REPUBLIC OF SLOVENIA
MINISTRY OF THE ENVIRONMENT AND SPATIAL PLANNING
SLOVENIAN NUCLEAR SAFETY ADMINISTRATION

Fourth 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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October 2011

Publisher:

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Ljubljana, October 2011

URSJV/RP-083/2011
ISSN 1581-6141

Cover photo: Photos of the Central Storage Facility and related activities

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PREFACE

The National Report on Fulfilment of the Obligations of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management is prepared in fulfilment of Slovenia's obligation 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 Krško NPP, the Jožef Stefan Institute, the Agency for Radwaste Management, the Žirovski vrh Mine d.o.o., the Ministry of the Economy, the Isotope Laboratory of the Institute of Oncology, the Department for Nuclear Medicine of the Ljubljana University Medical Centre and the Slovenian Radiation Protection Administration.

The report was adopted by the Government of the Republic of Slovenia in September 2011.

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LIST OF ABBREVIATIONS

ADR	European Agreement Concerning the International Carriage of Dangerous Goods by Road
ALARA	As Low As Reasonably Achievable
ARAO	Agency for Radwaste Management
CFR	Code of Federal Regulations
EU	European Union
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IJS	Jožef Stefan Institute
LILW	Low and Intermediate Level Waste
NPP	Nuclear Power Plant
OECD / NEA	Organisation for Economic Co-operation and Development/ Nuclear Energy Agency
OSART	Operational Safety Review Team
PHARE	Central and Eastern European Countries Assistance for Economic Restructuring
PWR	Pressurised Water Reactor
RS	Republic of Slovenia
SFRY	Socialistic Federative Republic of Yugoslavia
SNSA	Slovenian Nuclear Safety Administration
SRPA	Slovenian Radiation Protection Administration
TENORM	Technologically Enhanced Naturally Occurring Radioactive Material
TLD	Thermoluminiscent Dosimeter
TRIGA	Training Research Isotope General Atomic operated by IJS
USA	United States of America
US NRC	United States Nuclear Regulatory Commission
WANO	World Association of Nuclear Operators

EXECUTIVE SUMMARY

Slovenian Nuclear Programme

The Republic of Slovenia has a small nuclear programme: one operating nuclear power plant, one research reactor and one central storage facility for radioactive waste from small producers. In addition there is also a uranium mine and mill in the decommissioning stage at Žirovski vrh. The geographical locations of the nuclear and radiation facilities are given in the figure below. The Republic of Slovenia has no facility for final disposal of radioactive waste or spent nuclear fuel.

Figure 1: **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 727/696 MW_e (gross electrical power/net electrical power). It is designed to operate until the end of 2023. The designed life extension is being considered. 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. Spent nuclear fuel is stored under water in the spent fuel pool.

The Jožef Stefan Institute Reactor Infrastructure Centre (IJS Reactor Infrastructure Centre) is a part of the Jožef Stefan Institute (IJS). It is located in Brinje, about 15 km north-east of Ljubljana. The main purpose 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 used in research projects, and to a limited extent for the production of isotopes for medicine and industry as well as for education. Fuel elements are kept in the reactor building of the IJS Reactor Infrastructure Centre. In addition to spent fuel, 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 other licensed also for treatment of radioactive waste from small producers.

The research reactor is operated by the Jožef Stefan Institute, a public research institution that is financed through the national budget by the Ministry for Higher Education, Science and Technology.

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 was produced. The Žirovski vrh Uranium Mine terminated its regular operation in 1990. The decision to close it was influenced by economic reasons, since the 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 called Žirovski vrh Mine d.o.o. to perform the permanent closure of the mine (Permanent Cessation of Exploitation of the Uranium Ore and Prevention of Consequences of the Mining in the Uranium Mine at Žirovski vrh Act). The financial resources for decommissioning and restoration were provided through the national budget.

All entrances to the underground mine are closed. The uranium mill is decommissioned and the resulting wastes are disposed off on the mining waste disposal site Jazbec. To this site all mining waste from numerous other mining waste piles has been moved and disposed of. The total amount of disposed material on this site is 1,910,425 tons with a total activity of 21.7 TBq. On the uranium mill tailings disposal site Boršt, 610,000 tons of hydrometallurgical waste, 111,000 tons of mine waste and 9,450 tons of the material collected during decontamination of the mill tailings site Boršt vicinity have been disposed of with a total activity of 48.8 TBq. The remediation work on Boršt disposal is delayed due to activation of a landslide.

The Central Storage for Radioactive Waste in Brinje, situated at the IJS Reactor Infrastructure Centre, is intended for 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 operation of the 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.

The Agency for Radwaste Management is a non-profit organisation of the Slovenian Government which provides a state-owned public service for radioactive waste management. It is financed through the national budget and partially through the Fund for the Decommissioning of the Krško NPP.

Governmental Policy

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

- Establishment and functioning of the regulatory body, the Slovenian Nuclear Safety Administration (SNSA), which is competent in the area of nuclear and radiation safety and radioactive waste management. It was established in 1987. Previously, the functions of the regulatory body were held by the Committee of Energy and Industry.
- Establishment of ARAO as a state-owned public institution for radioactive waste management (1991).
- Establishment of the Žirovski vrh Mine d.o.o., a public enterprise for the decommissioning of the uranium production site (1992).
- Establishment of the Fund for the Decommissioning of the Krško NPP (1995).

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

The Resolution on the National Energy Programme adopted by the Slovenian Parliament in 2004. In this document the following policy was adopted:

- The share of nuclear energy shall be preserved at the current level.
- The Krško NPP shall operate at least until 2023.
- In order to secure safe and reliable operation of the Krško NPP, adequate measures are implemented.
- The decision on life extension of the Krško NPP shall be adopted in 2011 on the basis of an evaluation programme which shall start in 2008.

The revised National Energy Programme (NEP) is in public consultation. The life extension of the NPP Krško is considered and the construction of a new power plant is planned.

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). In the Agreement the following policy is adopted:

- Decommissioning of the Krško Nuclear Power Plant and management of its radioactive waste and spent fuel are a joint responsibility of the contracting parties, and they should ensure efficient common solutions both from the economic and environmental protection standpoint.
- If the contracting parties do not reach agreement on a common solution for RW and SF management during the lifetime of the Krško NPP, they undertake that two years after that period they must finish removal of operational RW and SF from the location of the Krško NPP (one half by each party) and will individually bear the costs of their management (including subsequent division and removal of RW from decommissioning).

- The contracting parties shall in equal shares assure funds for the preparation of the decommissioning programme and its execution and the 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 for the disposal of radioactive waste and spent fuel they shall finance it in equal shares or they shall finance their shares of activities.
- The Republic of Slovenia and the Republic of Croatia shall jointly prepare and approve a new plan for decommissioning of the Krško NPP and disposal of LILW and high level waste (hereinafter the Decommissioning Plan).
- The Croatian party has, according to the Agreement, established its own fund for the management and collection of financial resources for its share of decommissioning and radioactive waste disposal costs.

The current contribution to the Slovenian fund for financing one half of the decommissioning and spent fuel and radioactive waste disposal is 0.30 Euro cents per kWh_e of the Slovenian share of energy produced in NPP Krško.

The revision of the Programme for Decommissioning of the Krško NPP and Disposal of LILW and High Level Waste is not finished yet. According to current information the levy per kWhe shall be increased.

The Resolution on the 2006-2015 National Programme for Managing Radioactive Waste and Spent Nuclear Fuel was adopted by the Slovenian Parliament in February 2006. According to the programme, the NPP Krško as the major radioactive waste generator shall continue to operate until 2023 with an option of life extension. After termination of NPP Krško operation, the spent fuel will be transferred to dry storage for a period of about 35 years, when the spent fuel repository should be operable. The LILW waste repository shall be built in Slovenia. The design of the repository should be modular, with sufficient capacity to accommodate all future LILW waste arising in Slovenia. The spent fuel from the Triga Mark II research reactor will be returned to the country of origin. The waste stored at the Central Storage for Radioactive Waste in Brinje and the waste from small producers, meeting the waste acceptance criteria, shall be disposed of in the LILW repository. The remaining waste from the Central Storage for Radioactive Waste in Brinje shall be stored at the facilities of the repository if agreement on this issue is reached with the local community.

Siting of the LILW repository

Within the framework of "Siting of the LILW repository", the activities were carried out at two sites: Vrbina (Krško municipality) and Vrbina Šentlenart (Brežice municipality). The latter was proposed only at the beginning of 2007. Within the process of preparation of the Spatial Plan of National Importance for the Vrbina site, the SNSA issued guidelines determining the contents and scope of the Special Safety Analysis of the LILW repository. Considerable effort and attention are devoted to communication with stakeholders, both local communities, non-governmental organisations and others.

The municipality council of Krško gave its consent to the proposal of the national spatial plan in July 2009. A great success was acceptance of the Decree on a Detailed Plan of National Importance for a LILW repository in Vrbina in Krško municipality, at the end of 2009. With its publication in the Official Gazette of the Republic of Slovenia No. 114/09 on December 31, 2009 the procedure for siting of the repository was finished. Due to uncertainties regarding the decision on a joint solution for the disposal of LILW the preparation of environment impact assessment and preparation of the Safety Case is progressing with slow pace.

The following internet sites are available for additional information:

- Slovenian Nuclear Safety Administration: *http://www.ursjv.gov.si/*
- 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.: *http://www.gen-energija.si/*
- Žirovski vrh Mine d.o.o.: *http://www.rudnik-zv.si/*
- Fund for Financing the Decommissioning of the Krško Nuclear Power Plant and for the Disposal of Radioactive Waste from the Krško Nuclear Power Plant: *http://www.sklad-nek.si/*

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 in the Parliament in February 1999. It entered into force for the Republic of Slovenia in June 2001.

In this fourth report the fulfilment of the obligations in the period 2008-2010 is evaluated. The report presents the achievements and contributions to enhance the safe handling and disposal of spent fuel and radioactive waste.

This report is prepared to meet the obligation for reporting under Article 32 of the Convention. It is structured in accordance with IAEA guidelines INFCIRC/604/Rev.1. In order to provide fluent reading, certain information is provided in the form of attachments and referred to in the text. The information provided in the report presents the status at the end of 2010.

In the following sections the fulfilment of each 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.

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

In 1996, the Slovenian Government adopted the Strategy for Long-Term Spent Fuel Management, which was later superseded by the **Resolution on the 2006-2015 National Programme for Managing Radioactive Waste and Spent Nuclear Fuel**, adopted by the Slovenian Parliament in February 2006. The National Programme duly implements the relevant provisions of the Agreement with Croatia.

According to the Agreement the contracting parties shall, in equal shares, assure funds for the preparation of the decommissioning programme and its execution, and funds for the preparation of the programme for disposal of radioactive waste and spent fuel. If the contracting parties agree on a joint solution for the disposal of radioactive waste and spent fuel they shall finance it in equal shares or they shall be responsible for their shares of waste and they shall finance the related activities.

On the basis of the Agreement, the Republic of Slovenia and the Republic of Croatia jointly prepared and approved a **Programme for Decommissioning of the Krško NPP and Disposal of LILW and High Level Waste** (hereinafter the Decommissioning Programme) in 2004. In accordance with requirements from the Agreement that a new revision of the document should be adopted every 5 years, in 2008 the preparation of revision 2 of the Decommissioning Programme started and is now under the revision process from all involved stakeholders. For the decommissioning and disposal several options were evaluated.

According to the Decommissioning Programme for all domestic scenarios the disposal in deep geological formations is considered to be the only technically feasible and safe long-term solution for spent fuel and high level waste. In preparing the evaluation, the Swedish concept was used as a guideline.

The basic characteristics of the concept are:

- direct disposal of spent fuel in appropriate canisters, capacity for 1600 fuel elements or 620 metric tons of metallic uranium with a small additional volume of high level waste (~16 m^3).
- The following phases were studied and evaluated: research and development including site selection and characterisation, design and construction, operation and closure.

As an alternative to the disposal in deep geological formation either in Slovenia or in Croatia, also an option of export and disposal of spent nuclear fuel in a third country was considered.

The Decommissioning Programme in its long-term strategy for spent fuel management foresees spent fuel storage in dry casks. Spent fuel will be moved from pool to dry storage between 2024 and 2030 and will be stored in casks until 2065, when a deep geological repository is assured. The operational phase of the spent fuel repository will end in 2070 and the repository should be closed in 2075. In the case of export option, the removal of spent fuel from dry storage is planned between 2066 and 2070.

(ii) Spent Fuel Management Practices

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

Krško NPP

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. The storage capacity is sufficient for the planned lifetime operation until the year 2023. By the end of 2010, 985 locations were occupied with nuclear fuel.

After reracking, the spent fuel racks are of two types. The old racks are designed without neutron poison control. These racks provide 621 cells (6 times 72, plus 3 times 63 cells), and constitute 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 1073 usable cells.

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

Technical characteristics of the spent fuel pool

The spent fuel pool structure is made of reinforced concrete. The walls and the bottom 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 allow 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 cleanup system is designed to remove the decay heat generated by the spent fuel assemblies stored in the spent fuel pool, and 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.

Water purification system with a spent fuel pool demineraliser and filter is designed to provide adequate purification in order to permit unrestricted access of the plant personnel to the spent fuel storage area and to maintain 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 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 (US 10 CFR, Part 20, limit for unrestricted access for plant personnel).

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 $18.4 \cdot 10^4$ Bq/cm^3 (β and γ radiation) or less, the dose at the water surface is 0.025 mSv/h or less, thus allowing unrestricted access for the plant personnel.

Criticality analysis for 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 assured 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.

Fuel management Strategy

All the spent fuel is stored in the spent fuel pool. 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 38.9 GWD/MTU while the last three spent fuel regions had an average burnup of 49.7 GWD/MTU. The Low Leakage Loading Pattern was introduced in the design several years ago. With this type of design additional reduction of spent fuel production was achieved.

IJS Reactor Infrastructure Centre

The 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 in use. The second one was constructed in 1992. Its capacity is 195 spent fuel elements. It is located in the basement of the reactor building. It is accessible by the crane through the lid in the reactor hall floor. The pool is 3.5 m deep and is plated with stainless steel sheets. It is equipped with an on-line water radioactivity monitor.

Both pools have been empty since 1999, when all spent fuel elements (total 219) were shipped to the USA. The new pool is maintained 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 with spent fuel during normal operation and fuel handling was performed and is included in the Safety Analysis Report.

(iii) Radioactive Waste Management Policy

The Resolution on the 2006-2015 National Programme for Managing Radioactive Waste and Spent Nuclear Fuel (the Programme), which was adopted by the Slovenian Parliament in March 2006, is one of the key documents in the field of radioactive waste management and is prepared in accordance with the 2002 Act. In the Programme, LILW management is treated as an integral process, covering all stages from waste generation to waste disposal. Different current and near-future radioactive waste streams and waste arising are taken into account, considering the present and the planned waste management practices. Besides radioactive waste from the Krško NPP also other small producers (medicine, industry, research) and other activities with radioactive waste (uranium mine under decommissioning, TENORM, decommissioning of reactors, etc.) are described. The Programme includes the analysis of measures for minimisation of radioactive waste production, its treatment and its conditioning before disposal. The siting and 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 and practical solutions.

A significant step forward in solving this problem was made by selection and approval of the site for LILW disposal in 2009. The Vrbina site in the municipality of Krško has been approved by the Government decree on the national spatial plan.

The 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 a state-owned public service for radioactive waste management, are involved in the process of radioactive waste management. The operators of nuclear and radiation facilities are responsible for radioactive waste management at their facilities. The ARAO has the responsibility of collecting, transporting, treating, storing and disposing of LILW coming from small producers in the Republic of Slovenia. The ARAO also has the responsibility of disposal of all radioactive waste coming from the operators of nuclear and radiation facilities, when applicable. All activities are made transparent to the public through annual reports, the Internet and other outreach activities. Special attention is devoted to communication and participation in decision making with the public in local municipalities with nuclear facilities and in the area where the LILW repository site is selected and to non-governmental organisations.

(iv) Radioactive Waste Management Practices

Within the scope of the Convention, the Central Storage for Radioactive Waste in Brinje, the Boršt mill tailings site and the Jazbec mine waste pile at the 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 (IJS Reactor Infrastructure Centre, industry, research and medicine) is managed in the Central Storage for Radioactive Waste in Brinje.

The Central Storage for Radioactive Waste in Brinje

After receipt from small producers, the radioactive waste is stored in the centralised storing facility for radioactive waste, located in Brinje near Ljubljana. The facility is operated by the ARAO. In the past, the government financed the storage of waste. However, in 2000 the "polluter pays" principle was also introduced into the segment of small producers of waste. The producers now pay the costs of waste management, including the cost of storing, treatment and conditioning, as well as future disposal of waste. With the transfer of waste all liabilities for further waste management are on the ARAO.

In order to comply with regulatory requirements, major refurbishment of the storage was finished in 2004. The Safety Analysis Report was updated and the license for two-year trial operation was issued in 2005. Until mid 2007 all deficiencies that occurred during the trial operation were corrected and some additional improvements were made. The Safety Analysis Report was updated again. At the end of this process in early 2008 the ARAO obtained from the SNSA the operating license for the Central Storage for Radioactive Waste which is valid for 10 years.

The repacking and conditioning of waste was performed in steps over several years in the nearby hot cell facility at the IJS. In 2008 the ARAO finished the characterisation, treatment and conditioning of all historic waste packages. All non-radioactive material, empty packages, and waste which already decayed below clearance limits were exempted from storage. The volume of LILW was reduced by approximately 30 %. In 2010 all wet waste was retrieved from storage, dried, packed, and returned to the storage.

The Žirovski vrh Uranium Mine

There are two permanent waste disposal sites: the Jazbec mine waste pile and the Boršt mill tailings site. All temporary mine waste disposal piles in the area were relocated to the Jazbec mine waste pile.

The general goal of the site rehabilitation project was to minimise, to the lowest reasonable level, radiological and chemical long-term impacts on the environment. The major objective was decontamination of the sites, buildings, structures and equipment, so that the facilities and the land can be reused or opened for the public.

In the course of remediation of the mine, part of the galleries have been backfilled with mine waste. All entrances into the mine have been sealed. Institutional water and air monitoring is assured.

The ore processing area and buildings have been decontaminated or demolished. After rehabilitation, the ore processing area is in free public use. Contaminated waste materials (scrap metal, plastics, building debris) were disposed of either into the mine or onto the Jazbec mine waste pile. No regular monitoring is needed at the mill site.

At the Jazbec mine waste pile there are 1,862,425 tons of mine waste, uranium ore, contaminated soil and building debris with average concentration 69 g U_3O_8/t and 48,000 tons of red mud from raffinate neutralisation, with the specific activity 65 kBq ^{230}Th/kg. The area of Jazbec is 67,325 m^2. To divert background and underground water into the culvert, polyethylene, steel and concrete pipelines have been built. Through the remedial action the deposited mining debris and the Jazbec mine waste pile were isolated from the rainfall waters with a multilayer cover to prevent or reduce contaminants dissolution and radon exhalation. The underground culvert is repaired to assure long-term stability, and intake of the surface hinterland water into the culvert was prevented. All other mine waste, contaminated soil and rubble from mine objects were removed and disposed of to this site by the year 2006. Remedial actions were finished in the year 2008. The radon exhalation rate from the waste pile surface was 1 Bq/m^{2}s before the remediation, after completed remediation the exhalation is < 0.05 Bq/m^{2}s. Institutional monitoring on seepage water, ground water level, air, object surface and stability control will be needed in the future.

The Boršt mill tailings site is situated on a hillside, 535-565 m above the sea level. During the short operational life of the tailing approximately 610,000 tons of mill tailings and 73,000 tons of mine waste were deposited there. In 2004, additional 38,000 tons of mine waste was transported to Boršt. During the years 2008 and 2009 9,450 tons of contaminated materials from decontamination of auxiliary objects were deposited on Boršt. The total mass of deposited materials is 730,450 tons. The area of Boršt is 42,000 m^2. The mill tailing materials are sands and slimes under 28 mesh (0.5 mm). Average activity of ^{226}Ra is 8,600 Bq/kg.

The accomplishment of remediation is complicated due to reactivation of landslide of the base of the tailing. The current rate of movement is approximately 10 cm per year. The expert group concluded that probability of collapse of the slope is negligible, and proposed investigation of the landslide by drill holes. It is planned that additional measures will be implemented to stabilize the base rock sliding under the Boršt mill tailings pile in the year 2012 or 2013.

The current arrangement of the mill tailings assured protection of the mill tailings against background waters, prevention of spread of soluble components into underground and surface waters, reduction of radon exhalation and prevention of erosion by rainfall. The multilayer cover of total thickness 2.05 m is composed of a drainage layer (mine waste, crushed stone), compacted clay (sealing layer), local material (protecting layer) and humus with grass. Remediation of the Boršt mill tailings started in 2007 and was finished in 2010. The radon exhalation rate from the mill tailings surface before the arrangement was 1-5 Bq/m^2s, and after final arrangement it is less than 0.1 Bq/m^2s. Institutional monitoring of seepage water, ground water, ground water level, air, surface integrity and of stability will be needed in the future.

All other surfaces in the mining area affected by uranium production have been decontaminated and will be returned to unconditional land use.

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. The waste generation rates based on the present situation and future options are predicted. 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 siting and construction of the repository for LILW, the storage capacities at the NPP are almost exhausted. The NPP is planning to assure additional storage capacity in the waste preconditioning area of the storage building. The entrance area of the storage building will be adjusted for preconditioning of 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 storing 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 of waste in a suitable form to minimise releases into the environment. Three fundamental systems are used for radioactive waste management, namely 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 of six decay tanks for compressed fission gases. Four of the tanks are used during normal plant operation, while the remaining two are used during the reactor shut-down. 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 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. This system is designed to collect, segregate, process, recycle, and discharge liquid radioactive waste. The system design considers the potential personnel exposure and assures that the quantity of radioactivity release 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 Radioactive 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 are the major solid waste. 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.

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 different types. With the introduction of the 18-month fuel cycle, the generation of radioactive waste was 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 awaiting melting. To reduce the volume of solid radioactive waste to be stored, supercompaction campaigns have been carried out.

The original Westinghouse procedure for evaporator bottoms and spent resin treatment was replaced with a treatment of 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 converts the concentrate into dry solid waste products with low residual moisture and no free water. The Krško

NPP has started using an external service for the incineration of combustible waste and melting of metal radioactive waste material.

The hazards associated with radioactive waste management are kept reasonably low. Different types of waste are segregated in an early collecting 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 products for supercompaction in the plant radioactive waste storage facility. Any new type of radioactive waste resulting from a new technology applied is evaluated and incorporated into the Safety Analysis Report.

