SLOVENIA

a. National Framework for management of radioactive waste and spent fuel

Policies, strategies, roles and responsibilities of different stakeholders (e.g. institutions overview, implementing organizations)

Short presentation of nuclear programme in Slovenia

The Republic of Slovenia has a small nuclear programme; one operating nuclear power plant, one operating research reactor and one operating central interim storage facility for radioactive waste from small producers. In addition, there is also a closed uranium mine with mill tailings site Boršt and the Jazbec mine waste pile at Žirovski vrh.

The Republic of Slovenia has no operational facility for final disposal of radioactive waste or spent nuclear fuel. Repository for LILW is in the process of licensing and construction is planned in 2018 with trial operation starting 2020.

Key nuclear stakeholders and their roles:

Nuclear industry: The Krško Nuclear Power Plant (Krško NPP) is one of the main pillars of the Slovenian power system. It is a Westinghouse two-loop Pressurised Water Reactor with nominal output power 727/696 MWe (gross electrical power/net electrical power). Commercial operation started in 1983. It's designed operational lifetime was extended to 60 years in 2014. Lifetime extension till 2043 was approved by the owners and Slovenian Nuclear Safety Administration (SNSA).

The plant is owned by state-owned Slovenian and Croatian electrical power companies, GEN energija d.o.o. and Hrvatska Elektroprivreda d.d., respectively. It is operated by the public enterprise Krško NPP d.o.o. The Krško NPP is the major producer of radioactive waste in the Republic of Slovenia. As part of the technological process of electricity production, all operational radioactive waste and spent nuclear fuel are stored within the plant area. Solid radioactive waste is treated and then packed into steel drums, which are then stored in the solid radwaste storage facility.

Scientific research: The Jožef Stefan Institute Reactor Infrastructure Centre is a part of the Jožef Stefan Institute (IJS). One of the activities of the centre is operation of the TRIGA Mark II research reactor for the needs of IJS and other research groups. The TRIGA Mark II research reactor is a General Atomic open-pool type research reactor with the 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 mainly used in research projects and for education and training.

In addition the reactor produces a minor amount of low and intermediate level waste (LILW). The integral part of the IJS Reactor Infrastructure Centre is a hot laboratory, which is among others licensed also for treatment of radioactive waste from small producers.

Mining: The Žirovski vrh Uranium Mine was in operation in the period from 1984 to 1990. The Žirovski vrh Uranium Mine terminated its regular operation in 1990. In 1992, the Republic of Slovenia, established a company called Žirovski vrh Mine d.o.o. to perform the permanent closure of the mine. The uranium mill is decommissioned and the resulting wastes are disposed of on mill tailings site Boršt and the Jazbec mine waste pile. The remediation work on disposal sites Jazbec is completed and closure procedures are in final stage. Realisation of Boršt remediation is not complicated due to reactivation of a landslide of the base of the tailings. Additional measures will be implemented to stabilise the base rock sliding.

Roles and responsibilities of different stakeholders for RW&SF management

Responsibility in the area of LILW management is clearly defined. Three independent parties – the producers of radioactive waste, the SNSA as the regulatory body and the ARAO as implementer of the public service for radioactive waste management – 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.

Producers of radioactive wastes are Nuclear power plant Krško (see above) and small producers (research, medicine, industry).

National radioactive waste management implementing organisation (WMO) is ARAO (Agency for Radwaste Management). ARAO is organised as independent non-profit organisation financed from the Slovenian budget and from industry (through decommissioning Fund).

ARAO has the responsibility of collecting, transporting, treating, storing and disposing of LILW, coming from the small producers in the Republic of Slovenia. It also has the responsibility of disposal of all radioactive waste coming from the operators of nuclear and radiation facilities, when applicable. ARAO is responsible for long-term monitoring and maintenance of closed disposal sites Jazbec and Boršt. All activities are made transparent to the public through annual reports, the internet and other outreach activities.

The Central Interim Storage for Radioactive Waste in Brinje is situated at the IJS Reactor Infrastructure Centre and is operated by ARAO. It is intended for storage of LILWarising 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 operation of the interim storage was transferred from the IJS to the Agency for Radwaste Management (ARAO). Following the refurbishment and two and a half years of trial operation, a new operating license was issued in early 2008 for the period of 10 years.

