists of a reactor vessel with its internals and head, two steam generators, two reactor coolant pumps, the pressuriser, piping, valves, and reactor auxiliary systems. Demineralised water serves as the reactor coolant, the neutron moderator, and for the dilution of the boric acid solution. In the steam generator, the reactor coolant transfers the heat to the feedwater on the secondary side of the steam generator to generate steam. Reactor coolant pressure is maintained by the pressuriser, which is supported by electrical heaters and water sprays, which are supplied with water from the cold leg of the reactor coolant system. The data necessary for reactor control and reactor protection are provided by the neutron flux, reactor coolant temperature, flow rate, pressuriser water level and pressure detectors.

Reactor power is regulated by control rods. The control rods' drive mechanism is attached to the reactor head, while the absorber rods extend into the reactor core.

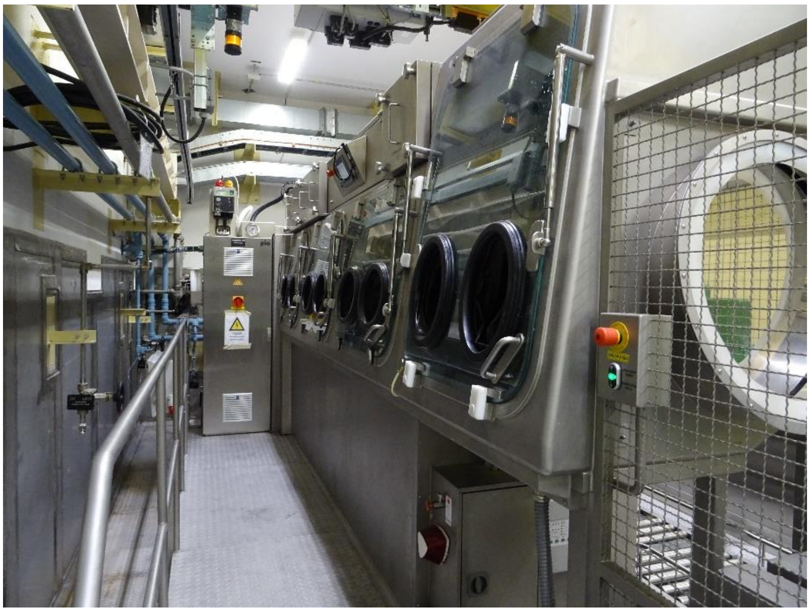
Long-term core reactivity changes and core poisoning with fission products are compensated for by changing the boric acid concentration in the reactor coolant. The pH of the primary coolant is regulated by dissolved LiOH as the means to suppress the corrosion of the reactor internals.

Nuclear Fuel

The reactor core is composed of 121 fuel assemblies. Each fuel assembly consists of fuel rods, top and bottom nozzles, grid assemblies, control rod guide thimbles and instrumentation guide thimbles. The fuel rods contain ceramic uranium dioxide pellets welded into zircaloy-4 or ZIRLO cladding. Uranium oxide fuel is shaped into sintered pellets and is enriched with ^{235}U to up to 4.95%.

Every 18 months at the end of the fuel cycle, approximately half of the fuel assemblies are replaced with fresh fuel. Fresh fuel assemblies are kept in the fresh fuel storage prior to their use in the reactor core. During refuelling, all fuel assemblies are transferred from the reactor vessel through the flooded transfer canal penetrating the containment vessel into the spent fuel pool. During refuelling, the reactor vessel is open and the reactor cavity is flooded. Fuel assemblies remain in the reactor core for up to three years. Spent fuel assemblies are kept under water in the spent fuel pool, where they are cooled. Some spent fuel assemblies were transferred to the dry storage facility where they are stored in special containers that provide passive cooling of the spent fuel.