Safety Review

According to the findings of the first Periodic Safety Review (2003), the Krško NPP radioactive waste storage operation is appropriate. In the original project, the radioactive waste storage was designed as a five-year interim storage. Some design changes have been conducted to increase storage capacity, including improved packaging. Consequently the storage period was extended. Due to the prolonged storage, a plant packaging inspection programme has been established to monitor the container integrity.

The 2nd NEK Periodic Safety Review phase shall be finished by December 15, 2013.

Small Producers of Radioactive Waste in the Republic of Slovenia

Management of radioactive waste generated by small producers (medical and industrial applications, research activities), was delegated to the state-owned public service, i.e. to the waste management agency ARAO. It includes: receipt of waste at the producer’s premises, transport of waste, treatment and conditioning, storage and future disposal of waste. The ARAO is also responsible for the management of radioactive waste in the case of industrial accidents and of historical waste.

- **Jožef Stefan Institute Reactor Infrastructure Centre**

  During the lifetime of the TRIGA Mark II research reactor, only a small amount of solid radioactive waste has been produced (approximately 50 litres per year in total). This waste consists mainly 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 Central Storage for Radioactive Waste in Brinje.

  The reactor does not directly produce any radioactive liquid waste. However, during the chemical treatment of irradiated samples in adjacent research laboratories, some radioactive liquids are produced. This liquid waste is collected and further conditioned. Waste water, containing radionuclides, is collected in a special 20 m^3 decay tank. After measuring the isotope concentration and activity, the liquids, when they reach the prescribed limits, are released to the Sava River.

No gaseous radioactive waste that needs further treatment and storing is produced. Radioactive gases produced 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, e.g. industrial radiography, thickness, level and density gauges, moisture detectors, eliminators of static electricity, lightning poles, etc. In the Republic of Slovenia, 88 industrial and research organisations possessed 1,093 sealed sources at the end of 2010. Spent and disused radioactive sources were either returned to the suppliers or shipped to the Central Storage for Radioactive Waste in Brinje.

Requirements for use and storage of disused radioactive sources and waste are set in the 2002 Act, Articles 9 to 16. For the conduct of radiation practices it is necessary to obtain a license. The applicant shall submit a plan for the use and storage of the radiation source as well as a plan for the handling of radioactive waste resulting from the radiation practice.

In 2005, the decontamination of buildings located at the Reactor Infrastructure Centre of the Jožef Stefan Institute, involved in past research in the field of uranium extraction for nuclear technology, started. The activities included removal of two standard transport containers where solutions containing uranium were stored. The solutions were chemically treated and uranium was transformed into 117 kilograms of sodium diuranate. The containers were chemically decontaminated as much as possible and some deeply contaminated areas were completely cut out. The uncontaminated steel went to scrap metal and the parts with irremovable contamination went into radioactive waste. A layer of contaminated soil under the containers was also removed. The technological hall was radiologically cleaned and allowed for unrestricted use.

The resulted radioactive waste was temporarily stored at the location of the Reactor center in Brinje. Since the waste contains low concentrations of natural radionuclides, the disposal at the Jazbec uranium mine tailing pile would be the preferred choice for their disposal. Although the SNSA has issued approval of the modified Safety Analysis Report for the Jazbec waste pile, the agreement for the disposal of a few tens of drums at this site was not reached because of the opposition of the local authorities. As a consequence, the Institute has begun the procedure for applying clearance over the content of 19 drums in which the concentration of the radionuclides is very low. The Institute prepared a dose estimation report and filed an application for the approval of conditional clearance for this waste. This was approved by the SNSA. According to the decision the material should be disposed of on a municipal landfill and covered with other waste material to prevent its collection and reuse. The material has not been cleared yet but the communication with local municipal landfill on its disposal is continuing.

The remaining drums, in which the concentration of the radionuclides was not low enough to be included in a clearance procedure, were transferred to the Central Storage in February 2010.

- **Radioactive Waste Management in Medicine**

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

  The Institute of Oncology imported (among other sources) 0.61 TBq of ^{131}I and the Ljubljana University Medical Centre – the Department for Nuclear Medicine imported 0.37 TBq of ^{131}I in 2010. All other users together imported 0.1 TBq of ^{131}I in the same year. The Institute of Oncology uses decay storage tanks in order to control releases of radioactive effluents. The Ljubljana University Medical Centre – the Department for Nuclear Medicine releases the effluents directly into sewage systems. Patients from other hospitals are not hospitalised. It is estimated that approximately 0.3 TBq of ^{131}I is released annually into the environment.

  The short-lived radioactive waste (residues contaminated with ^{131}I, ^{99m}Tc, ^{99}Mo, ^{201}Tl, ^{111}In or ^{67}Ga) which is produced during medical practice is stored locally at the users' locations. After decay, the material is transferred to the municipal disposal sites. In 2010, the Ljubljana municipal waste disposal site was equipped with a portal radiation monitor causing alert in several instances. It was determined that certain short lived radioisotopes from medical practices did not decay below clearance levels before being transferred to the disposal site. Corrective measures and procedures were later agreed and implemented.

  In August 2010, the last disused teleradiotherapeutic ^{60}Co source (about 100 TBq) was transported from the Institute of Oncology to the relevant recycling company in Germany. Other small amounts of solid radioactive waste, mainly containing ^{57}Co (in total less than 1 GBq), are temporarily stored at local sites and periodically transported to the Central storage for radioactive waste in Brinje.

  In April 2008, the Institute of Oncology transferred from its storage room to the Central storage for radioactive waste in Brinje all remaining disused sealed sources (mainly ^{137}Cs with total activity of 3.86 GBq and 5 pieces of ^{226}Ra, ^{133}Ba and ^{129}I with total activity of 7.3 MBq). The storage room for spent sources and other rooms in the old building were then examined. No contamination was found (only natural background dose rate). Labels and signs have been removed and rooms are used without any restriction. A report has been prepared by an independent radiation protection expert.

(v) Criteria used to define and categorise radioactive waste

The regulation on radioactive waste management and classification of radioactive wastes consider, with some modifications, the radioactive waste categorisation as recommended in the "EC Recommendation on a Classification System for Solid Radioactive Waste" (OJ L 265, 13.10.1999, p. 37).

Provisions of this regulation apply to substances in gaseous, liquid or solid form, 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, or if their holder intends or has to discard them since their further use is not foreseen, or if the holder does not have a license 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:
    - 3.1. 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;
    - 3.2. long-lived LILW, where 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 it has to be considered in its management;
5. radioactive waste containing naturally occurring radionuclides that are produced in 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 conditional and unconditional clearance of radioactive material as follows: "The competent ministry may approve the clearance of radioactive substances or radiation sources, provided that there is no possibility that after such clearance the radioactive substance or radiation source causes a collective dose higher than 1 manSv per year, nor that the effective dose received by any member of the public exceeds 10 μSv per year".

The regulatory control over radioactive substances can be terminated without a prior decision of the competent ministry if the specific activity of radionuclides in substances does not exceed the values set in Table 3 of the Decree on Activities Involving Radiation (clearance levels).

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.

This Convention applies to the safety of the spent fuel management in the Krško NPP and in the IJS Reactor Infrastructure Centre. No spent fuel reprocessing is foreseen.

This Convention applies to the safety of the operational waste in the Krško NPP, of the decommissioning waste from the Žirovski vrh Uranium Mine and of the waste from small non-power applications which are stored in the Central Storage for Radioactive Waste in Brinje.

The 2002 Act does not stipulate any special legal provision for the spent fuel or radioactive waste that occurs within military or defence programmes. Therefore the same legal provisions are applicable to such waste. However, it should be noted that there is practically 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 IJS Reactor Infrastructure Centre (TRIGA Mark II research reactor) is managed in storage facilities which are integral parts of these nuclear facilities.

(ii) Inventory of Spent Fuel

Krško NPP

The Fuel Handling Building is a part of the Krško NPP. It is operated under the plant's license and is therefore not considered an independent nuclear facility. The fuel handling building consists of a spent fuel pool and the related fuel handling system which enables the handling of spent fuel.

There were 843 spent fuel assemblies in the spent fuel pool at the end of 2010. The fuel batches of the spent fuel assemblies with corresponding region numbers are listed in **Section L**, Annex d. These fuel assemblies will probably never return to the core unless emergency core loading has to be performed.

There are five criteria which define the Krško NPP's spent fuel:

- All Westinghouse standard type fuel assemblies including Siemens KWU fuel are considered spent. Fuel batches No. 1 to No. 8B are standard fuel type.
- Vantage 5 fuel type including fuel batches No. 15 and No. 15B is spent.
- There are two leaking Vantage 5 fuel assemblies with very low burnup. These two assemblies can be repaired and reused in future cycles. Therefore they will be excluded from the spent fuel series.
- Fuel assemblies from fuel batches No. 16, 16B, 17, 17B, 18, 19, 20, 21, 22A, 22B, 23B, 24B and 25B with either:
  - average burnup higher than 50 GWD/MTU or
  - declared as spent fuel.
- Fuel Rod Storage Basket, containing single fuel rods from repaired fuel assemblies, is also considered as spent fuel.

IJS Reactor Infrastructure Centre

There are two interim storage pools which are part of the IJS Reactor Infrastructure Centre. The old storage pool is not in use. The newer storage pool is maintained operational and prepared for immediate use if necessary. Both pools have been empty since 1999, when all spent fuel elements (total 219) were shipped to the USA for final disposal.

(iii) List of the Radioactive Waste Management Facilities

The Central Storage for Radioactive Waste in Brinje, the Boršt mill tailings site and the Jazbec mine waste pile 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 storages under an operating license for the Krško NPP.

Central Storage for Radioactive Waste in Brinje

The storage 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 usable capacity of the storage is about 300 m^3 of radioactive waste. A small area is intended for workers, for loading and unloading the waste and for internal transport. The storage section at the back end of the building is deeper relative to the level of the other sections, and is intended for storage of highly active spent sources.

The facility is equipped with a ventilation system for reducing radon concentration and air contamination in the storage facility. To obtain relatively low and constant humidity it is equipped with the air drying system. The water and sewage collecting system is designed as a closed system to retain all liquids from the storage facility in the sump. Liquids are discharged after the measurements of radioactive contamination, which has to be below the limitation in the regulation. The electricity supply system is used for illumination of the storage facility, for heating of auxiliary rooms and for the powering of ventilation. The storage facility is also protected by a fire alarm and a security alarm system which are connected to a 24-hour security service.

The Jazbec Mine Waste Pile at the Žirovski vrh Uranium Mine

The Jazbec mine waste pile is located on the north-eastern slope of the Žirovski vrh hill at an altitude above 427 meters. The pile area was reshaped and was covered with a final 1.95 m thick layer. The detailed inventory of the Jazbec mine waste pile is provided in **Table 10**. The design and the Safety Analysis Report on final remediation of the Jazbec mine waste pile was accomplished in the year 2004. The remediation was completed in 2008. Currently the SNSA is evaluating the application for a "permanent closure" of this disposal site.

The Boršt Mill Tailings Site at the Žirovski vrh Uranium Mine

The Boršt mill tailings site is located on the north-western slope of the Boršt hill, at an altitude above 535 metres. The waste inventory is provided in **Table 11**. During the operation and construction of the Boršt mill tailings site some mine waste was used to consolidate the surfaces used for mill tailings transportation. In the remediation process the slopes were minimized and a support rock scarp was constructed at the head of the mill tailing. The surfaces were covered by a 0.5 m thick layer of mining waste overlaid by various soil layers with a total thickness of 2.05 m.

In 1991, a few months after a heavy rainfall, a landslide beneath the deposited mill tailings was activated. About $4.5 \cdot 10^6$ 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 sliding was probably the extremely high groundwater level. In the years 1994 and 1995 a drainage tunnel of nearly 600 metres in length was constructed together with vertical drainage wells. Consequently the sliding stopped in 1995.

The design and the Safety Analysis Report on final remediation was approved in the year 2005. The remediation was completed in 2010. In 2008, during intensive work on the implementation of final mill tailings arrangement, 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 is negligible, and proposed investigation of the incoming water by drill holes. Additional measures are planned to stabilize the base rock sliding under the Boršt mill tailings pile in the years 2012 or 2013.

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 is 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 (immobilisation, packaging). The conditioned waste is transported to the Solid Radwaste Storage Facility by a forklift or an electric-powered cart using a special shield when necessary.

The Solid Radwaste Storage Facility, an interim storage, originally built as a 5-year storage. Its operating license was extended in 1988 due to the lack of a LILW repository. It is a reinforced concrete structure, seismically qualified, located adjacent to the Auxiliary Building. The total area is 1,470 m^2; after an area optimisation project, 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 is dependent on waste generation rates and waste management plans. The inner area is divided into 6 fields by 60 cm thick interior concrete walls; the exterior walls as well as the ceiling are 100 cm thick, providing appropriate insulation and radiological shielding. The facility has provisions for storing different solid radioactive wastes separately and retrieving them for further processing (supercompaction, incineration, melting and clearance after decay of the radionuclide) 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. It is a seismically qualified reinforced concrete structure consisting of the following three areas: decontamination area, "mock-up" area and area for 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 the radiological shielding requirements.

(iv) Inventory of Radioactive Waste

Central Storage for Radioactive Waste in Brinje

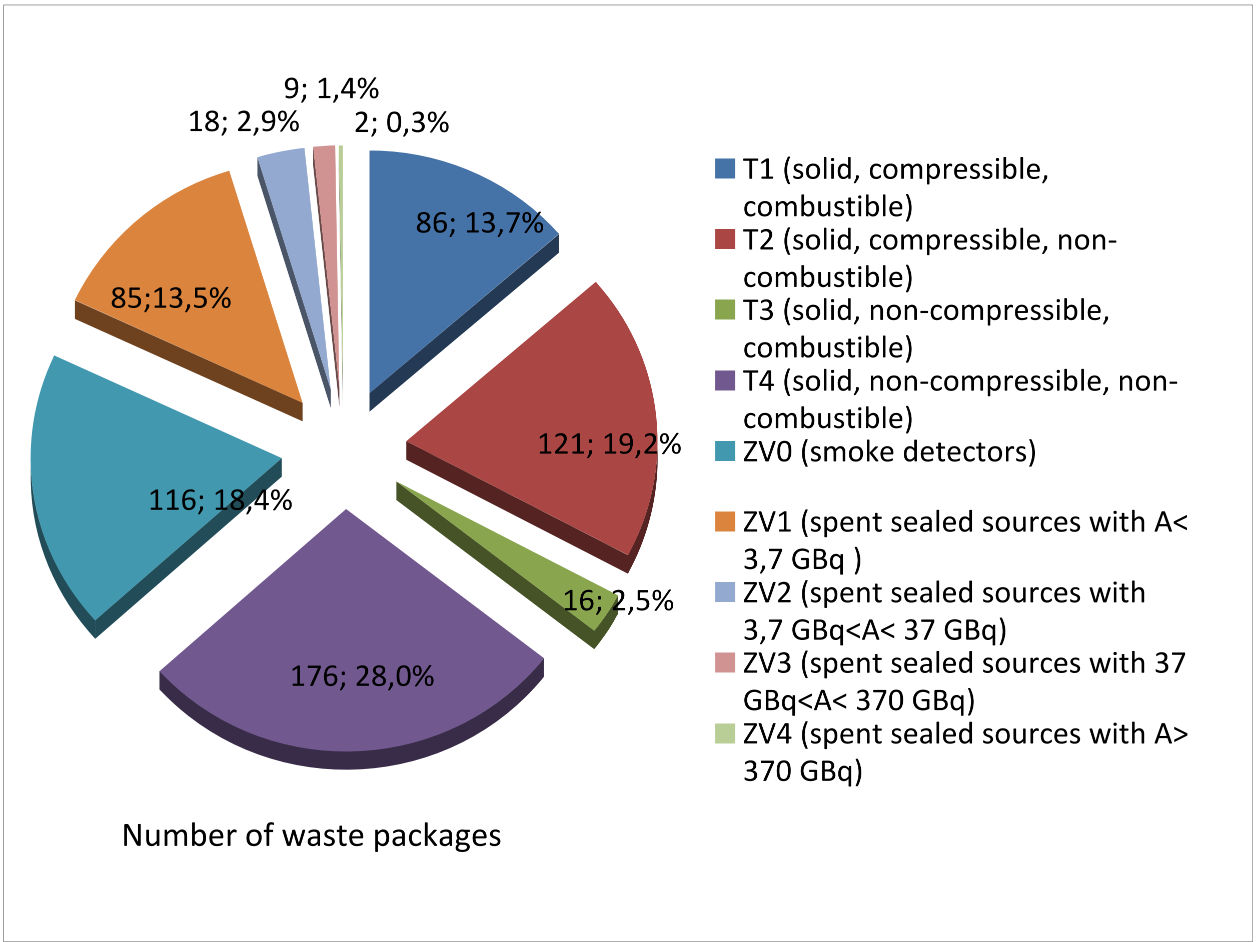
Currently around 86 m^3 of radioactive waste is kept in the storage with an estimated total mass of 48 tons. The total mass was reduced in the last years due to several campaigns of waste repacking and exemption of emptied and cleared containers. Annually there are approximately 50 receipts of waste from small producers. The waste forms are:

- solid, compressible, combustible (T1),
- solid, compressible, non-combustible (T2),
- solid, non-compressible, combustible (T3),
- solid, non-compressible, non-combustible (T4),

- smoke detectors (ZV0),
- spent sealed sources with A < 3,7 GBq (ZV1),
- spent sealed sources with 3,7 GBq < A < 37 GBq (ZV2),
- spent sealed sources with 37 GBq < A < 370 GBq (ZV3) and
- spent sealed sources with A > 370 GBq (ZV4).

Waste is packed in drums, in original containers with spent sealed sources and as contaminated or activated bulky items.

Figure 2: **Number of waste package types in the Central Storage for Radioactive Waste in Brinje at the end of 2010**



The drums contain mostly contaminated material such as paper, glass and plastic material with induced radioactivity caused by neutron exposure in the research reactor. Different contaminated or activated metal tubes and metal pieces that are too big to fit into the drums are stored as special bulky items. Disused sealed sources are stored in the original shielding containers or are repacked in lead containers placed in the standard drums fitted with concrete shielding.

The total activity of the waste at the end of 2010 was estimated at 3,200 GBq. During normal operation the Central Storage for Radioactive Waste receives approximately 3 m^3 of radioactive waste annually. The list of radioactive wastes is given in **Section L**, Annex (e), **Table 9**.

The Jazbec mine waste pile and the Boršt mill tailings site

Mine waste and other debris at the Jazbec and Boršt sites with basic data are summarised in **Section L**, Annex (e), **Table 10** and **Table 11**, presenting the situation at the end of the year 2010.

Krško NPP

See **Section L**, Annex (e), **Table 6, Table** 7 **and Table** 8.

(v) Nuclear Facilities in the Process of Being Decommissioned

There are no nuclear facilities being decommissioned. The Žirovski vrh uranium mine, which is a radiation facility in accordance with the definition in the 2002 Act, is the only facility which is in the process of being 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 main Act of the Republic of Slovenia in this area is the Ionising Radiation Protection and Nuclear Safety Act (the 2002 Act) which regulates also radioactive waste and spent fuel management. The Act was amended in 2003 and 2004. The next amendment of the Act is foreseen in mid-2011. The 2011 amendments will not bring any significant changes in the area of radioactive waste and spent fuel management.

On 6 March 2006 the Minister of the Environment and Spatial Planning adopted the Rules on Radioactive Waste and Spent Fuel Management.

On 1 February 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 RS, No. 15/2006). The Programme for Managing Radioactive Waste and Spent Fuel 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.

The resolution foresees general timelines and financing for activities related to radioactive waste and spent fuel management for all radiation and nuclear facilities. The resolution foresees the construction of a repository for LILW with the capacity to satisfy the needs of the Slovenian part of LILW generated in the operation and decommissioning of the Krško NPP and for the disposal of waste of all other Slovenian waste generators. In parallel the resolution requests provision of technical possibility for the construction of a full-capacity repository for all waste from the Krško NPP, if appropriate agreement with the Republic of Croatia on a joint solution of this issue is reached.

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

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

In addition to the main principles (among others also "justification", "optimisation", "ALARA" and "prime responsibility for safety" principles), the 2002 Act also includes, with respect to radiation protection areas, provisions on:

- reporting an intention to carry out radiation practices or to use a radiation source,
- licensing of the radiation practices or use of a radiation source,
- general principles on protection of people against ionising radiation,
- classification of facilities (nuclear, radiation and less important radiation facilities),
- licensing procedures with respect to 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,
- import, export and transit of nuclear and radioactive materials, radioactive waste and spent fuel,
- physical protection of nuclear materials and facilities,
- non-proliferation and safeguards,
- administrative tasks and inspection,
- penal provisions.

Based on the 2002 Act seven decrees have been adopted and issued by the Government and twenty-one rules have been adopted and issued by the competent Ministers. Three more second-level acts are in the process of adoption. In the period since the third report under the Convention the following decrees and rules have been adopted:

- Decree on Safeguarding of Nuclear Materials,
- Decree amending the Decree on the Criteria for the Determination of the Compensatory Amount due to the Limited Use of the Environment in the Area of a Nuclear Facility,
- Decree amending the Decree on the Implementation of Council Regulations (EC) and Commission Regulations (EC) on the Radioactive Contamination of Foodstuffs and Feedstuffs,
- Rules on Radiation and Nuclear Safety Factors (JV5),
- Rules on Operational Safety of Radiation and Nuclear Facilities (JV9),
- Rules amending the Rules on the Monitoring of Radioactivity,
- Rules on Transboundary Shipments of Radioactive Waste and Spent Fuel,

- Rules on the Transboundary Shipment of Nuclear and Radioactive Substances,
- Rules on the Use of Potassium Iodine.

The Slovenian legislation is based on broadly accepted international standards. Furthermore all the European Union directives from the field of radiation and nuclear safety have been completely transposed into Slovenian legislation.

Within the legislative and regulatory framework which covers spent fuel and radioactive waste management, the following decrees and acts should be mentioned:

- Decree on Establishment of a Public Agency for Radwaste Management,
- Decree on the Method and Subject of and Conditions for Performing a Public Utility Service of Radioactive Waste Management,
- Act Governing the Fund for Financing Decommissioning of the Krško Nuclear Power Plant and Disposal of Radioactive Waste from the Krško NPP,
- Permanent Cessation of Exploitation of the Uranium Ore and Prevention of Consequences of the Mining in the Uranium Mine at Žirovski vrh Act.