Regulatory authority: Slovenian Nuclear Safety Administration (SNSA) is a regulatory body with a mission to prevent or mitigate harmful effects of ionising radiation to workers, population and environment, and to assure use of nuclear energy for peaceful purposes only.
Its scope of competence includes carrying out administrative and professional tasks and regulating:

- nuclear and radiological safety of nuclear facilities, nuclear trade, transport and handling of nuclear and radioactive materials, accountability and control of nuclear materials,

- physical protection of nuclear facilities and nuclear materials liability for nuclear damage, professional qualifications of personnel operating nuclear facilities and their training,
- quality assurance in nuclear field,
- radiological monitoring of the environment,
- early notification in case of nuclear or radiological accidents, and
- international co-operation in the field of competence.

Radioactive Waste Management Policy

The Resolution on the 2006–2015 National Programme for Managing Radioactive Waste and Spent Nuclear Fuel (the Programme), is one of the key documents in the field of radioactive waste management. In the Programme, 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 producers (from medicine, industry and research) and other activities involving radioactive waste (the uranium mine under decommissioning, TENORM, decommissioning of reactors, etc.) are also described. The Programme includes an analysis of measures for the minimisation of radioactive waste production and its treatment and conditioning before disposal. The construction of a repository for short-lived LILW is one of the principal goals of LILW management in Slovenia. The limited storage capacities at nuclear facilities call for decisions to be taken and practical solutions to be found. 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 planned LILW repository includes all structures, systems and components required for its operation as an independent nuclear facility with an administrative building, a service building, a technological building and a disposal area with disposal silos.

In its long-term strategy for spent fuel management from NPP Krško Decommissioning Programme from 2004 foresees spent fuel storage in dry casks. To ensure uninterrupted operation and sufficient storage capacity in the spent fuel pool, a dry cask storage facility will be operational in 2018. The Resolution on the 2006–2015 National Programme for Managing Radioactive Waste and Spent Nuclear Fuel will be changed to take into account the results of stress tests and all the various solutions, which should include the options of long-term storage (100 years) and different options for fuel reprocessing and final disposal in a geological repository (national, regional and multinational).

b. National legal and regulatory framework

Primary legislation, regulations, regulatory organization, specific activities and facilities under regulation, and guidance on implementation

Slovenian legislation in the field of nuclear safety and radiation protection is comprehensive and harmonized with international standards.

The main law of the Republic of Slovenia in this area is the Ionising Radiation Protection and Nuclear Safety Act (the 2002 Act) which also regulates radioactive waste and spent fuel management. The Act was amended in 2003, 2004 and 2011. The next amendment of the 2002 Act is foreseen for 2015. The proposed amendments contain provisions on governing the implementation of different public services (management of radioactive waste, disposal of radioactive waste, long-term monitoring and

maintenance of repositories of mining and hydro-metallurgical tailings). The proposed amendments clearly define the obligations of the Agency for Radwaste Management, that carries out all the above activities, as well as its rights in the proceedings in which is undoubtedly expressed her legal interest (e.g. closure of the repository, where it will later perform a public service for long-term monitoring and maintenance).

In 2006, the Minister of the Environment and Spatial Planning adopted the Rules on Radioactive Waste and Spent Fuel Management.

In 2006, the Parliament of the Republic of Slovenia passed the Resolution on the 2006–2015 National Programme for Managing Radioactive Waste and Spent Nuclear Fuel (Official Gazette of the Republic of Slovenia, No. 15/2006). This Programme is a part of the National Environment Protection Programme and sets goals and tasks in the field of radioactive waste and spent nuclear fuel management. Update of resolution for period 2016-2025 is in progress and will be adopted by the end of 2015.