Figure 24: **Krško NPP radioactive waste separation**



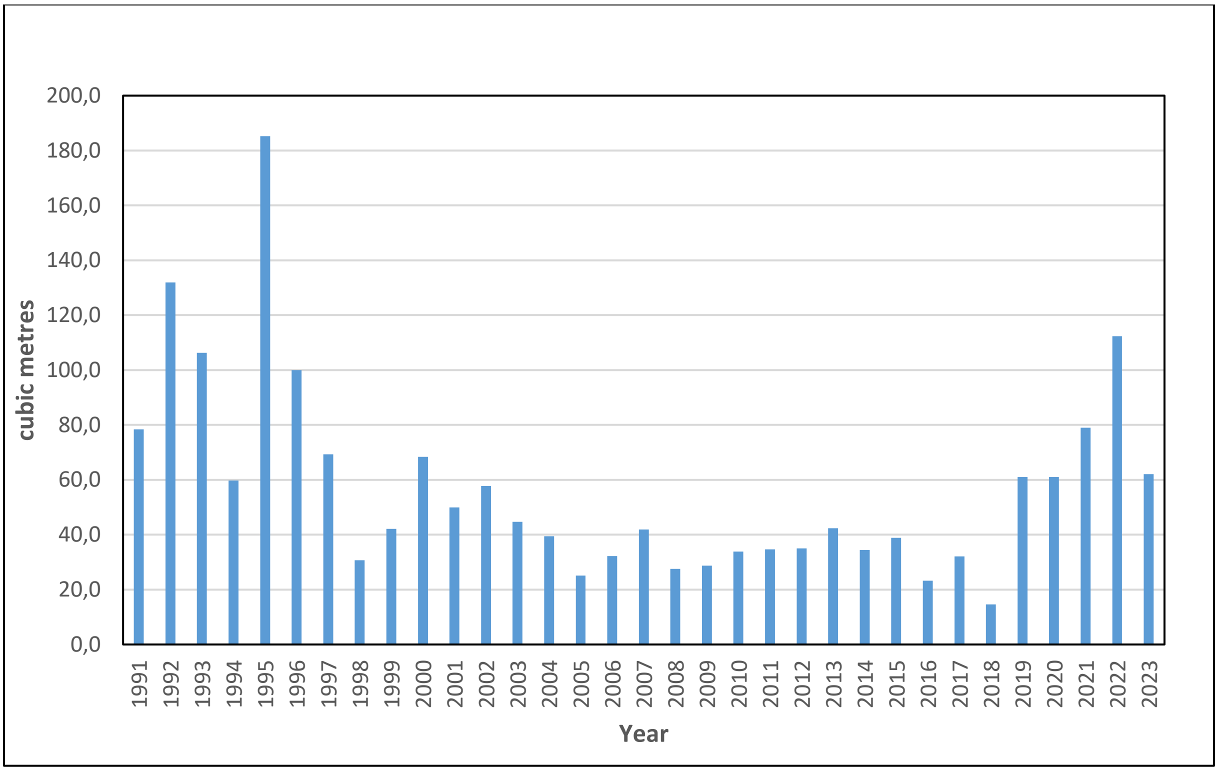
Performance Indicators of the Krško NPP

The volume of low- and intermediate-level solid radioactive waste is one of the performance indicators of the Krško NPP. The purpose of the low-level solid radioactive waste indicator is to monitor progress toward reducing the volume of low-level waste production, which will decrease storage, transportation, and the final disposal needs, and improve public perception of the environmental impact of nuclear power. This indicator is defined as the volume of low-level solid radioactive waste that has been processed and is, in its final form, ready for disposal during a given period. The volume of radioactive waste that has not completed processing and is not yet in its final form is not included. Low-level solid radioactive waste consists of dry active waste, sludge, resins and evaporator bottoms generated as a result of nuclear power plant operation and maintenance. Low-level refers to all radioactive waste that is not spent fuel or a by-product of spent fuel processing.

It can be noticed that the trend as to the volume of low-level radioactive waste stored at the end of year is positive. Contributors to this trend include improvement of the systems for radioactive waste treatment and the introduction of a highly restrictive programme for radioactive waste management control. The systems for radioactive waste treatment were improved by putting an in-drum drying system into operation, the reconstruction of the waste and boron evaporator packages, and the installation of the supercompactor. Additional volume minimisation is achieved with incineration of burnable waste.