(2ii) Licensing System

A system of licensing of spent fuel and radioactive waste management is provided in the 2002 Act, while the Rules on Radiation and Nuclear Safety Factors lay down details on the documentation which must be submitted in a particular phase of licensing. The prescribed licensing process is of general nature, thus it is applicable to whole spectra of nuclear and radiation facilities.

The basic classification of facilities is provided by the Act itself, where in definition No. 22 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 and heating plant, a facility for storing, processing and disposal of nuclear fuel or high radioactive waste, a facility for storing, processing or disposal of low and intermediate radioactive waste". Therefore the entire spectrum of licensing requirements (for siting, construction, trial operation, operation, decommissioning, and/or closure of the repository) has to be taken by the applicant (investor or operator of the facility) in accordance with provisions of the 2002 Act and of the Rules on Radiation and Nuclear Safety Factors.

An investor planning to construct a radiation or nuclear facility shall compile and submit in application for the facility among other the following principal documents demonstrating nuclear and radiation safety:

- A special safety analysis in the procedure of approval of the national spatial plan;
- The environment impact assessment in the procedure of approval of the use of land;
- A safety analysis report in the procedure of approval of construction.

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

In the licensing processes the investor/operator shall attach to the license application, in addition to the design documentation, a Safety Analysis Report, and the opinion of an authorised radiation and nuclear safety expert (authorised by the SNSA) and other prescribed documentation set by the Rules on Radiation and Nuclear Safety Factors.

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

General provisions and responsibilities of the holder of the radioactive waste and spent fuel (as well as of the State) are defined in Section 4.8. - "Radioactive waste and spent fuel management" of the 2002 Act. The 2002 Act (Articles 93 to 99) contains the following provisions:

- on radioactive waste and spent fuel management,
- on the national public utility service for radioactive waste management,
- on the national public utility service for the disposal of waste from energy producing nuclear facilities,
- on repositories of mining and hydro-metallurgical tailings,
- on national public utility institutions,
- on the national programme of radioactive waste and spent fuel management,
- on national infrastructure facilities.

On the basis of the provisions of the 2002 Act, the Rules on Radioactive Waste and Spent Fuel Management were adopted. The Rules (see Addenda 5 of the Report) contains inter alia the following provisions:

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

The Decree on the Method and Subject of and Conditions for Performing a Public Utility Service of Radioactive Waste Management contains among others the following provisions:

- on the scope and type of public service,
- on general requirements of discharging the public service,

- on requirements which have to be fulfilled by the performer of the public service,
- on the rights and duties of the use of the public service,
- on financial sources and the method of establishing the price,
- on inspection.

The public commercial institution for radioactive waste referred to in Article 97 of the 2002 Act was established already in 1991 as the ARAO (Governmental Decree on Establishment of a Public Agency for Radwaste Management).

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

The spent fuel and radioactive waste management facilities are defined by the 2002 Act as nuclear facilities. Consequently, all relevant licenses are needed, including the operating license. Operation of such a facility without a license is prohibited according to Article 57 of the same Act.

In the penal provisions of the 2002 Act it is foreseen that a financial penalty between 250 and 375,000 EUR shall be imposed on the legal entity which violates the above stated prohibition; in addition to this a financial penalty between 125 and 12,500 EUR shall be imposed on any responsible person appointed by a legal entity for the same violation. If the violation is committed by a sole trader, a financial penalty between 1,250 and 187,500 EUR shall be imposed on him.

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

Institutional control and regulatory inspection with respect to safety of spent fuel and radioactive waste management 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 assure that the licensee fulfils all legal requirements regarding the safety,
- order to terminate radiation practices or use of a radiation source in the case the inspector finds that a proper license 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.

The 2002 Act has only one article on inspection, since the Inspection Act prescribes the general principles of inspection, its organisation, status, the rights and duties of inspectors, inspection measures and other issues relating to inspection, which is to be followed also by nuclear and radiation safety inspectors.

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

The enforcement of applicable regulations and of the terms of the licenses is ensured by the application of penal provisions, inspection and provisions related to the issuing, renewal, amendment, withdrawal and expiration of licenses, as provided for in the 2002 Act.

Based on the Inspection Act, as well as on the 2002 Act, a graded approach in enforcement policy is ensured. The inspector may (if by their assessment such a measure is sufficient and appropriate) only warn the licensee about the irregularities and set a date (period) for corrective measures to be carried out. The inspector may also (among other measures) perform all measures in line with the Minor Offences Act, or report (in the case of a criminal offence) the licensee to the public prosecutor.

The inspector may also terminate radiation practice or use of a radiation source (if the operator operates without the license), but may not revoke or suspend the license. This can be done by the authority which has issued the license (in most cases the SNSA); however, the inspector may propose such a measure.

(2vi) Allocation of Responsibilities

As described above, the legislative framework (the 2002 Act, the Decree on the Method and Subject of and Conditions for Performing a Public Utility Service of Radioactive Waste Management and the Rules on Radioactive Waste and Spent Fuel Management) provides a clear allocation of responsibilities of the bodies involved in the different steps of regulating the spent fuel and radioactive waste management (producer, 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 the Environment and Spatial Planning (hereinafter the Ministry). The SNSA's responsibilities and competencies are defined in the Governmental Decree on Administrative Authorities within Ministries.

The SNSA performs specialised technical and developmental administrative tasks and tasks of inspection in the area of radiation and nuclear safety, radiation practices and use of radiation sources (except in health and veterinary care), protection of the environment against ionising radiation, physical protection of nuclear materials and nuclear facilities, non-proliferation of nuclear weapons and safeguards of nuclear goods; the SNSA furthermore monitors radioactivity in the environment, third party liability, and transport, import and export of radioactive materials.

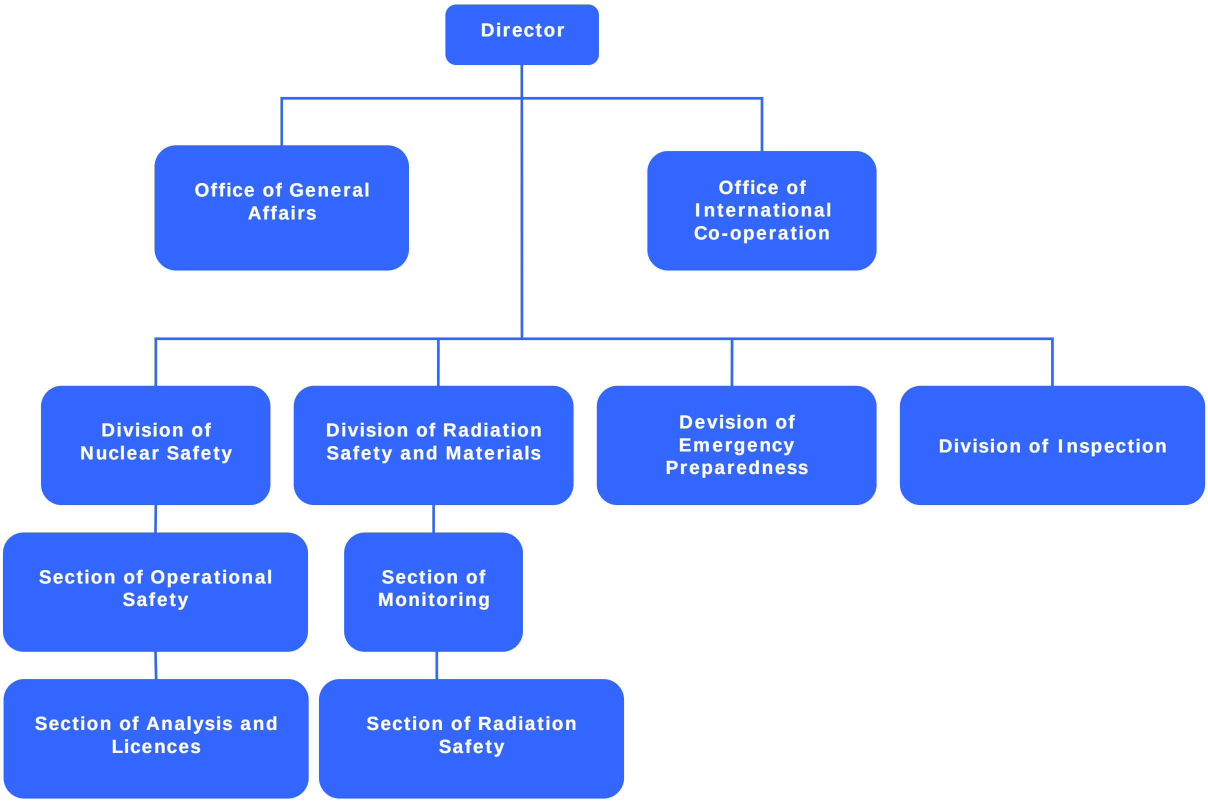
The precise competencies of the SNSA and other relevant administrations which are entrusted with implementation of the legislative framework are prescribed in particular in the 2002 Act and other legislation listed in **Section L**, Annex (f) of this report.

The SNSA is organised into five divisions and one office. These are (the number in brackets denotes the number of staff in the respective division):

- Division of Nuclear Safety (10),
- Division of Radiation Safety and Materials (12),
- Division of Emergency Preparedness (3),
- Division of Inspection (5),
- Division of International Co-operation (3),
- Office of General Affairs (6),
- QA Manager and Librarian (2).

The SNSA's internal organizational units are shown in **Figure 3**.

Figure 3: **SNSA's internal organisational units**



The staff of the SNSA is interdisciplinary, consisting of employees with different educational backgrounds: physicists, mechanical, electrical and chemical engineers, mining and geotechnologist, architect, metallurgist, geologists, lawyers, linguist, and administrative workers.

At the end of 2010, the SNSA had 41 employees, out of these 8 with a doctor's decree, 12 with a master's decree, 20 with higher or university education and one with high-school education.

In December 2010, the SNSA successfully passed the third regular yearly control audit of the management system (the first was conducted in 2008) based on ISO standard 9001:2008. During the audit no incompatibilities were found and it was confirmed that the SNSA quality management system is in accordance with standard ISO 9001:2008.

The Director of the SNSA is the head of the regulatory authority and represents the SNSA. On the Governmental and Parliamentary level, the SNSA is represented by the Minister of the Environment and Spatial Planning. The Director is responsible to the Minister for his 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 related to spent fuel and radioactive waste management are dealt with by the Division of Radiation Safety and Materials.

The budget of the SNSA is determined on the basis of the realisation of the previous year, taking into account new needs, which have to be well justified. The budget is the only source for financing the SNSA's basic activities. There are also very limited extra-budgetary sources, i.e. within the licensing process for some direct costs.

Although the SNSA is within the Ministry, it still has its own share in the Ministry's budget and is independent in allocating the programmes, projects and other expenses from the budget. The composition of the SNSA budget for 2011 is shown in **Table 1**.

Table 1: **The SNSA budget for 2011**

Structure		**in thousands EUR**
Salaries		1,649
Material Expenses		180
Investments		30
Membership fees (IAEA, OECD/NEA membership, USNRC programs)		279
Outsourcing	Nuclear Safety	280
	Radiation Safety	262
Total		App. 2,681

Other Regulatory Bodies

The 2002 Act gives the competence in the area of radiation practices and use of radioactive sources in health and veterinary care to the Slovenian Radiation Protection Administration (SRPA) within the Ministry of Health. In general the competences between the SNSA and the SRPA are divided in the area of radiation protection, while the area of nuclear safety is the SNSA's sole competence). The SNSA is responsible for the monitoring of emissions into the environment, while the SRPA is responsible for the monitoring of exposure to population. Based on the 2002 Act the SNSA is competent for consents to mining work, licensing for operation, the completion of decommissioning and the closure of a repository, while the SRPA performs inspection tasks in the area of radiation protection (dose limits, protection of exposed workers, etc.).

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

Besides the SNSA and the SRPA, some other administrations, ministries and organisations are also entrusted with the implementation of the 2002 Act, in particular:

- The Administration for Civil Protection and Disaster Relief (within the Ministry of Defence), as the operator of the National Notification Centre, is responsible for notification procedures in the event of radiological emergency,
- The Ministry of the Interior, inter-alia, has competencies in the area of physical protection of nuclear materials and nuclear facilities in general, while the SNSA only approves the Safety Analysis Report, to which the

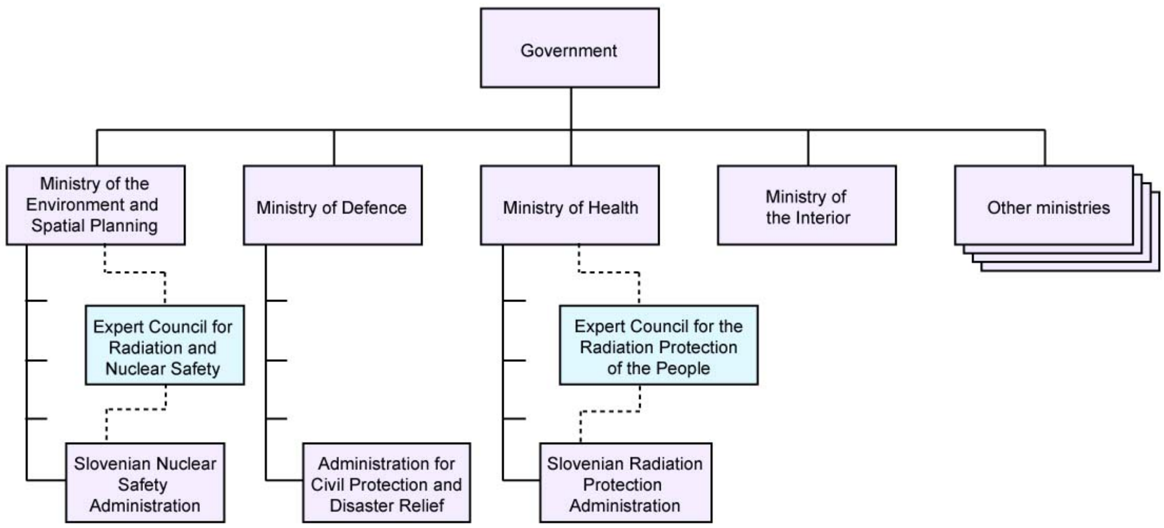
plan of physical protection is attached as a separate and restricted document,

- The Environmental Agency within the Ministry of the Environment and Spatial Planning,
- The Spatial Planning Directorate within the Ministry of the Environment and Spatial Planning,
- The Directorate for Energy (within the Ministry of the Economy).

Based on the 2002 Act, the Expert Council for Radiation and Nuclear Safety was appointed as an advisory body to the Ministry of the Environment and Spatial Planning and the SNSA, as well as the Expert Council for the Protection of People against Ionising Radiation, for radiological procedures and use of radiological sources in health and veterinary care, as an advisory body to the Ministry of Health and the SRPA.

The position of the SNSA and the SRPA in the governmental structure is shown in **Figure 4**.

Figure 4: **The SNSA and the SRPA within the governmental structure**



2. Effective independence

The SNSA is a part of the state administration. Based on the Public Administration Act the SNSA is in its administrative decisions an independent body within the Ministry of the Environment and Spatial Planning. Administrative decisions mean all decisions taken by the SNSA within the licensing process as well as within the inspection control. Decisions adopted by the SNSA within its scope of competence are taken solely and exclusively by the SNSA and can not be dictated or imposed on the SNSA from the Ministry of the Environment, the Minister or any other body within the Ministry.

The Director of the SNSA is directly subordinate to the Minister and reports to the Minister, but in administrative decisions (s)he is independent from the Minister or any other body within the Ministry. The Public Administration Act and the 2002 Act assure de iure independence of the SNSA.

SECTION F: OTHER GENERAL SAFETY PROVISIONS

Article 21: Responsibility of the License 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 license 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 2002 Act.

Article 57 of the 2002 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 pursuant to this Act. The safety of a facility including the safety of handling radioactive substances, radioactive waste or spent fuel which are found or produced in the facility, must be ensured by the operator".

The system of licenses is set up to assure that facilities are designed, constructed, commissioned and prepared for operation in accordance with the national or international codes, standards and experience.

A clear requirement for the handling of radioactive waste and spent fuel is set in Article 93 of the 2002 Act, which provides that the holder of radioactive waste and spent fuel shall ensure that the radioactive waste and the spent fuel are handled in the way prescribed and that transfer of the burden of disposing of radioactive waste and spent fuel to future generations is avoided as far as possible. The person 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 to him by the person responsible for its occurrence, or if he 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 resume full responsibility for its management.

The holder of radioactive waste and spent fuel must forward the information on generation of radioactive waste and spent fuel 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 their facilities. This responsibility includes provision of both adequate financial and human resources to support the safety of facilities for spent fuel and radioactive waste management during their operating life-time and for the decommissioning.

Krško NPP

(i) Human Resources

The Krško NPP has the overall responsibility for the design, engineering, construction, license application, operation, fuel management, procurement and quality assurance as well as for radioactive waste management. The Krško NPP is organised in several divisions, including the Technical Division, which is responsible for operating, maintenance and technical services, the Engineering Division, responsible for design, engineering, configuration management, licensing, procurement engineering and project management, the Quality Systems Division, which encompasses also the Nuclear Oversight Section, which is responsible for independent safety assessments, the Administrative Division and the Financial Division. At all positions, qualified personnel perform all the different activities needed for radioactive waste and spent fuel management. At the end of 2010, 591 people, both technical and non-technical staff, were employed at the NEK.

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

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

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

Personnel Qualifications and Experience

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

The qualifications consist of the basic formal education and of special knowledge. Special knowledge involves basic principles of operation of nuclear power plants, radiological protection, work safety, etc. The courses and training exercises are organised by the Training Department, which also takes care of qualification record keeping.

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 given at different levels of complexity, depending on the level of responsibility of the employee. A basic training course is given to all personnel before entering 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 provided from abroad.

(ii) Financial Resources

The expenses for radioactive waste treatment, conditioning and storing as well as 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 assure the funds for the decommissioning and the final disposal of radioactive waste and spent fuel.

The Slovenian share of assets for the decommissioning of the Krško NPP and for the post-operational radioactive waste and spent fuel management are assured through the Act Governing the Fund for Financing Decommissioning of the Krško NPP and Disposal of Radioactive Waste from the Krško NPP. This Act was amended in 2003 in the light 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 Investment, Exploitation and Decommissioning of the Krško NPP. The Slovenian share of financial assets is collected through a levy for the kWh_e delivered to the Slovenian grid since 1996. Due to a revision of the Decommissioning Programme in 2004 the levy was in 2005 increased to 0.30 Euro cents per kWh_e delivered to the Slovenian electrical power company GEN energija d.o.o.

The Croatian share of assets for the decommissioning of the NPP Krško and for the post-operational radioactive waste and spent fuel management shall be assured in accordance with the bilateral Agreement through an adequate Croatian Fund for Decommissioning and Spent Fuel Management. The Croatian Fund was established by the Act on Governing the Fund for Financing Decommissioning and Disposal of Radioactive Waste and Spent Fuel of the Krško NPP. The Act was adopted by the Croatian Parliament in October 2007.

Jožef Stefan Institute Reactor Infrastructure Centre

(i) Human Resources

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

The Hot Cell Laboratory operates under the TRIGA Mark II research reactor operating license. The staff consists of three part-time workers.

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

The personnel must also have some practical experience with spent fuel shipment projects and 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 IJS Reactor Infrastructure Centre are provided within the budget for reactor operation. Financial provisions for decommissioning are not provided. However, the Republic of Slovenia is the owner of the facility, so it will have the responsibility to assure financial resources for proper decommissioning and spent fuel management.

Agency for Radwaste Management

(i) Human Resources

At present the ARAO has a staff of 23 people. It is organised into four units: planning and development, disposal, operations and joint services. The radiation protection special service is established according to the provisions of the 2002 Act.

The educational structure of the ARAO reflects its professional attitude towards its responsibilities. 71% of employees have graduate degrees, 12% postgraduate and only 17% secondary school education. The personnel cover different fields: physics, biology, chemistry, civil and mechanical engineering, architecture, geology, hydro-geology, metallurgy, law, economics and journalism. Several employees have past experience in reactor physics, nuclear engineering and other engineering and scientific fields. Professional improvement is an important part of the ARAO policy. On-the-job training is a standard activity of all employees. The staff also participates regularly in various training courses, workshops and seminars. Preparation of lectures, papers and other contributions is also regarded as part of the learning process.

(ii) Financial Resources

ARAO's activities are financed from different sources:

- the national budget,
- the Decommissioning Fund for the Krško NPP, and
- fees for storage and future disposal of waste according to the price list.

The annual budget varies, depending on the planned activities for the current year. In the last five years the income has gradually increased from 2.3 million EUR to 5.5 million EUR in 2010. Certain activities are also financed through the EU Framework Programme.

Žirovski vrh Uranium Mine

(i) Human Resources

At the beginning of the year 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.

The Žirovski vrh Mine d.o.o. has an adequate and experienced staff of 7 people, mostly the monitoring staff. It is a standard practice that additional expertise and elaboration of projects as well as major remedial activities are contracted on a commercial basis.

(ii) Financial Resources

The financial resources for the activities of the public company Žirovski vrh Mine, d.o.o. are assured only through the state budget.

Isotope Laboratory of the Institute of Oncology

(i) Human Resources

The staff working with radioisotopes at the Institute of Oncology has appropriate education and experience as required by the national legislation.

At the moment, the staff of the Isotope Laboratory is sufficient (3 medical doctors, 2 radiopharmacists, 8 radiological engineers, 1 maintenance worker and 2 nurses). The number of the staff was increased due to introducing new technologies (Positron Emission Tomography – Computer Tomography), and will be further increased if new nuclear medicine techniques are introduced.

(ii) Financial Resources

The Institute of Oncology is mainly financed by the Health Insurance of Slovenia and partly by the budget of the Ministry of Health. The Department of Radiological Safety at the Institute of Oncology will strive to ensure additional financial resources for its projects connected to radiological safety and safe storage and disposal of radioactive waste.

Ljubljana University Medical Centre - Department for Nuclear Medicine

(i) Human Resources

The Department for Nuclear Medicine consists of three sections: Section for Thyroid Diseases, Section for Nuclear Medicine Diagnostics and Section for Radiopharmacy and Radiochemistry. At present 83 persons are employed at the department (17 medical doctors, 5 radiopharmacists, 1 biologist, 1 physicist, 2 electrical engineers, 11 radiological engineers, 10 senior hospital nurses; the others are technicians and administration and maintenance personnel). The staff working with radioisotopes at this department has appropriate education and experience as required by the national legislation.