The Republic of Slovenia implemented the basic standards of the International Atomic Energy Agency in its legislation. In 2011, all WENRA European Reference Levels for nuclear power plants were transferred into the binding Slovenian regulations and in that way Slovenian legislation was harmonised with the best European practice.

c. Radioactive waste management, decommissioning and spent fuel strategy and current practices & technologies

Waste and spent fuel management activities/facilities, overview of main waste and spent fuel issues, overview of research and development programs, overview of financing of waste and spent fuel management

In 2003 Agreement between the governments of Slovenia and Croatia on the status and other legal issues related to investment, exploitation, and decommissioning of the Nuclear power plant Krško was ratified by both sides. Both contracting parties will regularly contribute into special national funds in the amount estimated in jointly prepared programs. Each fund will finance half of all the activities related to decommissioning of NPP Krško and to joint management of RW and SF. Decommissioning of the Krško Nuclear Power Plant and 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 the economic and environmental protection points of view.

1st revision of Programme of NPP Krško Decommissioning and SF & LILW Disposal, Revision 1 (DP Rev.1) was completed in the first half of 2004.

Integrated scenario of the NPP decommissioning and joint RW & SF management foresees that decommissioning activities will begin immediately after the NPP shut down and will be completed in 15 years. One LILW repository (either in Slovenia or in Croatia) would be built starting to operate in 2020.

Conditioning, Treatment, and Storage Facilities

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 storing in the plant's radioactive waste storage locations. These radioactive substances are processed in a system for radioactive waste treatment. The system is constructed for collecting, processing, storing and packaging of waste in a suitable form to minimize releases into the environment. Three fundamental systems are used for radioactive waste management, namely for liquid, solid and gaseous radioactive waste.

All solid radioactive waste generated during plant operation, maintenance activities and servicing, is collected in the Solid Radioactive Storage Facility.

Solid waste is compressed and encapsulated in standard-size 208 l stainless steel drums. These drums are presently stored in the Solid Radwaste Storage Facility within the plant area. The solid radioactive waste processing system is designed for packaging all solid waste in standard-size 208 l stainless steel drums. Spent resins, evaporator bottoms and chemical drain tank effluents are encapsulated in the drums, while solid compressible waste is compressed directly in the drums. Incompressible waste is packed in the drums without further processing.

To reduce the volume of solid radioactive waste to be stored, supercompaction campaigns have been carried out. In 2006, the Krško NPP obtained a license and started to compress LILW with their own on-site supercompactor. Tube-type containers are used as preferred final package and as a drum overpack in the plant radioactive waste storage facility.

The Krško NPP has started using an external service for the incineration of combustible waste.

Central Interim Storage for Radioactive Waste in Brinje is a near-surface concrete building with the roof covered with a soil layer. The building is subdivided by concrete walls into nine storage sections and an entrance area. The ground plan of the facility is 10.6 m x 25.7 m with a height of 3.6 m. The useful capacity of the storage is about 115 m^3, and the remaining small area is intended for workers, for loading and unloading the waste and for internal transport.

The facility is equipped with a ventilation system for reducing radon concentration and air contamination in the storage facility. The water and sewage collecting system is designed as a closed system to retain all liquids from the storage facility in the sump.

Spent Fuel storage: Spent fuel is stored in the spent fuel pool, inside the Fuel Handling Building of the Krško NPP. In 2003, a project of increasing the storing capacity of the spent fuel pool (reracking) was completed. After the reracking, 1694 storage locations are available for spent fuel. Following the accident at Fukushima in 2011, more restrictive requirements were implemented for safe storage of nuclear fuel in the spent fuel pool under potential beyond design bases accidents. Due to these requirements the storage capacity of the spent fuel pool was estimated to be sufficient for operation until 2018.

d. Radioactive waste classification, waste and spent fuel quantities (inventory) (including disused sources that are declared radioactive waste)

The Regulation on Radioactive Waste Management and Classification of Radioactive Wastes takes into account, with some modifications, the radioactive waste categorisation system recommended in 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 being 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.

With regard to their aggregation state, radioactive waste is divided into solid, liquid and gaseous waste.

With regard to the level and type of radioactivity, the solid radioactive wastes are 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:
    a. short-lived LILW, containing radionuclides with a half-life shorter than 30 years and 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;
    b. 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.