One of the highest priorities at the Krško NPP in recent years has been to reduce the volume of low-level solid radioactive waste produced. The Krško NPP goal for the period 2005-2007 was ≤ 45 m^3 per year and for the period 2008-2019 ≤ 35 m^3 per year. This task was more or less fulfilled, as it can be seen in Figure 25 that only in 2013, 2015 and 2019-2023 did the amount of LILW exceed the goal. The amount of LILW in the period 2019–2023 was exceeded due to the inaccessibility of the storage during the construction of the Waste Manipulation Building in the previous years and the repositioning of the supercompactor from the RW storage to the WMB, causing the supercompactor inoperable during this time. The forced outage in 2023 also resulted in the generation of more radioactive waste. Volume reduction of generated LILW was additionally performed with the incineration of burnable waste and the compaction of compressible waste.

Figure 25: **Annual generation of LILW at the Krško NPP**



General Description of the TRIGA Mark II Research Reactor

The TRIGA Mark II research reactor is a part of the JSI Reactor Infrastructure Centre. A view of the JSI Reactor Infrastructure Centre is shown in Figure 26.

Figure 26: **View of the JSI Reactor Infrastructure Centre**

The reactor is a typical 250 kW TRIGA Mark II light-water reactor with an annular graphite reflector cooled by natural convection. Approximately 40 litres of spent ion exchange resins, 100 litres of activated or contaminated experimental and protective equipment, and 600 litres of aluminium irradiation containers are produced annually during the operation of the reactor, as well as from work in the hot cell and controlled areas of the Department of Environmental Sciences. The Radiation Protection Unit of the Institute collects disused radioactive material in the temporary storage in the hot cell facility. The material is declared radioactive waste after repacking, treatment (compression), and detailed characterisation. The Jožef Stefan Institute annually produces approximately one drum (0.2 m^3) of solid radioactive waste.

Figure 27: **JSI TRIGA Mark II reactor**

The core is placed at the bottom of a 6.25 m-high open tank with a 2 m diameter filled with demineralised water. The core has a cylindrical configuration. There are 91 locations in the core, which can be filled with either fuel elements or other components, such as control rods, a neutron source, irradiation channels, etc. The core lattice has an annular but not a periodic structure. The elements are arranged in six concentric rings. Each location corresponds to a hole in the aluminium upper grid plate of the reactor. A bottom grid plate supports the core, providing accurate spacing between the fuel elements. The top grid plate also provides precise lateral positioning of the core components.

A graphite reflector enclosed in an aluminium casing surrounds the core. Two horizontal irradiation channels run through the graphite reflector and the tangential irradiation channel. Other horizontal channels extend only to the outer edge of the reflector.

Fuel Elements

The TRIGA fuel element is a cylindrical rod with stainless steel cladding. There are cylindrical graphite slugs at the top and bottom ends, which act as axial reflectors. In the centre of the fuel material is a hole filled by a zirconium rod. A molybdenum disc is between the fuel meat and the bottom graphite end reflector. The fuel is a homogeneous mixture of uranium and zirconium hydride. The basic data on the TRIGA fuel element is given in Tables 20 and 21.

Table 20: **Data on the standard TRIGA fuel element**

Component	Dimension [cm]	Material	Density [g/cm^3]
Fuel element			
Outer diameter	3.8		
Element length	72.1		
Fuel material		U-ZrH	6.0
Outer diameter	3.6		
Inner diameter	0.64		
Height	38.1		
Zr rod		Zr	6.5
Diameter	0.64		
Height	38.1		

Component	Dimension [cm]	Material	Density [g/cm³]
Axial reflector		Graphite	1.6
Diameter	3.6		
Height upper	6.6		
Height lower	9.4		
Supporting disc		Mo	10.2
Thickness	0.079		
Cladding		SS-304	7.9
Thickness	0.025		
Top and bottom ends		SS-304	7.9
Height top	10.4		
Height bottom	7.6		

Table 21: **Standard TRIGA fuel element**

Total mass of the uranium [g]	278.0
Mass of ^{235}U [g]	55.4
U in U-ZrH [wt.%]	11.9
Enrichment [wt.%]	19.9
H/Zr atom ratio	1.6