(ii) Financial Resources

Functioning of the University Medical Centre – the Department for Nuclear Medicine is assured by the Health Insurance 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 63 of the 2002 Act as well as the Rules on Radiation and Nuclear Safety Factors –JV5 (hereinafter JV5, published in the Official Gazette of the Republic of Slovenia, No. 92/2009, 9/2010), which in 2009 substituted Regulation E1, explicitly require Quality Assurance (QA) measures to be taken for all activities related to nuclear and radiation facilities, from the design stage to operation and then to the decommissioning stage (Article 63). Operators of radiation or nuclear facilities shall implement, in a planned and systematic way, measures to meet quality requirements for constituent parts, for management and control systems of technological processes, and for constructions, including computer software and related services. Facility managers shall set up and implement a QA programme.

Krško NPP

The Krško NPP as the license holder is responsible for the overall quality of the design, construction, operation, maintenance and modification of the NPP. It is the policy of the Krško NPP to operate the plant in a manner which ensures the safety and health of the public and the on-site personnel. The quality assurance programme was implemented already for the design and construction of the plant, and was in full compliance with: the United States Atomic Energy Commission Appendix B to 10 CFR 50 Quality Assurance Criteria for NPP and Fuel Reprocessing Plant and the QA guidance provided in WASH 12833 Guidance on QA Requirements During Design and Procurement Phase of Nuclear Power Plants and in WASH 1309 Guidance on QA Requirements During the Construction Phase of Nuclear Power Plants, both issued in 1974.

The Krško NPP Quality Assurance Programme is implemented and maintained to comply with national legislation, best international practices and recognised industrial standards.

It consists of the Statement of Policy and Authority, the QA Plan and associated procedures. The Statement of Policy and Authority, issued by the Krško NPP Management Board, declares the overall policy for the Krško NPP, i.e. "to operate the Krško NPP in a manner which ensures the safety and health of the public, and the personnel on-site". This policy includes also a commitment that the Krško NPP shall comply with all the relevant codes, standards and guides applicable to the operation of the Krško NPP. In line with the policy the NPP Krško developed the following Quality Systems Manuals/directives:

- Krško NPP Quality Assurance Plan (QD-1),
- Quality Control Plan (QD-2),
- Training Programme of the Krško NPP Personnel in the Area of Quality Assurance (QD-3),

- Programme of Inspection of the Secondary Systems - Erosion/Corrosion (QD-4),
- Programme of Inspection of the Fire Protection System (QD-5),
- Quality Assurance Manual – Laboratory for dosimetry (QD-6),
- Inspection Programme for Pressure Vessels (QD-7),
- Quality Assurance Manual – Radiation Protection Laboratory for measurements of radionuclides' activity (QD-8),
- Quality Assurance Manual – Radiochemistry Laboratory (QD-9) and
- Quality Assurance Manual – Environmental Management System (QD-10).

Care for the environment has always been a special concern of the plant's business policy. In order to assess and improve the NPP practices concerning the environment, the plant implemented the ISO 14001 standard, internationally the most widely recognized environmental management standard.

Special consideration is paid to emission control. The NEK laboratories, as evidence that they are competently qualified to carry out plant operations monitoring, acquired and maintained accreditation for measuring liquid and gaseous discharges from the NPP.

The Quality System Division has been reorganized. For this purpose the plant has established a Quality and Nuclear Oversight Division. The new division was formed by integrating the activities of quality assurance, quality control and nuclear oversight. The Quality and Nuclear Oversight Division is also responsible for executing and reporting on the effectiveness of the QA Programme implementation to the Management Board.

The Quality Management System, which includes quality assurance activities, is built in the established Plant Corrective Action Programme (CAP). The Plant CAP, besides the requested corrective actions and analysis (operating experience), has spread to non-conformances, self-assessments, audits and observation findings with different codes used for trending issues. Internal audits cover the functional and the cross-functional area in accordance with WANO Guidelines. The Krško NPP is striving to implement the procedures in compliance with the new IAEA Safety Standards, such as GS-R-3, GS-G-3.1, etc.

The requirements and responsibilities identified by the QA Plan are implemented through the Plant Management Manuals and related programmes, including the Radioactive Waste Management Programme and the Fuel Management Programme.

Jožef Stefan Institute Reactor Infrastructure Centre

QA of the IJS Reactor Infrastructure Centre is part of the Jožef Stefan Institute QA Programme. The Director of the IJS and the head of the reactor operation department are responsible for its implementation. Specific internal QA and quality control documentation is applied. QA activities of reactor operation are subject to internal (Jožef Stefan Institute QA management and an audit team) and external inspections of the regulatory body. The QA Programme is subject to periodical reviews.

The Jožef Stefan Institute QA Programme is implemented and maintained in accordance with acceptance criteria as follows:

- SIST EN ISO 9001:2000, and
- IAEA 50-C-QA, Rev. 1.

In 2009-2010 three new quality assurance documents were implemented:

- Programme for assessment of request for performing work in the hot cell laboratories,
- Programme for performing work in the hot cell laboratories, and
- Programme for informing public about unusual events on the reactor site,

and revised three old ones:

- Programme for assessment of request for performing work at the reactor,
- Programme for performing work at the reactor, and
- Instructions for performing work in the hot cell laboratories.

Agency for Radwaste Management

A QA system of the ARAO is documented by a quality manual including administrative and working procedures, covering all aspects of waste management in the Central Storage for Radioactive Waste in Brinje and radiation protection dealing with waste. In 2004, a manual was prepared which integrates the quality management system (ISO 9001:2000), the environmental management system (ISO 14001) and IAEA 50-C-QA, Rev. 1. It was amended in 2007 as a Manual for Quality Assurance and Environment Management to fulfil standard ISO 14001 and was certified in October 2007 by an independent authorized organization. The introduction of the ISO 14001 standard for the Central Storage for Radioactive Waste in Brinje was officially put into force in 2007, with the corresponding procedures required by the standard, especially emphasising environmental planning. In 2008 the ARAO started with preparation to obtain also certificate ISO 9001:2008 for quality management. In 2011, a new revision of the Manual was prepared and approved according to ISO 9001, ISO 14001 and requirements of the JV5 as a basis for certification.

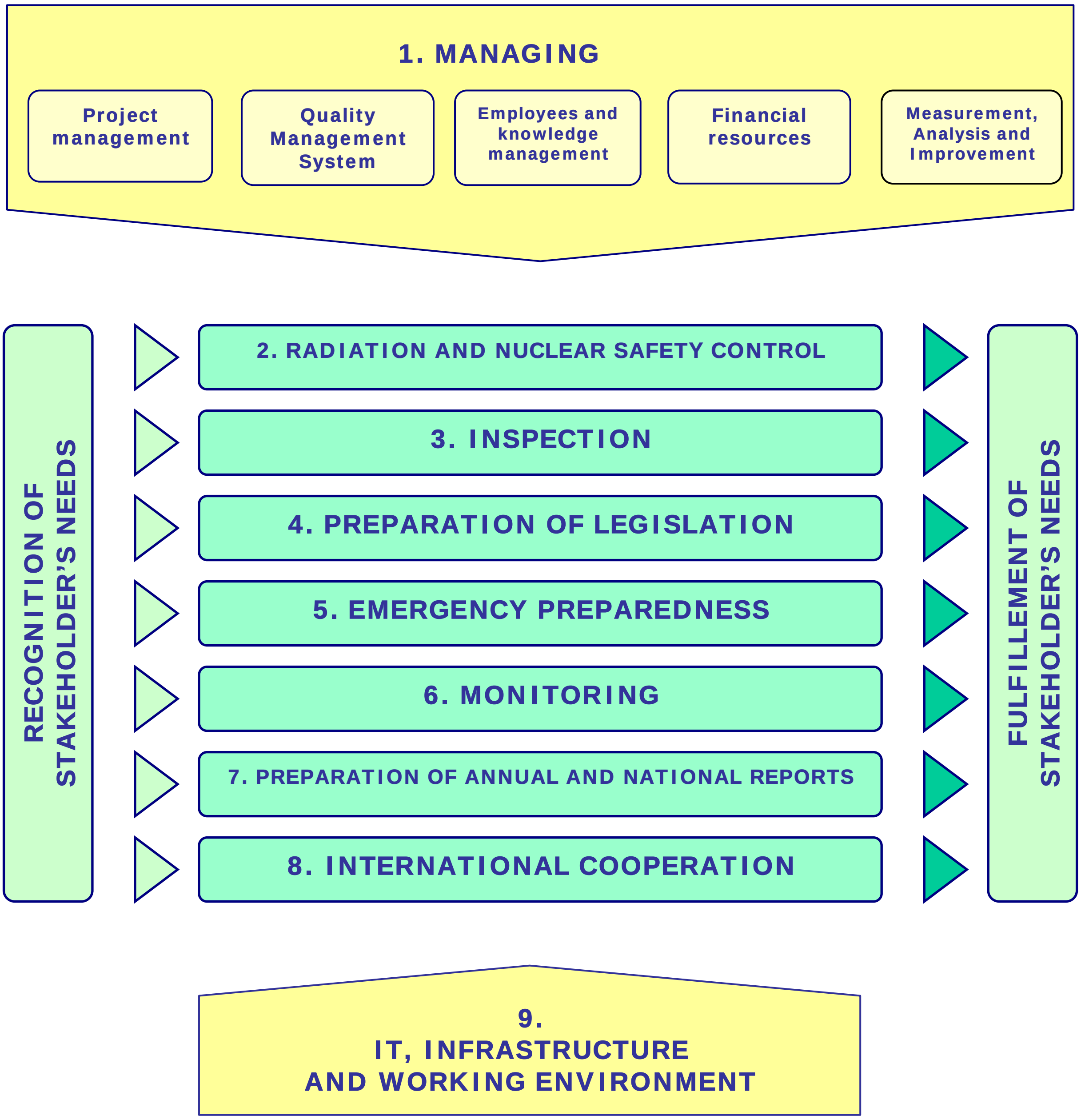
Slovenian Nuclear Safety Administration

In the year 2001 the SNSA decided to establish and implement a Quality Management System based on the programme of the Government on Management for Excellence in State Administration, supported by the 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, 1996; ISO 9001, "Quality Management Systems – Requirements", Third Edition, 2000 and IAEA-TECDOC-1090 "Quality Assurance within Regulatory Bodies", 1999.

In 2006 the SNSA decided to redefine the management system according to the IAEA Safety Standards Series No. GS-R-3 "The Management System for

Facilities and Activities", 2006. The SNSA management system is based on the process approach. The processes are divided into seven core processes and two supporting processes (**Figure 5**).

Figure 5: **The SNSA management system**



The SNSA Management System is documented at five levels of management documentation (**Figure 6**):

Level 0: mission, vision, values and policy statement of the SNSA.

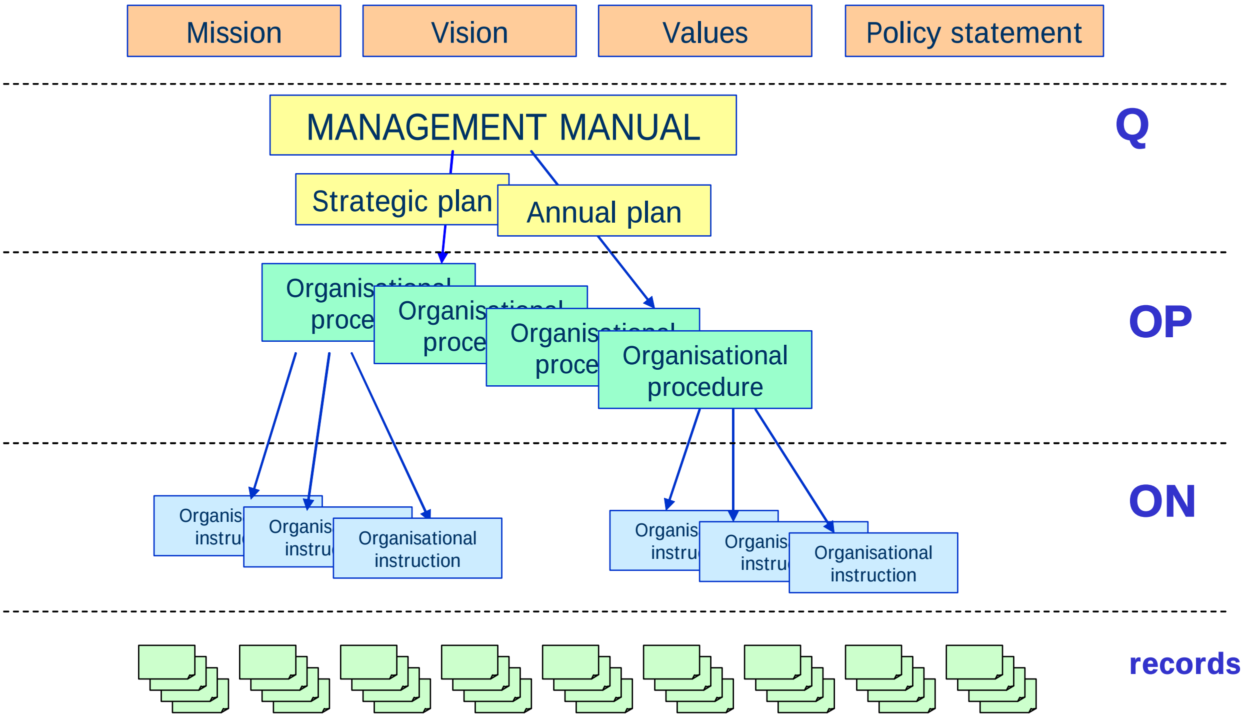
Level 1: Management manual (**Q**), which defines the concept of the management system in the SNSA. This level also includes the SNSA strategic objectives and the annual plan.

Level 2: organizational procedures (**OP**), where management of the processes is described.

Level 3: organizational instructions (**ON**), where detailed performance of individual activities is defined.

Level 4: records that are made by performance of the management system.

Figure 6: **The SNSA management documentation**



In December 2007 the certification audit took place and the SNSA successfully acquired the ISO 9001:2000 certificate for the management system.

During the period from the year 2008 up to the beginning of the year 2011 the SNSA management has been ensuring that the SNSA employees were familiar with the management system and its vision, mission, values and the management policy. Usually several internal audits of the SNSA management system are performed annually and management reviews of the SNSA management systems have been carried out to ensure its continuing suitability, effectiveness and efficiency. Based on findings noted deficiencies have been remedied and several improvements of the management system have been introduced.

In December 2010 the first external recertification audit was carried out. The external auditor concluded that the SNSA management system complied with the newer standard ISO 9001:2008.

Žirovski vrh Uranium Mine

The basic objective of the Žirovski vrh Mine d.o.o. is to perform the permanent closure of the 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 the Žirovski vrh Mine d.o.o. for the purpose of uranium mine remediation at the end of the year 2005 (Quality Assurance Manual – 1st edition, December 2005).

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 operation quality of the company. The Manual was revised due to personnel and organizational changes (Quality Assurance Manual – 3rd edition, June 2007).

Internal audits of individual activities and procedures have been carried out on the basis of the annual programme. On the basis of findings of non-conformities, corrective measures have been introduced to assure quality during the implementation of permanent closure of uranium ore exploitation and prevention of mining consequences in the Žirovski vrh Uranium Mine, as well as protection of the environment and people against the consequences of mining.

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 2002 Act. The subsidiary regulations and decrees, published in the period 2003 to 2007, are mostly based on the Council Directive 96/29/Euratom.

The new subsidiary regulations concerning categorisation of sources and radioactive waste are the Rules on Radioactive Waste and Spent Fuel Management, the Rules on the Use of Radiation Sources and on Activities Involving Radiation, and the Decree on Checking the Radioactivity for Shipments of Metal Scrap. The control of radioactive discharges and monitoring of environmental radioactivity are covered by the Rules on the Monitoring of Radioactivity.

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

According to the 2002 Act, the design, planning, subsequent use and operation of sources, and handling (including radioactive waste) shall be performed in a way 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 consulting, radiation safety assessments, dose calculations, etc. Two such technical support organisations are authorised in Slovenia to perform specific tasks regarding radiation protection of workers and the public, radiological surveillance, monitoring of individuals, monitoring of radioactivity of the environment, interventions, etc. Five medical institutions are authorised for health surveillance of workers.

The prescribed annual limit of effective dose for workers is 20 mSv, the annual equivalent dose limit for individual organs or tissue of workers is 500 mSv, except in the case of eye lenses, where the annual limit is 150 mSv. In general practice, it has been found in the last decade that exposure of 20 mSv per year was exceeded only in a few cases. Since 1999 the Republic of Slovenia has had a computerised registration system of occupational radiation exposure for workers in the country, including outside radiation workers. In total, about 10,700 workers, (together with outside radiation workers) have been registered, with an average of around 1000 workers per year, in the nuclear fuel cycle.

The general limit for the annual effective dose for a member of the public is 1 mSv. The annual equivalent dose limit for individual organs and tissue of members of the public is 50 mSv. Dose constraints were used only for three specific cases (nuclear power plant, uranium mine, central storage facility).

1. Steps 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, structures and spent fuel storage were already implemented during the licensing procedure. The Report on the Safety Assessment of Exposed Workers against Radiation is required to be submitted as part of the licensing documentation and the licensee shall provide comprehensive measures in order to protect workers and the public as required in Article 23 (basis for radiation protection) of the 2002 Act. In order to implement the ALARA principle these measures give special attention to the protection of pregnant women, breast-feeding women, students, workers employed by contractors, etc. The license holder for operation of a nuclear facility (including radioactive waste storage) shall assure its own special organisational unit for radiation protection, responsible for planning and implementing the measures for radiation protection. In all other cases the person responsible for radiation protection could be contracted by the licensee. The individual dosimetry is based on the TL dosimetry and/or monitoring of workplaces, as appropriate. The dosimetric services are authorised by the Ministry of Health.

According to Article 124 of the 2002 Act and 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:

- monitoring of radioactive discharges from a radiation facility or nuclear installation into the environment,
- monitoring of environmental radioactivity (in air, surface and underground waters, and ground) and monitoring of radioactivity of drinking water, foodstuffs and animal feed as the result of radioactive discharges.

Radioactive discharges are monitored and reported at regular intervals weekly, monthly, quarterly and annually. Public exposure is estimated annually via all exposure pathways. The operator shall also carry out monitoring of the effects of remediation works in the case of an emergency.

2. Steps to ensure that discharges shall be limited to keep exposure to radiation as low as reasonably achievable and 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

The legal basis for the control of discharges in normal operation are the 2002 Act (Article 124, Operational Monitoring of Radioactivity), the Rules on the Monitoring of Radioactivity and Rules on Radioactive Waste and Spent Fuel Management.

According to the 2002 Act two levels of radiation monitoring ensure that no individual is exposed in normal situations above the prescribed dose limits.

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

Control of radioactive discharges into the environment from nuclear installations has been carried out regularly by the operator. Effectively independent measurements have been provided by the technical support organizations. To a much smaller extent, clearly independent supervision is carried out by the SNSA as the regulatory authority. The discharge limits for nuclear installations were set by the SNSA in relation to the dose constraints. Monitoring of radioactive discharges from nuclear installations and radiation facilities in the Republic of Slovenia started in the early eighties with extensive programmes at the Krško NPP (1981), at the Žirovski vrh Uranium Mine (1985), at the IJS Reactor Infrastructure Centre (1986) and at the Central Storage for Radioactive Waste in Brinje (1986). Radioactive discharges from hospitals with nuclear medicine departments are monitored at times to verify if annual effective doses for reference individuals in the environment are below 10 µSv. Rough estimates of discharged activities for very short lived isotopes are made every year, based on the purchased and applied activity of radioisotopes. The Institute of Oncology regularly orders measurements of radioactivity in its decay tanks at the approved radiation protection expert. When specific activity decreases below authorised limits, liquid waste is discharged to the municipal sewage system. The Institute keeps all records and reports.

b) Environmental monitoring of radioactivity

Monitoring of environmental radioactive contamination in the surrounding of the nuclear facilities has been performed exclusively by the authorised technical support organisations. Radiation exposure of the representative members of population have been 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. The samples are taken and collected from the environment, air, water and soil, as well as underground and drinking water, foodstuffs and animal feed, and analysed. The exposure to the public is estimated as a result of environmental contamination due to operation of facilities in the nuclear fuel cycle and compared with the dose constraints and limits.

An automatic radiation monitoring system on the territory of the Republic of Slovenia was developed soon after the Chernobyl accident. At the moment, the entire system comprises on-line data of dose-rate measurements (75 stations) and aerosol radioactivity measurements (3 stations).

During the operating lifetime of the nuclear facility, for the case 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.

During the last few years the SNSA established a comprehensive database on past discharges and environmental radioactivity measurements. 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 radiation exposure of a representative person of the reference group(s).

Measures Taken by the License Holders

Krško NPP

a) Radiation Protection

The Radiological Protection Unit at the Krško NPP is organized according to the 2002 Act in order to implement radiation protection measures such us measurements, assessment 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 or contractors, inspectors and 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 shall be 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 (area under constant radiological surveillance) includes: the reactor building, the fuel handling building, the auxiliary building, a part of the intermediate building, the primary laboratory, hot machine workshops, the decontamination area, the building for decontamination and the areas for processing and storage of radioactive waste.

In the controlled area – where irradiation and contamination is highly probable – the Krško NPP staff and contractors must be equipped with regular protection equipment, electronic alarm dosimeters and thermoluminiscent personal dosimeters (TLD). Internal contamination is measured by the whole-body counter before and after the work for all workers working in the radiological controlled areas where there is a risk of internal contamination (i.e. during annual outages or major maintenance works).