Table 1 Radioactive Waste In Storage (including spent fuel that is considered waste)

Route Waste Class	Processed (type)/ Unprocessed)	Total Current Volume (m^3)	Estimated Disposal Volume (m^3)	Distribution (%)							Planned Disposal Route (if known)
				RO	FFE	RP	NA	DF	DC / RE	ND	
Total of all		(m^3)	(m3)	(%)	0 (%)	0 (%)	(%)	0 (%)	(%)	(%)	

Classes											
Line for each class (as per national classes or IAEA classification)		(m3)	(m3)	(%)	0 (%)	0 (%)	(%)	0 (%)	(%)	(%)	
Line for each class (as per national classes or IAEA classification)		(m3)	(m3)	(%)	0 (%)	0 (%)	(%)	0 (%)	(%)	(%)	
…		(m3)	(m3)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	
…		(m3)	(m3)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	
…		(m3)	(m3)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	

NEWMDB waste origin type codes:

RO – reactor operations

FFE – fuel fabrication & enrichment

RP – fuel reprocessing

NA – nuclear applications

DF - defence

DC/RE – decommissioning & remediation

ND – Not Determined

Table 2 Radioactive Waste Disposed (as disposed volume)

No disposed waste volumes!

Waste Class	Processed (not)	Total Volume (m^3)	Distribution (%)							
			RO	FFE	RP	NA	DF	DC / RE	ND	Disposal Route Used
Total of All Classes		(m3)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	
Line for each class (as per national classes or IAEA classification)		(m3)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	
…		(m3)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	

(Note: Abbreviations as in Table 1)

Table 3 Spent fuel in Storage (MTHM)

Type	Current Amount (NPP)	Current Amount (Research Reactors)
Total Spent Fuel Storage	MTHM	0 MTHM
Wet storage (AR)	450 MTHM	0 MTHM
Wet storage (AFR)	0 MTHM	0 MTHM
Dry storage (AR)	0 MTHM	0 MTHM
Dry storage (AFR)	0 MTHM	0 MTHM
Total spent fuel held in storage for other countries (amounts also included above)	0 MTHM	0 MTHM

Table 4 Spent fuel sent for reprocessing (in the country or sent to another country)[1] (MTHM)

No fuel sent to reprocessing!

Type	Current Amount (NPP)	Current Amount (Research Reactors)
Total amount Spent Fuel sent to Reprocessing (in your country)	MTHM	MTHM
Total amount Spent Fuel sent to Reprocessing (in another country)	MTHM	MTHM
Total amount of Spent Fuel received from another country for reprocessing and recycling	MTHM	MTHM
Total amount of Spent Fuel (MTHM) or radioactive waste (cubic metres) returned to country of origin for storage/disposal	MTHM /m3	MTHM/m3

AR = "at reactor site", including fuel pools at NPP

AFR = "away from reactor site"

In the case of disused sources not included in volumes according to the relevant national waste classes, please include a similar table for disused sources declared as numbers of items stored and disposed.

Table 5 below shows a translation matrix from national classification system to IAEA classes.

[1] All years

Table showing conversion factors from stored waste volumes to disposed waste volume for forecasts, if required.

Table 5 Example of a translation matrix (from NEWMDB) that can be used for transition from a national classification system to IAEA classification (see Section 3)

National Waste Classification Name	**VLLW**	**LLW**	**ILW**	**HLW**
Class A	100%			
Class B		90%	10%	
Class C			80%	20%
Class D				100%
…				

a. Tabulation of processing, storage and disposal facilities for waste and spent fuel, including their capacities and status

Tabular information of spent fuel facilities Total number of Fuel cycle facilities (by type and status) from INFCIS types "Spent Fuel Storage"; "Spent Fuel Reprocessing and Recycling" and "Spent Fuel Conditioning" Total number of waste management facilities (by type and status) from NEWMDB

Table 6 (sample of data based on format of table from INFCIS)