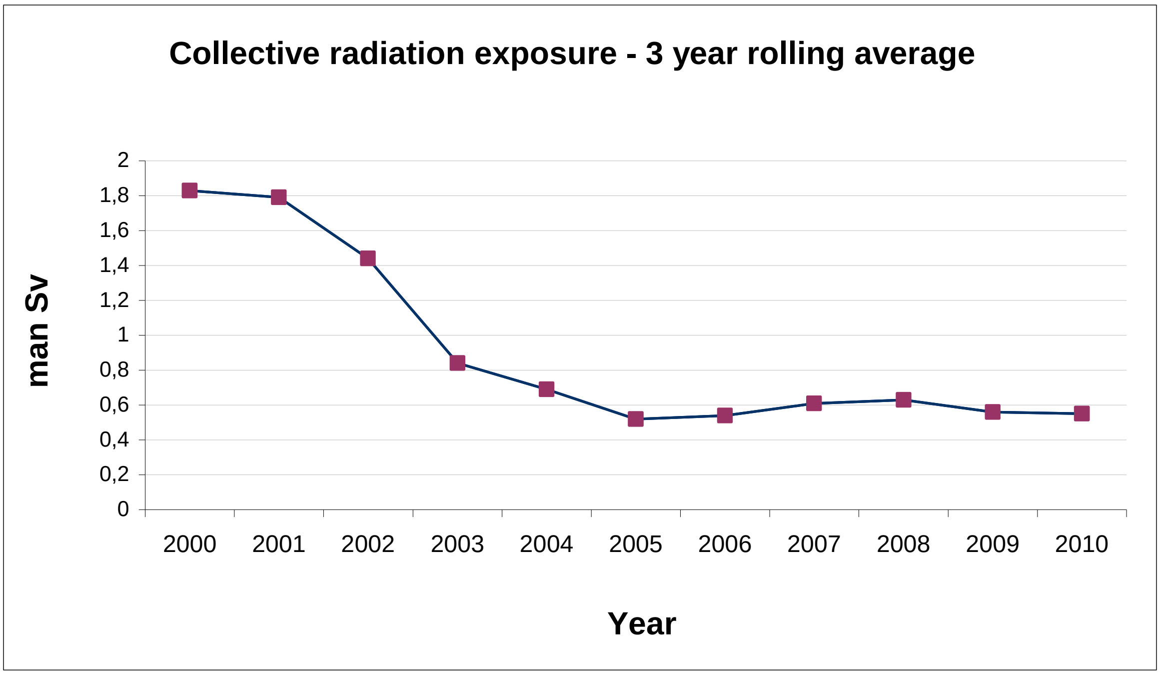
The ALARA Committee of the plant is an advisory body which reports to the General Manager on radiological protection trends of radiation impact on the environment and advises on countermeasures during accident conditions. The committee is responsible for adopting and reviewing the ALARA programmes. The reduction of personal and collective doses is the primary objective when preparing procedures for spent fuel management. During the ALARA planning procedure, radiological conditions are analysed, personal protection equipment is defined, and radiological control determined, so that all key elements are taken into account.

In 2004, the SNSA approved the Radiological Effluent Technical Specifications as a separate part of the Technical Specification for operation of the Krško NPP. 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 the case of emergency. The operator is obliged to notify in advance the SNSA about 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 minimisation of radioactive waste generation are in place. All relevant elements regarding waste minimisation are taken into consideration (fuel integrity programme, reduction of leakage, decontamination process, segregation practices, etc.).

The collective dose in 2010 was 0.85 manSv. The three-year average is 0.55 manSv and the trend is illustrated in the figure below. The maximum individual dose in 2010 was 6.5 mSv, and the average dose per person was 0.76 mSv. From 2000 onwards, after the modernisation of the plant and steam generators replacement, the annual collective doses show a decreasing trend.

Figure 7: **Collective effective dose at the Krško NPP in the period 2000-2010**



In the year 2010 the collective effective dose of workers involved in the processing of radioactive waste in the Krško NPP was 5.9 man mSv, which represents 0.7 % of the total collective dose. These data are lower than before. The maximum individual dose due to waste processing was 3.2 mSv in the year 2008, 2.9 mSv in 2009, and 3.0 mSv in 2010.

b) Liquid and Gaseous Discharges

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

- The effective dose constraint at 500 m distance from the reactor and beyond, due to liquid and gaseous radioactivity releases during normal operation, is less than or equal to 50 μSv.
- The radiation dose constraint from the radioactive waste storage building and the reactor is less than or equal to 200 μSv at the site fence.

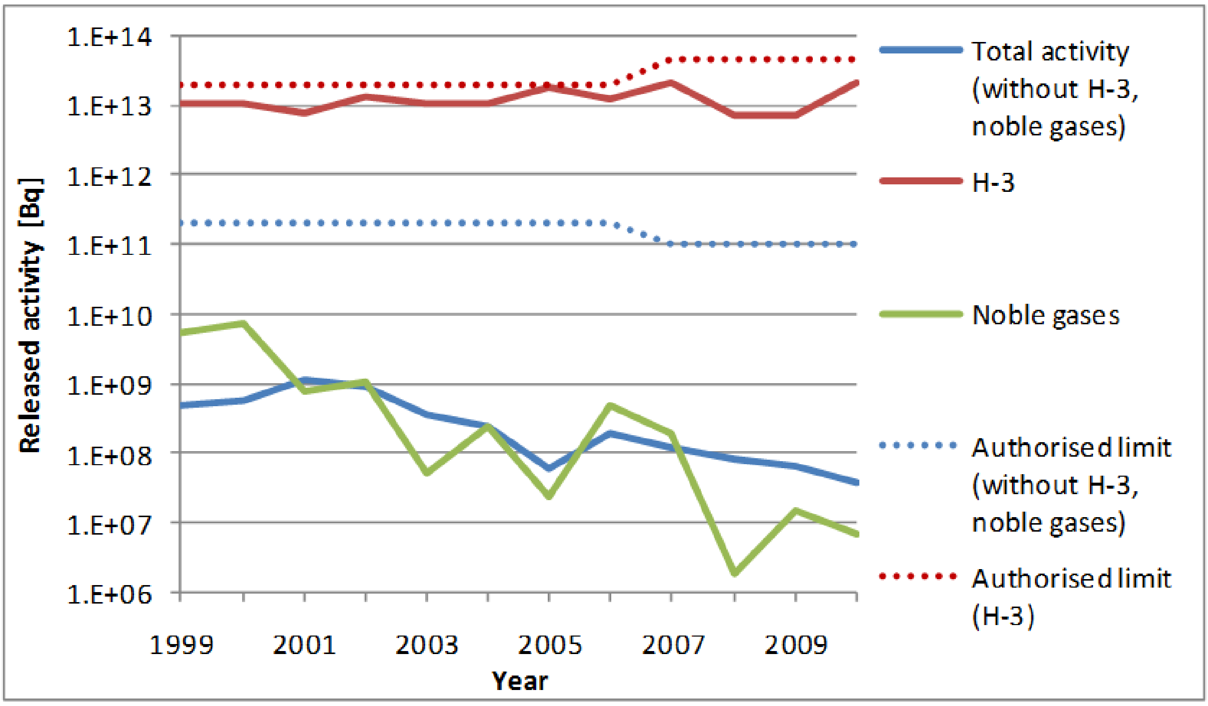
The limits of radioactive flow into the environment were initially authorised by the Operating License of the Krško NPP, issued on 6 February 1984. In 2007 the operating limits were revised and slightly modified in order to assure the compliance with the form of Standard Radiological Effluent Controls for Pressurized Water Reactors. The modification was done in order to include the corresponding effective dose as an additional parameter for the control of plant operation performance. For noble gases release only, the annual limit of activity is replaced by dose constraint. In addition, to assure operation of radioactive waste processing systems, a threshold of activity concentration for monthly projected liquid releases and a dose threshold for projected gaseous releases are introduced.

After the power up-rate and transition to a 18-month fuel cycle the limit for tritium release has been raised from 20 to 45 TBq in a year. At the same time, the limit for beta/gamma emitters has been reduced from 80 to 40 GBq in a calendar quarter, and from 200 to 100 GBq in a year. The new limits enable operating flexibility concerning higher tritium releases. The production of tritium in the reactor coolant system is higher due to higher enrichment of the fuel and higher boron concentration in the coolant. The effective dose to a member of the public due to tritium releases is assessed to be less than 0.1 μSv per year for the maximum activity.

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

The liquid radioactive discharges are released into the Sava River through the Essential Service Water System outlet upstream of the dam. The dominant radionuclides in liquid discharges are: ^{3}H, ^{58}Co, ^{60}Co, and some dissolved noble gases. The activities of ^{134}Cs, ^{137}Cs, ^{59}Fe and ^{125}Sb are up to two to three orders of magnitude lower. The main contribution to the dose originates from the radioisotopes of caesium and cobalt. The dose to the critical group due to liquid discharges is assessed to be below 0.1 μSv per year.

Figure 8: **Radioactive liquid discharges from the Krško NPP in 1999-2010**

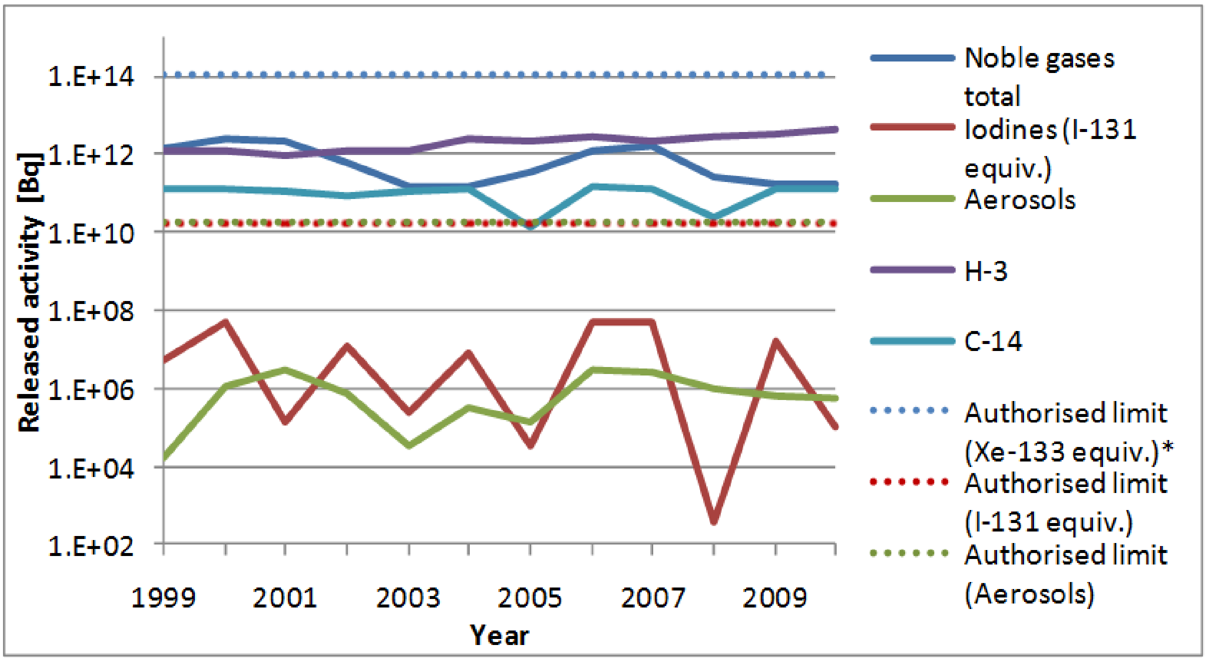


Notes:

– the new limit for fission and activation products is 100 GBq (since 2007)
– the new limit for ^{3}H is 45 TBq (since 2007)

Radioactive gases from the Krško NPP are released into the atmosphere mainly from the reactor building and fuel handling building ventilation through the common plant vent. The radiation monitoring system continuously measures and monitors the concentrations of individual radioactive elements at both discharge points. The maximum calculated dose due to inhalation and external radiation caused by gaseous releases at a 500 meters distance from the reactor was 1.45 μSv in the year 2008, 0.81 μSv in the year 2009 and 1.01 μSv in the year 2010.

Figure 9: **Radioactive gaseous discharges from the Krško NPP in 1999-2010**



Note:

* ^{133}Xe equivalent was effective until 2006, since 2007 only total annual dose limit of 50 μSv has been introduced

Conservatively estimated individual exposures for the members of the public are based on directly measured discharge values and on model calculations. This amounts to a value of the effective dose usually in the range of 0.1 μSv/year for an adult. Dose assessment showed that exposures to members of reference groups have been well below the regulatory limit of 50 μSv/year and less than 0.1% of exposure due to natural radiation.

Central Storage for Radioactive Waste in Brinje

a) Radiation Protection

Radiation protection in the Central Storage for Radioactive Waste in Brinje includes occupational radiation protection of workers and monitoring of radioactivity in the environment of the storage site (protection of the public).

Radioactive waste management and other activities in the storage are performed according to the procedures. For non-regular tasks the radiation exposure of workers is estimated in advance and optimised in accordance with ALARA procedures. All workers are included in monthly individual dose monitoring performed by the authorised dosimetry service. The radiation exposure data for workers in the central storage facility due to the radioactive waste management activities from 2005 until 2010 are given in **Table 2**.

Table 2: **Radiation exposure of workers at the central storage facility due to radioactive waste management from 2005-2010**

Year	Number of workers	Average [mSv]	Maximum individual dose [mSv]	Collective dose [man Sv]
2005*	20	0.199	1.68	0.004
2006*	15	0.045	0.35	0.001
2007*	27	0.046	0.38	0.001
2008*	21	0.175	1.420	0.004
2009	9	0.032	0.147	0.0003
2010	10	0.011	0.040	0.0001

Note:
* staff of the ARAO and outside workers

Monitoring of workplaces is performed regularly. The measurements include: surveillance of gamma dose-rate within the storage and determination of gamma radiation field, neutron dose-rate, surface and air contamination, radon and radon equilibrium equivalent concentrations, and gamma emitters in the samples of waste water.

In 2005 and in 2008 the characterisation of all historical waste with repacking and sorting was carried out. After carrying out the repackaging activities the level of external radiation in the storage was lowered substantially.

b) Liquid and Gaseous Discharges

The scope of monitoring covers emissions (measurements of gaseous and liquid discharges) and environmental concentrations of radioactivity. The average emission rate of radon into the environment is estimated at approximately 4 Bq/s in 2010. This amounts to a yearly release of 0.13 GBq. There were no liquid discharges from the storage.

In dose assessment of the public, two pathways were considered: radon progeny inhalation and external exposure due to gamma radiation based on the results of TLD measurements. Several reference groups have been identified. The annual effective dose for the most exposed representative of the reference group staying in the vicinity of the storage site for a part of his routine job does not exceed 10 µSv/year. The employees working in the nearby research institute facilities receive about 0.6 µSv per year. The annual effective dose received by a farmer who occasionally works in the field near the site is estimated to be around 0.01 µSv.

Conservatively estimated radiation exposure of the public due to the operation of the Central Storage for Radioactive Waste in Brinje is far below the dose constraint of 0.1 mSv/year, set in the operational licence for the Central Storage issued by the SNSA, the Ministry of the Environment and Spatial Planning, in April 2008.

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. Altogether 26 persons from the Reactor Department, from the Service, and from the Radiochemical Laboratory were exposed to ionising radiation with an average annual dose of 0.008 mSv in 2010 (not taking into account the neutron dose). The collective annual dose in 2010 was 0.203 man mSv.

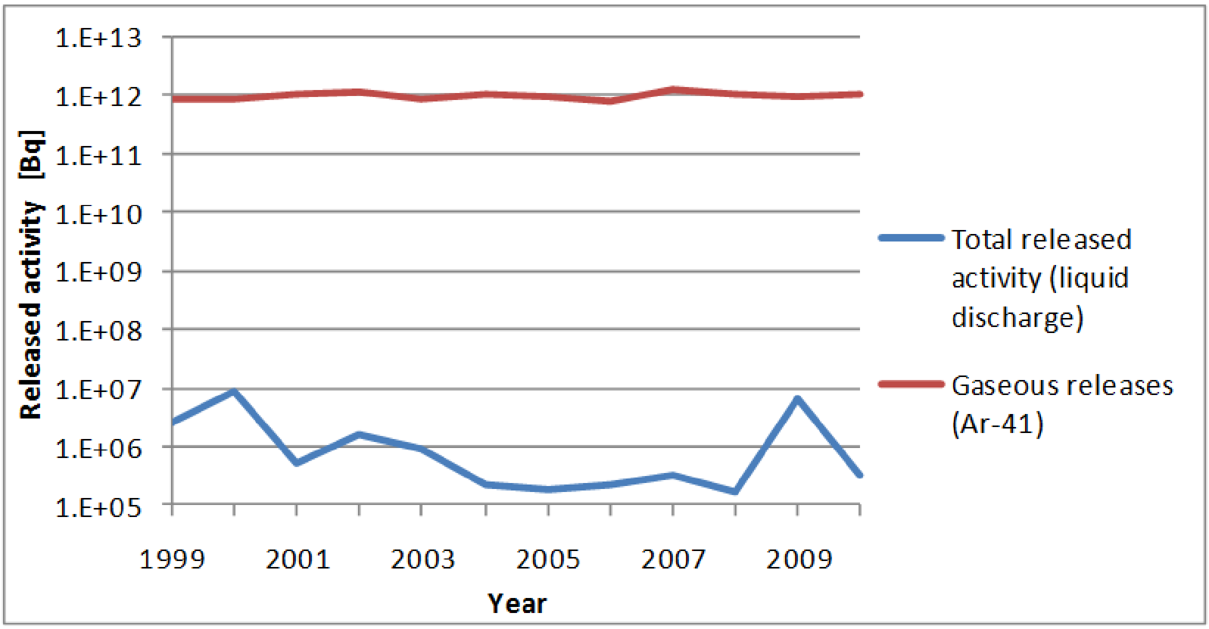
Table 3: **Radiation exposure of workers at the Jožef Stefan Institute Reactor Infrastructure Centre due to radiation practices and radioactive waste management from 2004-2010**

Year	**Number of workers**	**Average** [mSv]	**Maximum individual dose** [mSv]	**Collective dose** [man mSv]
2004	25	0.039	0.159	0.974
2005	29	0.046	0.222	1.343
2006	27	0.025	0.165	0.683
2007	28	0.034	0.197	0.964
2008	41	0.084	0.861	3.449
2009	29	0.005	0.040	0.147
2010	26	0.008	0.044	0.203

b) Liquid and Gaseous Discharges

The liquid discharges originated mostly from the radiochemical laboratory using reactor activation products. The annual reactor discharge of ^{41}Ar is proportional to the time of reactor operation and is estimated to be typically about 1 TBq (1.01 TBq in 2010).

Figure 10: **Discharges from the IJS Reactor Infrastructure Centre in the period of 1999-2010**



For the exposure of the public only two exposure pathways were considered: external exposure due to ^{41}Ar immersion and ingestion of contaminated released water. In the year 2010 the total dose received by the representative person of the reference group was estimated to be of the order of magnitude of 1 μSv/year (0.02 μSv/year for a farmer at the distance of 100 m and 0.52

μSv/year for a permanent resident living at a 0.5 km distant village). 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 the Žirovski vrh Mine d.o.o. is responsible for tasks related to radiation protection of workers and population.

Occupational exposure to ionising radiation is based on time records for the individual worker relating to their work at different workplaces and on the following workplace measurements:

- measurements of radon and potential alpha energy of radon progeny in the air,
- measurements of long lived alpha activity in the air (caused by remediation works at the mine waste piles),
- measurements of external radiation (measured with TLDs on a quarterly basis).

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

Table 4: **Radiation exposure of workers of the Žirovski vrh Uranium Mine due to radioactive waste management from 1996-2010**
1989-2001 effective equivalent dose, 2002-2007 effective dose

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

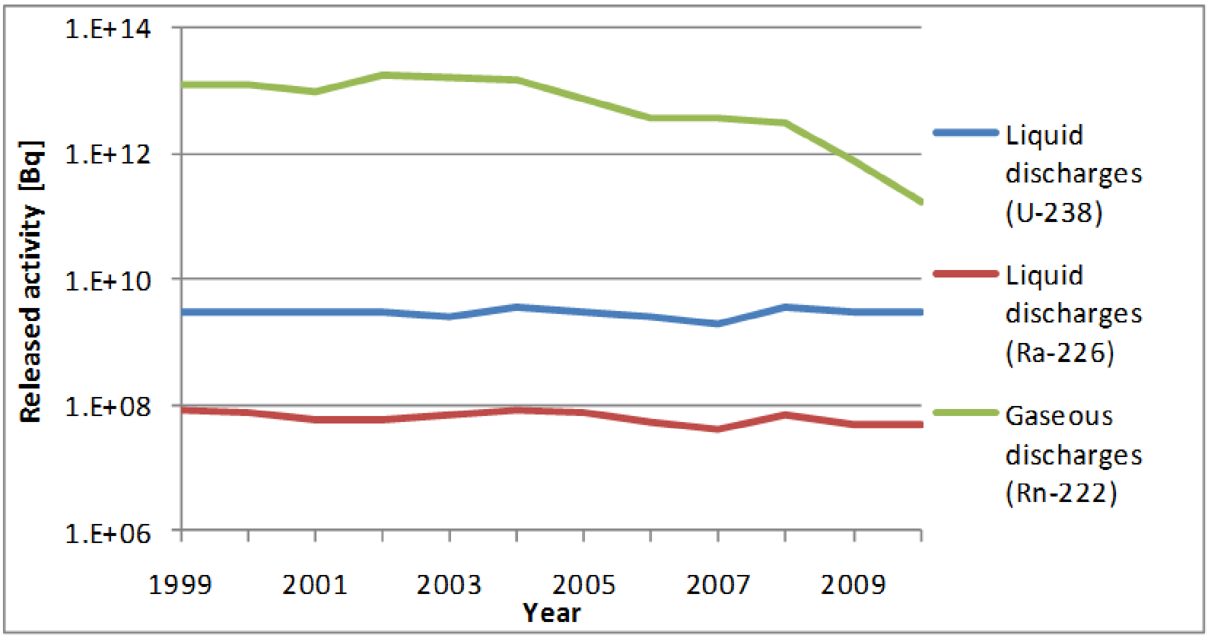
Notes:
* in the period of regular operation
** staff and contractors (outside workers)

b) Liquid and Gaseous Discharges

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

The permanent discharges of the dissolved long-lived radionuclide in percolating and run-off water from disposal sites and in mine water have been slowing down due to progressive remediation. It is expected that future fluctuations will depend mainly on weather conditions in individual years. Radon release estimation is based on the field measurements of radon exhalation rate (**Figure 11**).

Figure 11: **Radioactive discharges at the Žirovski vrh Uranium Mine in the period of 1999-2010**



The impact of the mine discharges extends over an area inhabited by about 330 people. The dose assessment was made for a representative of the reference population group: child - 1 year old, child - 10 years old and adult resident older than 18 years. Inhalation of radon and its progeny is the main contributing factor to the public exposure caused by mining activities. In 2010, the exposure of an adult member of the public was estimated to be 0.12 mSv/year, out of this radon and its short living products contributed 0.08 mSv/year.

Nuclear Medicine Departments

a) Radiation Protection

At the Institute of Oncology occupational exposure is monitored through regular individual monitoring of external exposure and with workplace monitoring. The annual dose of the majority of workers from the Institute of Oncology did not exceed the value of 1 mSv in the period 2001-2010. Individual radiological engineers and radiopharmacists, mainly those handling

^{18}F isotope, receive a higher dose, which is still below 5 mSv. The maximum annual dose in 2010 was 4.9 mSv, while the maximum annual personal dose of 8.8 mSv was received by a medical nurse from the Brachytherapy Department in 2001. No worker exceeded the annual limit of 20 mSv during the past 10 years. All the above mentioned values are related to the total exposures and include also the exposures received during 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 due to the fact that collective doses are very low (less than a few percent, which is far below 1 man·mSv per year).

Occupational exposure at the University Medical Centre – the Department for Nuclear Medicine is monitored through regular individual monitoring and workplace monitoring. All staff is under dosimetric control. In the year 2010 the effective dose of 74% of workers did not exceed 1 mSv and exposures between 1 and 2 mSv have been measured for 25% of workers. The maximum annual dose of 4.2 mSv has been attributed to one worker, who had an exceptionally high monthly reading of 3.8 mSv on his personal dosimeter. The reason for this has not been established. The quoted values are the result of overall individual exposures, not related only to waste management.

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

b) Liquid and Gaseous Discharges

The Institute of Oncology has a system of decay storage tanks in order to control the released radioactivity. The faecal sludge is released into the hospital sewage system only after a 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 – the Department for Nuclear Medicine are monitored at times (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 essentially lower activities of pharmaceuticals. Patients are released from hospitals after iodine ^{131}I therapy and no special decay tanks for this kind of release are in place, so discharges are estimated in the same way as above.

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

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 with the latest consolidated version of the Protection against Natural and Other Disasters Act and the 2002 Act. There are two authorities with responsibilities and competencies to regulate and supervise emergency preparedness at nuclear facilities. The Administration for Civil Protection and Disaster Relief is responsible for population protection during a nuclear accident and for the organisation of civil protection units in nuclear installations. The SNSA is responsible for regulatory control over on-site procedures and measures related to the onsite emergency plan. Their roles were described in more detail in the First National Report.

Concerning safety, the 2002 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 2002 Act provisions mostly focus on the intervention measures in the case of emergency. According to these provisions the operator needs to be capable to classify accidents, assess the consequences of the event and propose countermeasures. In the operator's emergency plan the intervention measures should be planned upon the emergency class declared. The operator shall provide to emergency planners all the requested data which are available to the operator. The operator shall maintain the emergency preparedness and provide response as stipulated by the emergency plan. The prompt notification, without undue delay, of the event is required and the public needs to be informed about important facts in the emergency plans.

The Regulation on Elaboration of Emergency Plans (Official Gazette RS, 3/2002 and 17/2006) stipulates that the on-site nuclear emergency plan should be coordinated on the national and local level 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 after their adoption. In 2006 the above mentioned regulation was supplemented with the requirement which specifies a set of data, relevant for the emergency, to be supplied to the authorities by the companies which are obliged to have an on-site emergency plan.

Overall National Emergency Preparedness Scheme and Off-Site Emergency Plans

The responsibilities and competencies for emergency planning and maintaining emergency preparedness for an accident at the nuclear facility are specified on three levels: plant, local and national. The state is responsible for the local and national radiological emergency response planning and maintenance of the radiological response plans. The content of the Plan was described in the First National Report.

Recently the National Nuclear and Radiological Emergency Response Plan (National Plan) was updated. Besides a possible accident at the Krško NPP, the plan also covers accidents in other nuclear and radiation facilities in the Republic of Slovenia and nuclear or radiological accidents abroad with potential impact on Slovenia, as well as other radiological accidents with sources of ionizing radiation.

The regulations governing the use of potassium iodide tablets have been updated.

The IJS has a standby Ecological Laboratory with a Mobile Unit (ELME), which is a special unit for radiological and emergency response on the national level. It would assist in any radiological emergency. It performs radiation measurements and interventions in the case of lost or dispersed radioactive material. Since 2007 the mobile unit of the Institute of Occupational Health also actively participates in emergency drills in field measurements and testing of radiation monitoring preparedness in the vicinity of the Krško NPP.

In 2009, the Mobile Units for field radiological measurements practised on the routes in the vicinity of the Krško NPP. The field radiological measurements include atmosphere sampling, dose rate and contamination measurements, in-situ measurements and gamma spectrometry of samples. The mobile unit of the Krško NPP, the mobile unit of the Institute of Occupational Safety and ELME all participated in these exercises.

On-site Radiological Emergency Response Plan

Krško NPP

The Krško NPP has competency and responsibility for on-site emergency preparedness and response and maintains the on-site radiological emergency response plan (RERP). The on-site RERP is harmonized with the national RERP, which was updated and upgraded in 2010.

The Krško NPP's RERP also considers the IAEA's recommendations and requirements of US 10 CFR 47 NUREG-0654; therefore, the RERP covers the spent fuel pool and on-site radwaste facilities.

The objectives of the Krško NPP's RERP are:

- identification and evaluation of the type and classification of an emergency,

- identification of the on-site emergency response organisation and responsibilities for the overall command and co-ordination between the on-site and the off-site particular emergency measures,
- identification of additional plant support in the case of emergency required from the off-site support organisation, the Civil Protection Headquarters of Slovenia and other competent authorities,
- identification of emergency response facilities, equipment, communications, protective and other means of managing emergencies,
- taking emergency measures and procedures to assure protection of health and safety of plant personnel and members of the public in the surroundings,
- taking on-site recovery measures to manage or mitigate the consequences of an emergency and to assure conditions for recovery,
- providing a basis for maintaining on-site emergency preparedness, and
- co-ordination between the Krško NPP and off-site local, regional and state authorities to assure on-site emergency preparedness, including public information about protective actions.

Jožef Stefan Institute Reactor Infrastructure Centre

The TRIGA Mark II research reactor has an on-site Radiological Emergency Response Plan. There is no off-site Radiological Emergency Response Plan, because short-term protection actions for the off-site population are not envisaged for operational accidents. According to the Safety Analysis Report the most severe accident (total loss of all reactor coolant) would not cause a core meltdown, therefore no significant radioactive release to the environment is expected.

The emergency response plan for the TRIGA Mark II research reactor is specified in the Safety Analysis Report. The emergency procedures are subject to internal and external verification and approval. The emergency procedures include: reactor status data, identification of emergency situation, description of the actions, alarming, 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),
- non-radiological accidents or events (fire in the reactor building, earthquake, sabotage and unauthorised access, riots and demonstrations, 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 is no spent fuel there). The off-site consequences of the gap release from damaged spent fuel elements are negligible.

Central Storage for Radioactive Waste in Brinje

The emergency response plan for the Central Storage for Radioactive Waste in Brinje, prepared by the ARAO, covers all anticipated abnormal events and emergency situations related to the operation of the facility and handling of radioactive waste. The plan defines the competencies and responsibilities of the personnel responsible for emergency preparedness, and the response to the emergency situation.

The following abnormal events and emergency situations in the Central Storage for Radioactive Waste in Brinje are included in the ARAO emergency response plan:

- fire in the storage,
- loss or theft of a spent sealed source,
- accident during handling of radioactive waste, and
- other similar emergency situations.

Žirovski vrh Uranium Mine

Radiological emergency situations at both disposal sites, Jazbec and Boršt, are not expected. As part of the monitoring programme, the surfaces of the Jazbec mine waste pile and the Boršt mill tailings site are inspected regularly, and after heavy rain additional inspections are conducted. The rate of sliding of the base of the Boršt mill tailings site is measured in real time, with the GPS system at the control points on the mill tailings.

Slovenian Nuclear Safety Administration

The SNSA Emergency Plan is harmonised with the National Radiological Emergency Response Plan. It contains procedures which are needed to support the SNSA staff when performing specific activities which are required during an emergency.

The SNSA Emergency Response Plan has been mainly focused on accidents in a NPP (the procedures mostly address the Krško NPP but also NPPs abroad). It is harmonised with the National Radiological Emergency Response Plan, which consists of a set of procedures for the SNSA emergency team, activated during a radiation emergency.

The SNSA emergency team has two subgroups in addition to communicators and other supporting positions - one for analysing the nuclear accident and the other for dose assessment. The team has 19 positions and works in 12-hour shifts.

The SNSA's main role during a radiation emergency is to recommend protective measures for the population to the chief of the Slovenian civil defence. In addition the SNSA issues press releases for the public and responds to the media and the public.

For primary communication between major organisations responding to a radiation emergency, a special on-line communication system MKSID is used, which is provided by the SNSA.

Exercises

In accordance with the legislation one national nuclear exercise shall be organised in a five-year period.

The SNSA emergency response is assured by regular training for the members of emergency expert groups and response verification, as well as through exercises, regular checks of computers and other equipment, participation in international activities, and regular checks on all organizational regulations and associated guidance. Thus, the SNSA has conducted many training sessions. Also, the SNSA each year actively participates in annual NPP Krško exercises and conducts several internal exercises.

In the Training Centre for Civil Protection and Disaster Relief, every year between 250 and 300 emergency team members, who can take part also in nuclear and/or radiological emergencies, are trained.

The professional fire brigade of Ljubljana and the ARAO regularly organise trainings and practical exercises for the professional firemen at the central storage facility.

The drills and exercises are an integral part of the NPP Krško radiological emergency preparedness program. It incorporates the human element with the emergency response facilities, emergency equipment and emergency implementing procedures to develop and maintain key emergency response skills and provide an indication of the effectiveness of emergency preparedness.

The program is based on a routine annual schedule of the activities which include the drills identified below:

- facilities and on-site emergency response organisation activation,
- evacuation and accountability,
- post-accident sampling,
- off-site field monitoring, dose assessment and off-site protective measures recommendations,
- on-site radiation protection and radiological control,
- fire fighting,
- first aid and medical response, and
- emergency notifications.

The objectives of the drills are also incorporated and checked in an annual on-site integrated exercise. The exercises are prepared by the Exercise Organisation Group, which is also in charge of preparation of the formal scenarios. Within a five-year period all emergency response segments are tested. The exercises are prepared and conducted regularly using the plant full scope simulator, which is also used for the Main Control Room (MCR) simulation. The NPP Krško emergency support organisations, local and governmental agencies also participate in integrated exercises. The last exercise of this kind was conducted in June 2010. A large, two-day national integrated exercise was carried out in October 2008.

International Agreements and International Projects

Slovenia is a party to the Convention on the Early Notification of a Nuclear Accident and to the Convention on the Assistance in the Case of a Nuclear Accident or Radiological Emergency. Slovenia has signed bilateral agreements with Austria, Croatia, Hungary and Italy on the early exchange of information in the event of a 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 is no nuclear facility in the process of decommissioning, excluding the remediation of the Žirovski vrh Uranium Mine, which is a radiation facility. In order to assess the contribution to the decommissioning fund, the decommissioning plan for the Krško NPP is being revised.

Krško NPP

The Agreement between Slovenia and Croatia on the Krško NPP of 2003 requires the preparation of a Decommissioning Plan for the Krško NPP by the Slovenian and Croatian agencies for the management of radioactive waste. In accordance with the Agreement, a Review of the "Programme for the Decommissioning of the Krško NPP and Disposal of Low and Intermediate Level Waste and Spent Fuel" was prepared in April 2004. An update of the Decommissioning Programme has to be made at least every five years.

Revision 2 of the Decommissioning plan was started in September 2008, with the purpose to incorporate relevant developments since the first revision, to improve the level of details and reliability of the decommissioning plan, and to propose updated and more accurate cost estimates and appropriate financing models. The revision is not finished yet.

(i) Staff and Financial Resources

The Slovenian share of assets for decommissioning of the Krško NPP is collected and managed by the Fund for Decommissioning of the Krško NPP. Due to the revision of the Decommissioning Programme, the levy per kWh_e was increased from approximately 0.2 to 0.3 Euro cents. As the decommissioning of the Krško NPP will occur after the year 2023, it is assumed that the Krško NPP staff will perform decommissioning together with external contractors.

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

There are no specific regulations for the decommissioning of nuclear facilities. All legal requirements and limitations that are applicable to all operating facilities are applicable to the 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, it is required and shall be prepared for the application for the license for decommissioning.

(iv) Records of Information

There is an Engineering Support Department in the Krško NPP, which is in charge of record keeping and of maintaining the database required by regulations, also regarding decommissioning.

Jožef Stefan Institute Reactor Infrastructure Centre

A research project estimating the quantity and composition of LILW material resulting from dismantling was carried out and the Decommissioning Plan for the reactor prepared in 2007. The IJS decided to ship all spent fuel (presumably 84 fuel elements) to the US within the scope of the "US originating fuel repatriation program" by 2019. The reactor will be decommissioned after the year 2020. It has been estimated that not more than 50 tons of LILW would be produced in decommissioning. The Decommissioning Plan will be revised during the Periodic Safety Review, which is planned to start in the year 2011.

Žirovski vrh Uranium Mine

Properly qualified staff is available to accomplish all remaining tasks, activities and long-term supervision of the disposal sites at the Žirovski vrh. Adequate financial resources are available for the accomplishment of remediation activities. For this purpose the Ministry of the Environment and Spatial Planning assures financial means from the national budget.

The funds necessary for institutional control and monitoring of the Jazbec mine waste pile, the Boršt mill tailings site and the mine water outlet will be assured by the Slovenian Government.

Safety of remediation of the Jazbec mine waste pile and the Boršt mill tailings site is ensured through licensing and regulatory supervision, similarly as for the decommissioning of other nuclear facilities.

Central Storage for Radioactive Waste in Brinje

No detailed plans have been adopted so far for the decommissioning of the Central Storage for Radioactive Waste in Brinje. There is a general chapter in the Safety Report for Central Storage Facility which indicates possible approaches to decommissioning of the facility.

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 2002 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 2002 Act. For this reason, in order to avoid redundancy in the report and to assure fluency of 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 2002 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 and in non-binding guidance on content of the safety case for a particular type of nuclear facilities.

The requirement that generation of radioactive waste associated with spent fuel management and generation of other radioactive waste is kept to the minimum practicable, consistent with the type of fuel cycle policy, is assured through the 2002 Act. Paragraph (2) of Article 93 stipulates that the person responsible for the occurrence 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 Resolution on the 2006-2015 National Programme for Managing Radioactive Waste and Spent Nuclear Fuel, adopted by the Slovenian Parliament in 2006. 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 licenses. The request to consider interdependencies among different steps in spent fuel and radioactive waste management is provided also in the Rules on Radioactive Waste Management that entered into force in May 2006.

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 Safety Analysis Report for each particular nuclear and disposal facility. The content of the documentation is prescribed by the regulation issued by the Minister of the Environment and Spatial Planning (2002 Act, Article 71), while the content of the Safety Analysis Report for the disposal of spent fuel, radioactive waste (2002 Act, Article 73) and for the disposal of uranium mining and ore processing waste (2002 Act, Article 76) shall be prescribed by the SNSA, which also acts as a licensing authority for the approval of the Safety Analysis Reports.

There are no special provisions for avoiding actions that impose reasonably predictable impacts on future generations 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. The legal and licensing requirements in the area of spent fuel and radioactive waste management that are applied at present do not stipulate any relaxation in the future.

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 IJS Reactor Infrastructure Centre (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 license 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 for Radioactive Waste in Brinje, the Boršt mill tailings site and the Jazbec mine waste pile at the Žirovski vrh Uranium Mine.

The Central Storage for Radioactive Waste 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 (IJS) obtained a license for the use of this facility on the basis of the Construction Act. In 1998, the SNSA required by decree that the operator apply for an operating license under the 1984 Act and prohibited further operation of this facility, except for emergency cases.

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

The refurbishment of the Central Storage for Radioactive Waste in Brinje and the licensing were performed in compliance with the 2002 Act. The license for trial operation of the Central Storage for Radioactive Waste was issued in 2005, and the license for normal operation was issued in April 2008.

The remediation of the Žirovski vrh Uranium Mine has been in progress since the termination of operation in 1990. Remedial actions in Jazbec were finished in the year 2008. The remediation work on the Boršt disposal is delayed due to 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 facilities. The principal Act governing their operation was the Mining Act. This situation changed with the 2002 Act. According to Article 76 of the 2002 Act, the construction of mining or ore processing waste repositories was approved on the basis of SNSA consent. The key document is the Safety Analysis Report.

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.

One of the major tasks in the area of radioactive waste management in the Republic of Slovenia is the siting and construction of the facility for management and disposal of LILW. The decision on siting and construction of the facility for management and disposal of spent fuel has been deferred according to the Resolution on the 2006-2015 National Programme for Managing Radioactive Waste and Spent Nuclear Fuel and the Programme of

Krško NPP Decommissioning and Spent Fuel and Low and Intermediate Level Waste Disposal. It is planned to identify sites by 2035 and to propose the site by 2055. At present, spent fuel management is part of the operation of the Krško NPP and the TRIGA Mark II research reactor at the IJS Reactor Infrastructure Centre and no immediate activities in siting of the spent fuel repository are envisaged in the near future.

The course of procedure in the licensing process of nuclear facilities such as repositories is stipulated in the 2002 Act, the Environment Protection Act, the new Spatial Planning Act, The Act regarding the siting of Spatial Arrangements of National Significance in Physical Space, the Construction Act, the Rules on Radiation and Nuclear Safety Factors (JV5), the Decree on Categories of Projects for which an Environmental Impact Assessment is Mandatory and the Decree on the Content of Report on the Effects of Intended Activity to the Environment and Method of its Preparation.

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

According to the 2002 Act and the Environment Protection Act the safety documentation concerning nuclear and radiation safety during the siting of a nuclear facility shall consist of three main documents: Special Safety Analysis, Environ–mental Impact Assessment Report, and Safety Analysis Report. The content of all three documents is similar, since they are prepared for the same facility, but they differ regarding the level of details presented.

Assessment of all relevant site-related factors likely to affect the safety of the repository of LILW during its operating lifetime and assessment of the likely impacts of the facility on individuals, society and the environment, taking into account possible evolution of the site conditions of the repository after closure, is assured through various legally binding documents and procedures further discussed in this text.

Article 64 (location of a nuclear facility) and Article 65 (analysis of the safety of a site for the location of a nuclear facility) of the 2002 Act determine that the selection of a site for the location of a nuclear facility shall be based on a Special Safety Analysis, which will be used to assess all the factors at the site of the nuclear facility which may affect the nuclear safety of the facility during its active life and the impacts of operation of the facility on the population and the environment.

The Environment 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.

Environmental Impact Assessment is provisioned in Article 51 of the Environment Protection Act in the course of issuing environmental protection consent for a nuclear facility. The SNSA shall propose the content of the Environmental Impact Assessment in the part related to radiation and nuclear safety. The conditions, the scope and the content of the Environmental

Impact Assessment shall be drawn up by the Environmental Agency of the Republic of Slovenia on the basis of the SNSA’s proposal.

Public involvement in the siting process is assured through prescribed public hearings, consultations, exhibitions and by making all the information available to the public. In the siting phase it takes place in the frame of strategic environmental assessment (SEA), and in the licensing phase in the frame of environmental impact assessment (EIA).

The Environmental Report based on the Environment Protection Act is prepared for strategic environmental assessment. The Special Safety Analysis is also prepared and both documents are subject to public presentation and are both public documents.

A similar procedure is in place for the Environmental Impact Assessment which is required for obtaining the Environmental Protection Consent from the Environmental Agency of the Republic of Slovenia. The public presentation must last at least 30 days (Article 58 of the Environment Protection Act). The Ministry of the Environment and Spatial Planning shall announce its decision in the public media within eight days. The decision must include a statement that opinions and comments made in the public presentation, discussion, and hearings have been implemented.

Siting of the LILW Disposal

Due to the growing need for a 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 following three main criteria were taken into consideration when deciding on the site selection approach:

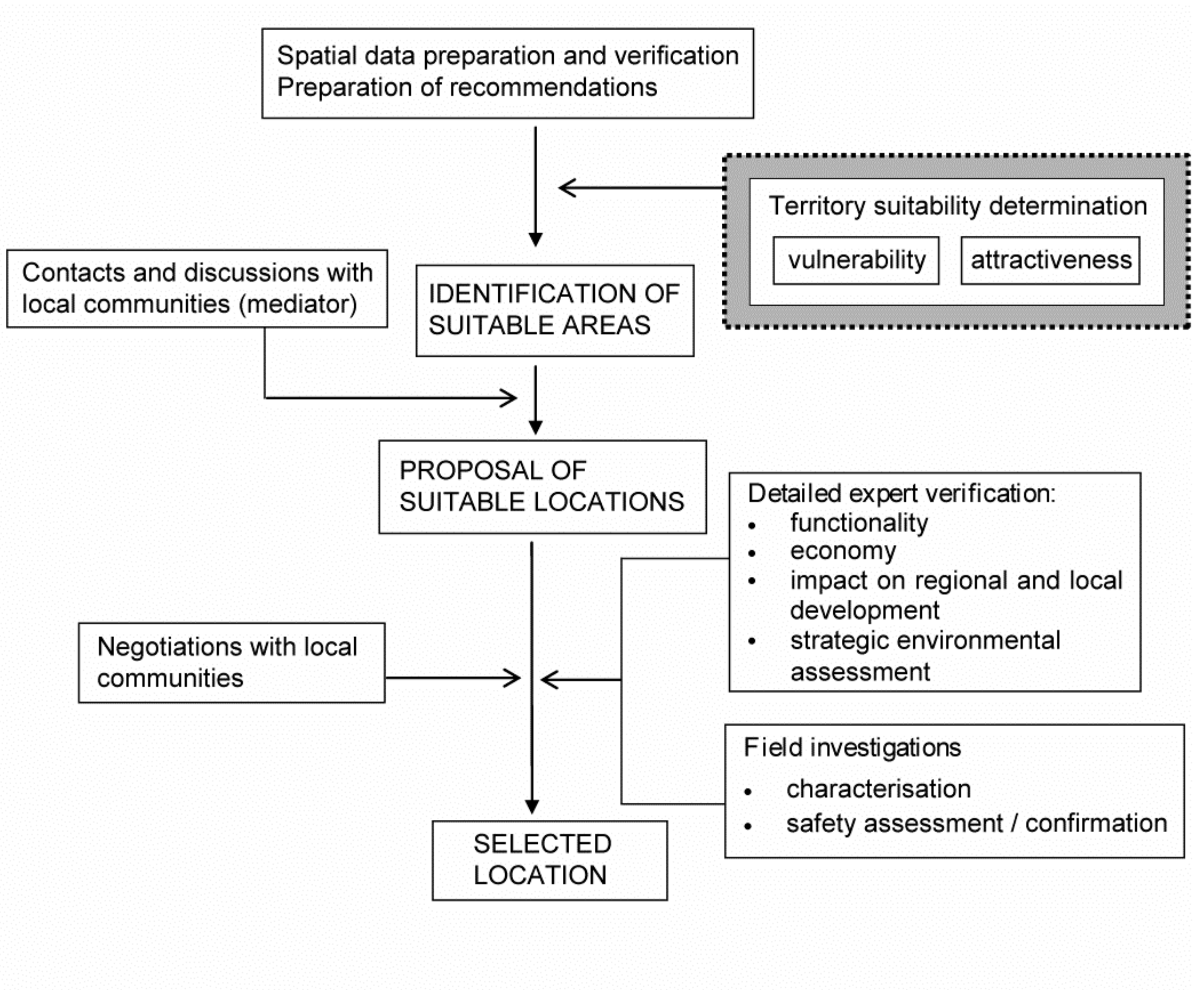
- the site together with the repository should provide a safe disposal solution, which must be supported by the safety assessment,
- the site selection must be performed in agreement with the local community,
- the site should have a consent of all stakeholders.