Type	**Planned**	**Construction**	**Commissioning**	**In Operation**	**Shutdown**	**Decomm.**	**Other**	**Total**
Spent Fuel Storage	(number)	(number)	(number)	(number)	(number)	(number)	(number)	
Spent Fuel Reprocessing and Recycling	(number)	(number)	(number)	(number)	(number)	(number)	(number)	
Spent Fuel Conditioning	(number)	(number)	(number)	(number)	(number)	(number)	(number)	
Spent Fuel disposal	(number)	(number)	(number)	(number)	(number)	(number)	(number)	
Waste processing								
(multiple lines by country waste class)	(number)	(number)	(number)	(number)	(number)	(number)	(number)	
Waste storage:	(number)	(number)	(number)	(number)	(number)	(number)	(number)	
(multiple lines by country waste class)	(number)	(number)	(number)	(number)	(number)	(number)	(number)	

Type	Planned	Construction	Commissioning	In Operation	Shutdown	Decomm.	Other	Total
Waste disposal:	(number)	(number)	(number)	(number)	(number)	(number)	(number)	
(multiple lines by country waste class)	(number)	(number)	(number)	(number)	(number)	(number)	(number)	

Table 7 Summary of major sources of waste (from IAEA PRIS, INFCIS & RRDB databases)

Type	Planned	Construction	Commissioning	In Operation	Shutdown	Decomm.	Other	Total
Research reactors*	(number)	(number)	(number)	(number)	(number)	(number)	(number)	
Nuclear Power reactors	(number)	(number)	(number)	(number)	(number)	(number)	(number)	
Spent Fuel Reprocessing and Recycling	(number)	(number)	(number)	(number)	(number)	(number)	(number)	
Other (define)**	(number)	(number)	(number)	(number)	(number)	(number)	(number)	
(multiple lines if required)								

* Note: research reactors with medium or high power from RRDB

Note: "Planned" means it has been identified in a national report, strategy, or formal plan. It includes: Planned, Under Study-Assessment, Siting-Design phases

** if applicable, where included in national inventory, e.g. decommissioning of contaminated facilities, cleanup of accident related sites

e. Trends and future prospects (volumes of waste and spent fuel arising, waste and spent fuel management facilities)

text field that summarizes significant points, e.g. from Joint Convention report

tabular data of amounts, where available

Table 8 e. Trends and future prospects (estimation of volumes of waste and spent fuel arising, waste and spent fuel management facilities)

Type	Current amount	Estimated Current amount when prepared for disposal*	Current Disposal Capacity	Total forecast at 2030		Total forecast at 2050	
Spent Fuel Storage	MTHM			MTHM		MTHM	
Wet storage (AR)	MTHM			MTHM		MTHM	
Wet storage (AFR)	MTHM			MTHM		MTHM	
Dry storage (AR)	MTHM			MTHM		MTHM	
Dry storage (AFR)	MTHM			MTHM		MTHM	
Total amount Spent Fuel sent to Reprocessing and Recycling	MTHM			MTHM		MTHM	
Total amount Spent fuel disposed	MTHM		MTHM	MTHM		MTHM	
Waste in storage:	(m3)	(m3)		(m3)		(m3)	
(multiple lines by country waste class or IAEA classification)	(m3)	(m3)		(m3)		(m3)	
Waste disposal:	(m3)		(m3)	(m3)		(m3)	
(multiple lines by country waste class or IAEA classification)	(m3)		(m3)	(m3)		(m3)	

AR = "at reactor site"

AFR = "away from reactor site"

* calculated equivalent amount when waste has been conditioned and packaged for disposal as per table of conversion factors given.

Sources of data, assumptions (especially for future waste forecasts) and references

text field that summarizes significant sources of data, assumptions (e.g. number and expected life of NPPs, number being decommissioned, etc), etc

List of references

[1] Fifth Slovenian Report under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management date of profile preparation, October 2014.

[2] Annual Report 2013 on Radiation and Nuclear Safety in the Republic of Slovenia, Slovenian Nuclear Safety Administration, June 2014

[3] Resolution on the 2006-2015 National Programme for Managing Radioactive Waste and Spent Nuclear Fuel, Off. Gaz. of the RS Nr. 15/2006

[4] Resolution On Nuclear and Radiation Safety in the Republic of Slovenia for the period 2013–2023 (ReNRS13–23) , unofficial translation of the original published in Slovene language in the Official Gazette of the Republic of Slovenia, No. 56/2013

[5] Rules on radioactive waste and spent fuel management, Off. Gaz. of the RS Nr. 49/2006