The ARAO decided on the mixed mode site selection process. It is in practice a combination of technical screening and volunteer siting. It is flexible, transparent and it guarantees high public involvement. According to the IAEA recommendations it is divided into four stages:

- concept and planning,
- area survey,
- site characterisation,
- site confirmation.

The mixed mode site selection process is presented schematically in **Figure 12**.

Figure 12: **Schematic presentation of the mixed mode site selection process**



Special attention was devoted to the involvement of the local communities in the site selection process. For the first communication with the local communities an independent mediator was recruited to facilitate negotiations between the community and the government as the investor. In the second part of the site selection process, the so-called local partnerships were established to support the decision-making process, and to assure compliance with the Aarhus convention.

At the end of 2003, a Decree on the Criteria for the Determination of the Financial Compensation due to the Limited Use of Land in the Surrounding of a Nuclear Facility was adopted. It determines the financial compensation to the local communities also during the site qualification phase.

At the end of 2004, the official administrative procedure for the siting of the repository was announced. Based on this the ARAO invited local communities with a clear offer on how to participate in siting. By the end of the first bidding period in April 2005, eight applications from local communities were received.

Based on the assessment of technical aspects the ARAO selected 11 potentially suitable sites in 4 local communities, and one was proposed by a fifth local community. After preliminary characterisation the sites were ranked; first by local communities according to public acceptability. In the second step, all other aspects were considered. Based on this process three most favourable sites for further field investigations were selected and approved for further field investigations and continuation of the siting procedure. All three selected local communities (Brežice, Krško, Sevnica) are in the vicinity of the NPP Krško site.

By involvement of all stakeholders and the general public through the local partnership, a communication forum facilitating the dialogue with local communities was created. It provides the opportunity for local and national stakeholders to work together on issues that are of common interest and concern.

The municipality Sevnica withdrew from the siting procedure very soon due to strong public opposition to the repository.

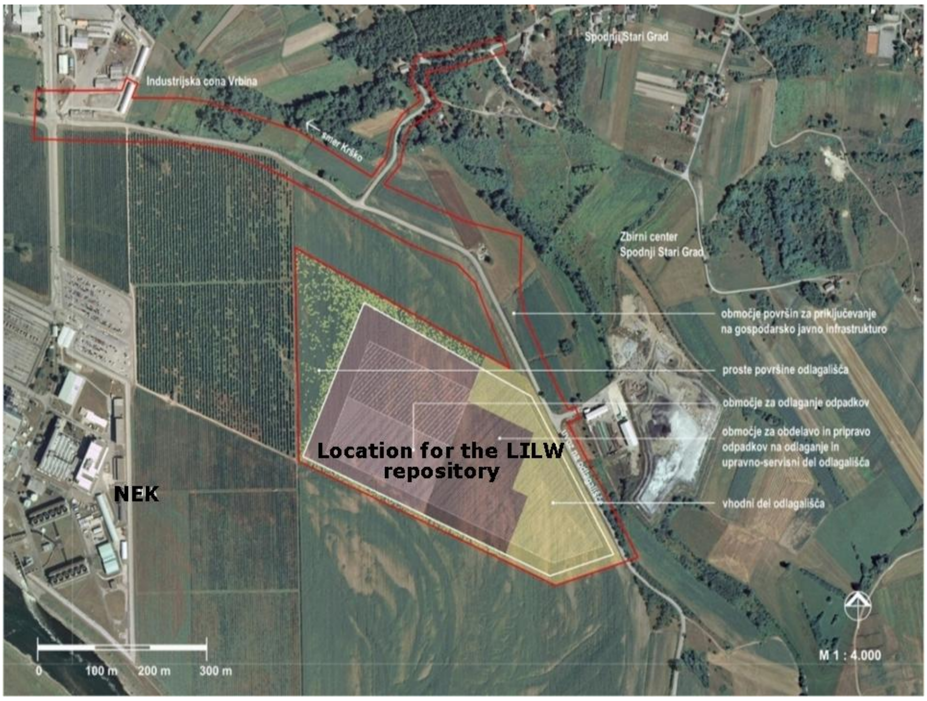
Due to strong opposition organized by the Civil initiative Globoko in the municipality of Brežice the municipality council decided in August 2006 to withdraw the site but local partnership continued with its activities. After thorough discussion the municipality proposed a new potential site (February 2007) at the locality Vrbina Šentlenart (Brežice municipality) which was lagging behind with site characterisation.

Meanwhile, the procedure for preparation of the National Spatial Plan for a LILW Repository at Vrbina in the Krško municipality continued. Three repository variants were considered on the site - the surface repository, the silo type repository and the tunnel type repository. Based on the evaluation, the ARAO proposed construction of the silo type of LILW repository and prepared a proposal of a Detailed Plan of National Importance for a Low and Intermediate Level Waste Repository at Vrbina in the Krško municipality. A public hearing was organized in spring 2008 and recommendations and opinions from all stakeholders were collected and incorporated into the draft proposal. Negotiations between the government and the municipality to increase social acceptability of the proposed site continued and resulted in adopting protocols that ensure additional financial benefits for the municipality. The municipality council of Krško gave its consent to the proposal of the national spatial plan in July 2009.

According to the Act on Spatial Planning many governmental organizations and public companies gave their official opinion to the proposed plan and prescribed design conditions for the preparation of the project documentation. Some changes of the proposed Decree followed and at the end of the year 2009 the Slovenian government adopted the Decree on the Detailed Plan of National Importance for a Low and Intermediate Level Waste Repository at Vrbina in the Krško municipality.

The location for the LILW repository at Vrbina in the Krško municipality is shown in **Figure 13**.

Figure 13: **Location for the LILW repository at Vrbina in the Krško municipality**



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 that are prescribed in Articles 7 and 14 of the Convention are assured through the licensing process for the construction of nuclear facilities.

The license for the construction of a nuclear facility is issued by the Ministry of the Environment and Spatial Planning on the basis of the Construction Act; among other sub-conditions is the consent of the SNSA (2002 Act, Article 68). In issuing a consent the SNSA evaluates the technologies incorporated in the design and construction of the spent fuel management or radioactive waste management facility from aspects related to nuclear and radiation safety and environmental protection.

According to Article 68 of the 2002 Act, the application for the issue of a consent for the construction license for a nuclear facility 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 compiled in compliance with the design bases according to the provisions of Chapter II of the Rules on Radiation and Nuclear Safety Factors (Rules JV5). The contents of the project documentation, methods of its preparation and revision are prescribed by the rules governing project and technical documentation, and in the case of mining works, with the provision of the rules governing the method of 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 the 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 chapters of the Safety Analysis Report are prescribed by the Rules JV5 (Article 40).

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

Design basis for the LILW repository

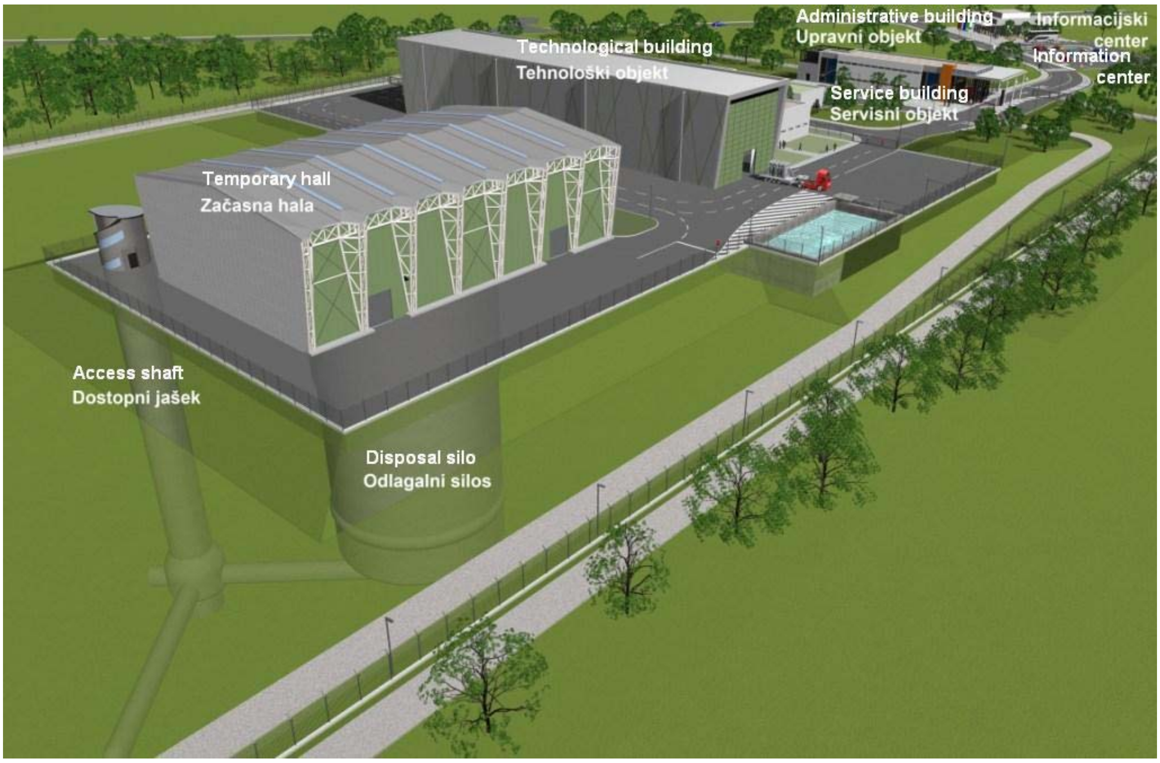
Three repository variants have been considered in the siting process at the Vrbina site in the Krško municipality: surface repository, silo type repository and tunnel type repository.

The silo repository type was confirmed with the adoption of the Decree. The area included in the National Spatial plan is 18 ha. The planned LILW repository with a net surface area of about 10 ha includes all structures, systems and components required for its operation as an independent nuclear facility. It is composed of an information center, entrance area with an administrative building, service building, technological building and disposal area with 2 disposal silos as shown in **Figure 14**. An area for additional two silos is reserved for future extension of the capacity, if needed. Additionally there are monitoring structures, physical protection (security) structures, earth-filled platforms and structures of external and landscape arrangement, and infrastructure lines and connections to utility networks. The largest area covers:

- Eastern part of the repository where an access from the Vrbina road is provided and a public building of the repository information center is constructed;
- Narrow area of the repository, intended for administrative-service activities, waste acceptance and conditioning, waste disposal into disposal units and provision of physical security of the repository; this area is surrounded by a fence;
- Free surfaces of the repository which are planted by trees; and
- Surfaces required for connections to commercial infrastructure.

Surfaces within the disposal units area and a major part of inner surfaces of the waste conditioning structure are classified as a radiologically controlled area and protected by a fence.

Figure 14: **LILW Repository Facilities**

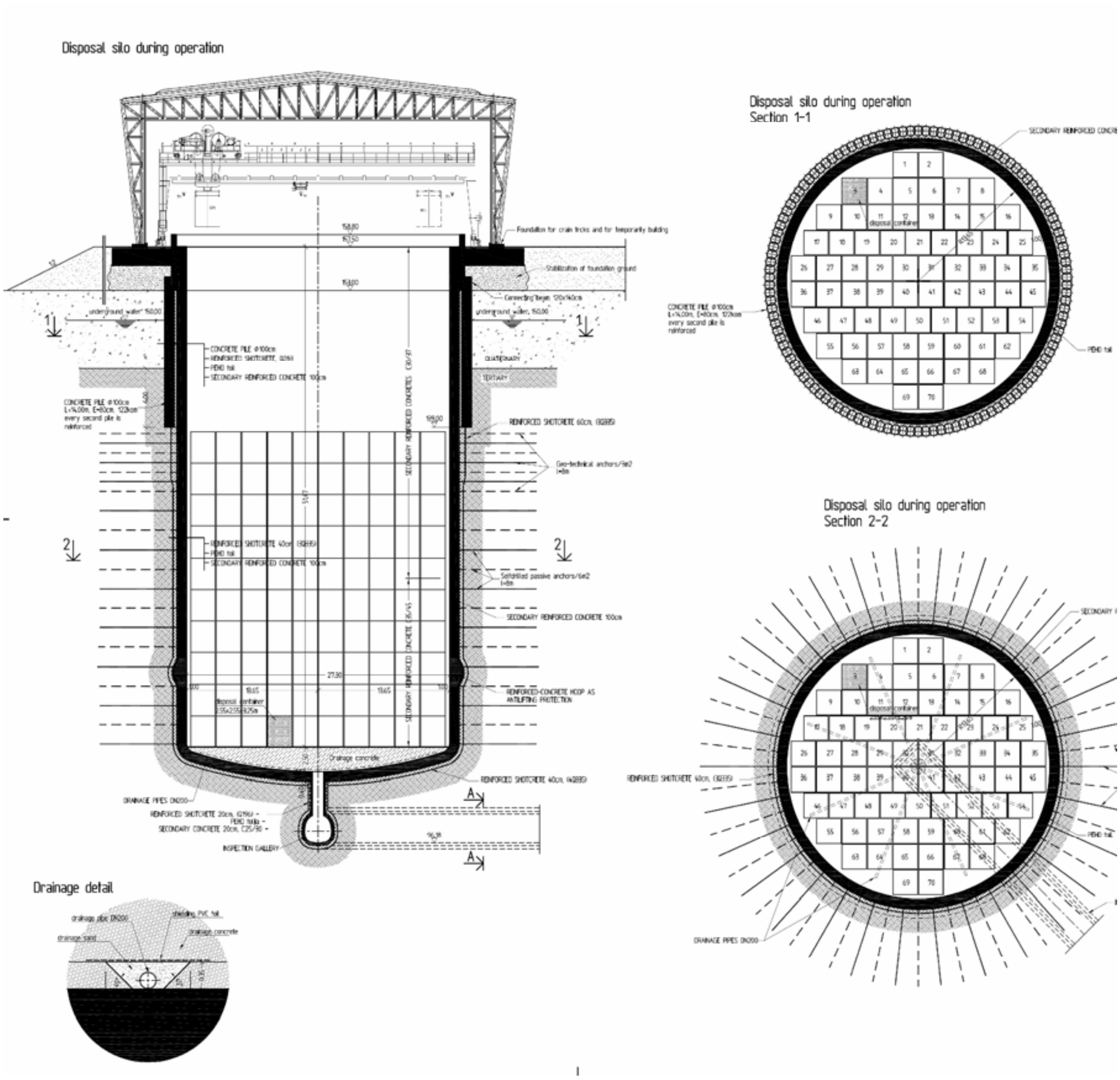


The silos structure is 33 m high and has 27.3 m in diameter (**Figure 15**). The bottom of the silo is approximately 55 m below the elevation of the flood protective platform. Into each silo 700 concrete containers could be placed at 10 levels. 2 silos are foreseen in preliminary design with an overall capacity of 9400 m^3 of LILW, which could be placed in 1400 concrete containers. The silos are connected with an access shaft where also access to drainage corridors below each silo is planned for the collection of waters percolated across the silo walls.

During the insertion of concrete containers the silo is protected with a temporary hall where also a portal gantry crane is located. The disposal containers will be transported from the technological building to the handling area near the silo by a vehicle and then disposed of with a crane. The voids shall be backfilled with backfilling material. The last layer of containers will be covered with a concrete plate and a layer of low-permeable material (e.g. clay).

Flexibility of the repository concept was an input to the project to cover as many future developments in the programme as was reasonable to expect. It consists of a modular approach and an intermittent mode of operation. Each silo is an independent unit. The number of silos is expandable. The second silo will be constructed when the first one is filled up and the need for the second one arises. The repository can operate intermittently, being temporarily in standstill mode for longer or shorter periods of time. The repository also has the potential to accommodate all LILW from the Krško NPP if it is decided that this will be a joint LILW disposal of Slovenia and Croatia.

Figure 15: **LILW Disposal Silo and Repository Layout**



In addition, during the preparation of the preliminary design also some new inputs appeared, requiring harmonization with the original LILW repository design:

- LILW quantities, predicted in the Preliminary Decommissioning Plan for NPP Krško from 2010, are significantly lower than assumed in the preliminary design, which reduces the number of containers and silos needed.
- Prolongation of NPP Krško life-time is under consideration and will be decided on by the end of 2011, therefore necessary changes in LILW volume have to be addressed.
- Possibilities of optimization of some activities regarding radioactive waste management have been suggested also by an international peer-review of the preliminary design, therefore different other variants of activities and corresponding structure needs are being studied and will be incorporated in the repository documentation.

Article 8: Assessment of 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 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

Assessment of safety before the construction of a spent fuel management facility or a radioactive waste management facility is assured through Article 71 of the 2002 Act. It is ensured through the provision that an application for license shall contain project documentation, a Safety Analysis Report and an opinion of an authorised expert for radiation and nuclear safety.

Rules JV5 in Article 40 lay down the general contents of the Safety Analysis Report. The Safety Analysis Report shall give 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 achieved,
- 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, a description of the design bases

of the radiation or nuclear facility and a description of their methods of fulfilment,

- a detailed description of the safety functions, of all safety systems, 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 safety aspects related to the facility's 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 probabilistic safety analyses,
- a description of the emergency operational procedures and of the severe-accident management guidelines in the case of a nuclear power plant,
- a description of the emergency plan for the facility and of the facility operator's internal organisational set-up in emergency events and of its alignment with the national protection and rescue plan in case of 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,
- operating limits and conditions of safe operation and technical bases explaining 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 protection of the exposed personnel against ionising radiation, including an assessment of their protection against radiation and an assessment of the population and environment exposure,
- 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 termination of operation and decommissioning,
- a description of the quality-assurance and management programme,
- an outline of the physical protection of the facility, nuclear and radioactive substances,
- the anticipated and maximum allowable releases of radioactive substances into the environment,
- a programme of meteorological measurements and radioactivity monitoring in operation, and

- in the case of a radioactive waste repository, a spent fuel repository, a hydrometallurgical tailings repository or a mining tailings repository, a plan for long-term surveillance.

The Safety Analysis Report shall be amended when changes of the situation referred to by the Safety Analysis Report arise during the construction or decommissioning of the facility or during the period of trial operation.

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 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 the changes which occurred during the construction, an opinion from an authorised expert for radiation and nuclear safety and other prescribed documentation.

Article 24 of Rules JV5 sets the contents of the application for consent for the start of trial operation of a radiation or nuclear facility.

The SNSA shall issue a 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 refusal of consent for the start of trial operation.

Special Safety Analysis for the LILW repository

Special safety evaluation for a low and intermediate level waste repository was prepared as part of the Special Safety Analysis prescribed by the Slovenian Nuclear Safety Administration according to the 2002 Act. Safety assessment was performed for three repository types at Vrbina in the Krško municipality, on the potential location close to the NPP Krško:

- for a surface vault type repository, constructed on an artificial embankment,
- for a near-surface silos type repository, and
- for an underground repository.

The safety assessment of the three repository types consists of the dose assessment for workers within the repository through its operating and closing phase - for the normal evolution of events and for abnormal events, as well as for the post-closure repository phase - for the normal evolution (or design) scenarios and for alternative scenarios.

The assessment was performed in accordance with the IAEA recommendations and the Slovenian legislation. With the first step, potential events were identified and in accordance with the repository type characteristics, scenarios were developed. These scenarios were further analysed from the nuclear safety point of view: each of the scenarios identified as important, either due to the high expected occurrence or due to the expected strong consequences, was calculated and the resulting effective equivalent doses to a member of the critical group were compared to the dose constraints. In this way, 6 scenarios for normal events within the period of repository operating and closing phase and 12 scenarios for the abnormal events were treated. For the post-closure repository period several design scenarios for each of the three repository types and a number of alternative scenarios were identified: 7 for the surface repository, 3 for the silos and 4 for the underground type of repository.

In accordance with the SADRWM and ISAM methodology, the doses to a member of the critical group were calculated. The results obtained were very low doses for all scenarios with normal events through the operating and closing repository period. The doses from abnormal events were somewhat higher. The highest dose to the worker showed for the container fall-and-crash scenario in the surface and silos repository and for the fire scenario within the silos and underground repository. In both cases, the doses were well under the dose constraint prescribed in the Slovenian regulation. Dose calculation for the post-closure period gave very low doses to the members of the critical group for all three repository types. For the surface repository, the assessed dose was one order of magnitude below the dose constraint, while for the other two types, these values were 5 orders of magnitude lower. The calculations for the alternative scenarios gave somewhat higher doses, especially in the case of all-barrier-demolition scenarios (after 300 and 10,000 years). This scenario for the surface repository is highly unlikely to occur; it was taken as a limiting scenario. In this case, the calculated dose was one order of magnitude higher than the dose constraint for normal operation, but it is well below ICRP recommendations.

In 2009 and 2010 the conceptual model of near and far field in the Vrbina area was upgraded based on the results of field investigations which were performed during these years. It will be included in the preparation of environmental impact assessment which started in 2010. In parallel also activities on waste acceptance criteria determination started in order to be included in the safety report prepared in the process of obtaining the construction licence.

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

The operating license is issued by the SNSA only after the Ministry of the Environment and Spatial Planning issues, in accordance with the Construction Act, a license for the use of a facility.

The application for the operating license shall contain an updated Safety Analysis Report, an opinion from an authorised expert for radiation and nuclear safety and other documentation prescribed by Article 25 of Rules JV5. The Safety Analysis Report shall be updated with the changes that occur during the trial operation.

A license shall be issued by the SNSA within ninety 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. However, in 2011 the 2002 Act will be amended to allow 24 months for the issuing of the license after the complete application is received.

Operational Limits and Conditions

In accordance with Article 71 of the 2002 Act, the proposed operational limits and conditions (Technical Specifications as a part of the Safety Analysis Report) have to be submitted to the regulatory body as a part of the Safety Analysis Report first with the application for a consent for trial operation and later with the application for the operating license.

Article 43 of Rules JV5 sets basic requirements for operational limits and conditions and defines also that they shall be specified for all operational states of the facility.

Article 44 of Rules JV5 defines the contents of the operational limits and conditions, which should contain:

- definitions of terms,
- safety limits,
- limits on operating parameters for safety systems,

- limits on operating parameters, stipulation for minimum amount of operable equipment, including the number of SSC's important to safety that should be in operating condition 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 Rules 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 on 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 the facilities fitted with a control room, such information shall be available in the control room.

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

Article 83 and Article 84 of the 2002 Act outline the procedure for approval of the changes to the Safety Analysis Report. The procedure defines three classes of changes depending on safety relevance:

1. changes for which it is necessary to notify only the competent ministry,
2. changes for which the intention of their implementation shall be reported to the ministry competent for the environment,
3. changes of significance for radiation or nuclear safety and for the implementation of which a license from the SNSA shall be obtained.

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

Operation, maintenance, monitoring, inspection and testing

In accordance with Article 25 of Rules JV5, the documentation submitted for the application for an operating license shall also contain a list of prepared operating procedures, report on trial operation, radioactive waste or spent fuel management programme, management system documentation, decommissioning programme, a programme of following operational experiences, programme of monitoring ageing, programmes of SSC maintenance, testing and inspection, results of pre-operation monitoring, Safety Analysis Report, opinion by an approved radiation and nuclear safety expert and other prescribed documentation. At the request of the SNSA, the investor or the facility operator of a radiation or nuclear facility shall make license-application reference documentation available.

Periodic safety review

In accordance with Article 81 of the 2002 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 a periodic safety review.

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

In case that 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 the respective changes.

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

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 86 of the 2002 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 an emergency at the facility and after the completion of work relating to the mitigation of the consequences of an emergency.

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 are capable of processing minor design changes in-house. The capability of preparing purchase specification, reviewing bids and bidder selection, Quality Assurance, Quality Control and engineering follow-up of the projects, as well as review and/or acceptance testing of the product are available to a certain extent at the above facilities. Other engineering and technical support is assured through outsourcing at Slovenian research and engineering organisations or from abroad. However, major projects require an open invitation to tender. The Ministry of Higher Education, Science and Technology 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 93 of the 2002 Act and the Rules on Radioactive Waste and Spent Fuel Management, the license holder shall collect radioactive wastes, classify them with regard to the aggregation state, level and type of radioactivity, report on radioactive waste and spent fuel generation, keep accounting records for the waste, label the waste, provide for processing, transport and storing of waste, as well as 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 to safety

Article 87 (reporting on the operation of facilities) of the 2002 Act stipulates that an operator shall submit exceptional reports to the SNSA containing information on:

- equipment malfunction which could cause an emergency, emergencies and measures taken for the mitigation of the consequences of the defects or emergencies,
- mistakes made by workers while handling or operating a facility which could cause an emergency,
- deviations from operational limitations and conditions,
- all other events or operational circumstances which 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 case of an abnormal event. They specify the time period for each report. Reporting criteria are also given and abnormal events are specified.

According to Article 108 of the 2002 Act, the license holder is required to report to the ministry which issued the operating license and to other competent agencies about the accidental condition in the shortest possible time.

Programmes to collect and analyse relevant operating experience

In accordance with Article 60 of the 2002 Act (the use of experience gained during operational events) the operator of a radiation or nuclear facility shall ensure that programmes of collecting and analysing operating experience at nuclear facilities are implemented.

The method and frequency of reporting on the implementation of operating experience collection and analysis programmes 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 referred to in the first paragraph.

Decommissioning plans

In accordance with Article 3 of the 2002 Act (definitions) decommissioning of a facility shall mean all the measures leading to a cessation of control over a nuclear or radiation facility pursuant to the provisions of the 2002 Act. Decommissioning includes both decontamination and dismantling procedures, as well as the removal of radioactive waste and spent fuel from the facility.

The legal requirements for approval of decommissioning of a nuclear facility is a two-step procedure and is defined in Articles 71 and 80 of the 2002 Act, which prescribe that an investor intending to decommission a radiation or nuclear facility shall attach to an application for the 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 the permit for commencement of decommissioning activities the updated Safety Analysis Report, an opinion from an authorised expert for radiation and nuclear safety and other documentation. Detailed contents of the applications are defined in Articles 28 and 29 of Rules JV5.

In the case of 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 Parliament for the decommissioning of nuclear facilities, namely the Act Governing the Fund for Financing Decommissioning of the Krško Nuclear Power Plant and Disposal of Radioactive Waste from the Krško NPP and the Permanent Cessation of Exploitation of the Uranium Ore and Prevention of Consequences of the Mining in the Uranium Mine at Žirovski vrh Act. Through the legal provisions of these Acts, the legal framework is established for 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 Analysis Report of the repository facilities relating to the time period following the closure thereof all the possible risks due 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 after the closure (Article 73 of the 2002 Act).

The plan of long-term supervision of the repository of radioactive waste and the repository of mining or hydro-metallurgical tailings 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 individual parts of the repository,
- the criteria on the basis of which decisions on the carrying out of 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 76 of the 2002 Act).

The records on the location, design and inventory of that facility required by the regulatory body are preserved through the provision of Article 80 (application for a permit) stipulating that it is necessary to attach to the application for the closure permit a Safety Analysis Report, an opinion from an authorised expert for radiation and nuclear safety and other prescribed documentation.

Article 80 of the 2002 Act further stipulates that the owner or operator of a facility who 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 in line with the conditions laid down in the Safety Analysis Report.

Article 96 (disposal of uranium mining and ore processing waste) of the 2002 Act stipulates that the long-term supervision and maintenance of the repositories of mining and hydro-metallurgical tailings appearing in the extraction of nuclear mineral raw materials shall be responsibility of the ARAO.

The contents of applications for a permit for the closure of a radioactive-waste or spent-fuel repository and for the closure of a repository of mining or hydrometallurgical tailings are defined in Rules JV5, in Articles 33 and 34, respectively.

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

For the long-term spent fuel management, a dual track strategy has been adopted as a reasonable solution in the present situation. The basic reference scenario for the geological disposal has been developed assuming the disposal of spent fuel in 2065. The option of multinational disposal is kept open.

Jožef Stefan Institute Reactor Infrastructure Centre

At present, no spent fuel from the TRIGA Mark II research reactor is planned for disposal. In 2007, the IJS decided to use the opportunity to ship and permanently dispose the spent fuel within the framework of the US government programme. In case that the return of spent fuel from the IJS Reactor Infrastructure Centre to the USA does not occur, the spent fuel management will be arranged jointly with the spent fuel disposal of the Krško NPP.

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 Act,*
   - *(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 2002 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 the 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 101 to 103 of the 2002 Act, Subparagraph 4.9 "Shipments into and out of the EU Member States, the import, export and transit of nuclear and radioactive substances and radioactive waste".

The SNSA issues permits for import, export, shipment into and shipment out of the EU Member States and transit of certain radioactive and nuclear materials. Detailed provisions defining for which shipment the permit is necessary, are stipulated in the 2002 Act and in the Rules on transboundary shipments of nuclear and radioactive materials. It is necessary to obtain the SNSA consent for shipments from and into the EU Member States, and licenses for the import, export or transit of radioactive waste and spent fuel. Before issuing consent or the license, the SNSA evaluates the measures related to radiation and nuclear safety throughout the duration of the transport of radioactive waste and spent fuel from the place of origin to the place of final destination.

The SNSA may refuse to issue an approval for the import, export or transit or 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.

In addition to the insurance stipulated by customs regulations, an exporter, importer or person carrying out shipments from and into the EU Member States, the transit of radioactive waste, spent fuel or nuclear substances, shall ensure for each consignment thereof financial warranties to a level which guarantees the payment of the expenses for:

- the refusal of the shipment by the competent regulatory authority in the destination country,
- the handling ordered by the regulatory authority if it has concluded that there is no assurance for the shipments out of the EU Member States of radioactive waste and imported radioactive waste being handled in the manner pursuant to 2002 Act.

The established legislation implements all obligations under Article 27 of the Convention.

Experience

In the framework of the United States and Russian research reactor spent fuel return programmes three transits and one export of own spent fuel were accomplished on the territory of the Republic of Slovenia before 2008. However, from 2008 the activities were intensified.

In 2008 three permits were issued for the transit of nuclear fuel through Slovenia.

At the end of July 2008, a road transport of irradiated fuel elements from Romania took place from Dolga vas to the Port of Koper. The cargo was loaded on a ship and transported to the USA. On the same vessel, bound for the USA, another shipment was loaded, namely non-irradiated enriched uranium. This road shipment derived from Italy.

In the middle of September 2008, a rail transport of irradiated fuel elements, either high- or low-enriched, from a Hungarian research reactor was accomplished. The containers with transfer casks were loaded on a vessel and the consignment continued its journey to the Russian Federation.

In 2009, no transit permits were issued.

In 2010 one permit was issued for the transit of irradiated high- or low-enriched fuel elements. The shipment was carried out in November 2010. The rail transport between the Slovenian-Hungarian border and the Port of Koper was followed by loading the containers onto a vessel that travelled across the Mediterranean Sea and the Atlantic Ocean to the port of Murmansk (north of the Russian Federation).

Figure 16: **Loading of containers with transfer casks on a specially equipped vessel in the Port of Koper**

Besides these occasional transits there is approximately every three years a shipment of radioactive waste from the Krško NPP sent for incineration and melting to one of the EU Member States. The last shipment was sent in December 2008 and was returned to the Krško NPP in November 2009.

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, police, army, etc.).

Licensing is required for all activities dealing with sealed sources: for purchase and use, for shipments from and into EU member states, for import or export, for transport or transit – the latter based mainly on the activity. The competent authorities (the SNSA and the SRPA) keep records on sealed sources in use.

In accordance with Article 130 of the 2002 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 131 of the 2002 Act and in Articles 85 to 87 of the Rules on the Use of Radiation Sources and on Activities Involving Radiation.

When the sealed sources are no longer in use, they become radioactive waste. Since 1986, disused and spent sealed sources from small producers have been stored in the Central Storage 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 managing of waste from small producers.

Until 2000, acceptance of waste for storing was free of charge. Since then, according to the "polluter pays" principle, each waste producer has to pay for the acceptance of waste by the Central Storage for Radioactive Waste in Brinje. When accepted into storage the liabilities for the disused source are transferred to the ARAO, which becomes responsible for further management of the spent sealed source including future disposal of the waste. It is also the ARAO's responsibility to accept and provide proper further management of waste when its producer or holder is not known (historical waste) or is incapable of paying the fee for transporting, storing and managing the source. The expenses in such cases are covered from the national budget. In cases where sealed sources are found at the premises of scrap-dealers, ironworks, etc., the above-mentioned fee is paid by them.

The Republic of Slovenia is not a significant producer of sealed sources. The IJS practically ceased the production of radioactive sources for the domestic market (no such sources have been produced since the First Report under the Convention in 2003), therefore the return of exported sources is only a hypothetical issue.

Yet in 2003, the SNSA started an action to promote transfer of disused sealed sources that are located at users to the ARAO. As a result more than five hundred of such disused sealed sources of various activities were transferred, appropriately treated and safely stored at the Central Storage for Radioactive Waste in Brinje since then. Disused sealed sources (^{192}Ir) - high-activity (i.e. category 2) at the time of manufacturing deriving from industrial radiography or brachytherapy, are returned to the foreign suppliers. In addition, the number of transferred (disused) ionising smoke detectors with mainly ^{241}Am in the central storage exceeded 5,200 in the last five years.

Figure 17: **Disused ionizing smoke detectors**

The Council Directive 2003/122/Euratom of 22 December 2003 on the control of high-activity sealed radioactive sources and orphan sources was transposed into the Slovenian legal system through the Rules on the Use of Radiation Sources and on Activities Involving Radiation. Among other provisions the holders of high-activity sources have to return each disused high-activity source to the supplier or place it in a recognised installation (Central Storage for Radioactive Waste). In December 2010, Slovenia reported to the European Commission on the experience gained through the implementation of this directive.

Disused sealed sources can also enter into the recycling stream of scrap metal. This happens practically everywhere in the world. The Slovenian experience shows that the number of cases of orphan sources is related to the imports of scrap metal into Slovenia and to transits of this material through Slovenia. 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 radiation detection devices in order to prevent illicit trafficking across the border. Since 2002, the Slovenian Nuclear Safety Administration (SNSA) provides a 24-hour on-duty officer who gives advice in the case of discovery of an orphan source.

Major scrap metal collectors and recyclers are equipped with portal monitors and hand-held radiation detection equipment. The Decree on checking the radioactivity for shipments of metal scrap has been implemented since 1 January 2008. This decree stipulates that every shipment of scrap metal which is either imported or shipped into Slovenia is measured, using adequate detection equipment. Such measurements shall be performed only by certified organizations. The experience after three years of validity of this decree is positive and the awareness, including adequate response, has improved in this regard. Authorised organisations have to provide their "annual reports". The average number of orphan sources which end up in the Central Storage Facility is less than two per year.

SECTION K: PLANNED ACTIVITIES TO IMPROVE SAFETY

Krško NPP

In order to optimise the use of the remaining radioactive waste storage capacity in the Solid Radwaste Storage Facility, a supercompactor has been installed permanently onsite. Burnable waste is periodically sent for incineration and a campaign for radioactive metal waste melting is being prepared.

Incineration of contaminated blow-down ion exchange resin from the past operation is planned for the future. The last batches of used and exhausted blow-down resin have been free-released.

The Central Storage for Radioactive Waste in Brinje

Characterisation of radioactive waste

In order to better assess compliance with the acceptance criteria, all inventory has been categorised, treated and repacked. There are approximately 86 m^3 of radioactive waste stored in the facility, fully in compliance with waste acceptance criteria as approved in the safety report for operation of the central storage facility.

It is planned to regularly maintain all technical components in the storage facility according to prescribed checks in the storage documentation. It is also required in the operation licence, valid until 2018, that periodic safety assessment needs to be performed. All radioactive waste which is stored needs to fulfil the waste acceptance criteria.

Siting and Construction of the LILW Repository

One of the major tasks in the area of radioactive waste management in the Republic of Slovenia was achieved in 2009 by selecting the site for a LILW repository. The next phase is obtaining the licence for its construction. Although the Slovenian Parliament has decided to have an operational LILW repository by the year 2013, this will need to be postponed because the activities are slower than foreseen. The organisation authorised to perform this task is the ARAO. The funds for the project are sufficient and will be available through the Fund for Decommissioning of the Krško NPP.

Jožef Stefan Institute Reactor Infrastructure Centre

In 2011 the periodic safety review of the TRIGA Mark II reactor and the hot cell laboratories will start. The fire protection system and the physical protection system will be upgraded.

Žirovski vrh Uranium Mine

The basic objectives of the programme of long-term supervision of the waste piles at Žirovski vrh are as follows:

- protection of the health of people, i.e. workers and members of the public living nearby the mine facilities,
- permanent protection of the environment against the consequences of exploitation of the uranium mine, and
- long-term assurance of supervision, monitoring and maintenance of mine waste piles.

The design and the Safety Analysis Report on final remediation of the Jazbec mine waste pile were accomplished in the year 2004 and the design and the Safety Analysis Report on the Boršt mill tailings in the year 2005. The SNSA issued the consent to the proposed activities. The remediation was completed at the Jazbec and Boršt disposal sites in 2008 and 2010 respectively. It is planned that additional measures will be implemented to stabilize the base rock sliding under the Boršt mill tailings pile in 2012, or in 2013 if the measures of groundwater drainage from the hinterland are not successful.

After the administrative closure of waste piles, the implementation of their long-term supervision will be transferred to the ARAO. The administrative centre required for long-term supervision will be in the former mine building which is located at the foothill of the Jazbec mine waste pile.

The funds for stabilization of the landslide at the Boršt site and long-term supervision of the waste piles are assured from the state budget.

Figure 18: **Jazbec mine waste pile in autumn 2010**

Figure 19: **Boršt mill tailings site in autumn 2010**

Ljubljana University Medical Centre - Department for Nuclear Medicine

The University Medical Centre – the Department for Nuclear Medicine has started with a project of construction of containers for collecting faecal water containing ^{131}I, with the intention to control the discharges of ^{131}I.

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 for Radioactive Waste in Brinje, and the Boršt mill tailings site and the Jazbec mine waste pile at the Žirovski vrh Uranium Mine are the only radioactive waste management facilities in the Republic of Slovenia.

c) List of Nuclear Facilities in the Process of Being Decommissioned

There are no nuclear facilities being decommissioned. The Žirovski vrh Uranium Mine, which is a radiation facility in accordance with the definition in the 2002 Act, is the only facility which is in the process of being decommissioned in the Republic of Slovenia.

d) Inventory of Spent Fuel

Spent Fuel Pool at the Krško NPP

Table 5: **The number, the average burn-up and the total mass of heavy metal of the fuel assemblies in each fuel batch**

Fuel batch	**No. of fuel assemblies**	**Burn-up** [GWd/MTU]	**Heavy metal** [kg]
1	41	18.6	16,335.0
2	40	24.3	15,788.4
3	40	30.9	15,613.2
4A	25	30.7	9,767.4
4B	16	34.3	6,258.0
5A	40	32.6	15,666.8
5B	2	30.2	780.1
6A	4	38.7	1,563.6
6B	1	36.7	390.6
6C	36	39.5	14,036.0
7A	24	35.9	9,463.0
7B	2	36.4	785.5
7C	20	33.7	7,913.3
8A	16	44.9	6,246.4
8B	8	44.8	3,122.3
KWU	40	34.8	14,980.1
9	12	41.7	4,694.9
10A	8	40.5	3,119.2
10B	12	43.3	4,656.6
10C	8	47.3	3,090.3
11	40	40.1	15,646.9
11B	20	40.2	7,832.8
12	24	44.4	9,317.3
12B	7	43.5	2,724.9
13	40	43.0	15,598.0
14	35	43.0	13,628.6
14B	4	44.5	1,554.2
15	24	46.4	9,290.9
15B	12	37.1	4,702.6
16	16	45.0	6,224.6
16B	8	46.6	3,107.9
17	20	45.4	7,776.1
17B	3	40.2	1,176.7
18	28	43.7	10,741.6
19	29	43.8	11,177.2
20	28	45.1	10,843.0
21	21	43.9	8,123.4
22A	12	41.6	4,653.9
22B	32	46.8	12,354.0
23B	32	48.9	12,328
24B	8	52.1	3,068.8
25B	4	50.8	1,539.2
FRSB	1	35.3	10.0

Spent Fuel Pools at the IJS Reactor Infrastructure Centre

There are no spent fuel elements stored in the spent fuel pools at the IJS Reactor Infrastructure Centre.

e) Inventory of Radioactive Waste

Radioactive Waste Storage facilities at the Krško NPP

Table 6: **Radioactive waste inventory in the Krško NPP Solid Radwaste Storage Facility on 31 December 2010**

Type of waste	**No. of drums**	**Volume** [m^3]	**Net weight** [kg]	**Total activity** [Bq]	**Specific activity** [Bq/m^3]
Ashes	91	18.928	22,807	8.71E+09	4.60E+08
Blowdown Resins	83	16.600	12,783	3.71E+09	2.23E+08
Compressible Waste	38	7.904	3,607	7.80E+08	9.87E+07
Evaporator Bottom	2	0.416	361	2.91E+08	7.00E+08
Filters	115	23.688	43,808	1.90E+11	8.02E+09
Other	5	1.040	659	1.55E+09	1.49E+09
Supercompacted Waste (SC)	617	197.440	181,763	1.94E+10	9.83E+07
Spent Resins	689	143.312	197,886	2.56E+12	1.79E+10
Supercompacted Waste (ST)	1,959	1,693.546	2,125,480	7.56E+12	4.46E+09
TI	124	107.756	62,914	9.43E+12	8.75E+10
TOTAL	**3,723**	**2,210.630**	**2,652,131**	**1.98E+13**	**8.96E+09**

The specific radionuclides (beta, gamma) are ^{58}Co, ^{60}Co, ^{134}Cs and ^{137}Cs.

The description of waste types and acronyms used are as follows:

- Evaporator Bottom - the residue from evaporating waste water, containing boric acid, solidified in vermiculite cement packed in 208 l drums.
- Filters - spent filters from the primary water purification and liquid waste processing system, packaged in standard 208 l steel drums with inner concrete biological shield.
- Spent Resins - spent ion exchange resins from purification systems, embedded in 208 l drums with vermiculite cement.
- Compressible Waste - waste arising mostly from using personal protective clothes, coveralls, shoe covers, plastics etc., packed into 208 l drums.
- Other - miscellaneous waste arising during operation and maintenance activities like contaminated used parts, cables, hoses, valves, concrete, wood etc., packed in 208 l drums.
- Supercompacted waste (SC) - radioactive waste of type Compressible Waste supercompacted and packed in 320 l carbon steel overpacks.

- Supercompacted waste (ST) - radioactive waste of type Compressible Waste and Evaporator Bottom, supercompacted, Spent Resins inserted and packed in tube-type container.
- Ashes - ashes, dust and other residues from incineration of combustible waste.
- Primary Resins - spent ion exchange resins from primary water purification systems dried and packed in stainless steel drums with 3 cm thick walls as biological shield.
- Blowdown Resins - resins arising from purification system of secondary system, packed in stainless steel drums.
- TI package as Primary Resins, Blowdown Resins and DC additionally inserted in tube-type containers (3 Primary Resins/Blowdown Resins/DC in 1 tube-type container).

Types of packages in the Solid Radwaste Storage Facility are as follows:

- 208 l standard drum, designed in accordance with ANSI DOT-17H standard, appropriate for the following solid wastes: Compressible Waste, Other, Filters, Spent Resins and Evaporator Bottom.
- 320 l overpack, used solely for packaging of compressed standard 208 l drums from the first supercompaction campaign.
- 200 l Stainless Steel heavy drum with biological shield (150 l of usable volume), used for dried primary spent resins (Primary Resins) tested as Type A Package in accordance with IAEA Safety Standards.
- 200 l Stainless Steel heavy drum without biological shield, used for secondary spent resins (Blowdown Resins) and dried concentrate (DC) tested as 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 drums 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, is an overpack, used in the second supercompaction campaign. Tested as 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 off-site disposal area. Tested as IP 2 container in accordance with IAEA Safety Standards.

Table 7: **Radioactive waste inventory in the Decontamination Building - Decontamination area, on 31 December 2010**

Type of radioactive waste	Number of pieces	Volume [m^3]	Mass [kg]	Contamination [Bq/dm^2]	Packaging
RB Ventilator motor	1	1	1,000	100	PE foil
RB Polar Crane Hook	4	4	5,000	100	PE foil
Bulk items	6	3	500	100	
Reactor vessel stud tensioner	5	5	5,200	100	PE foil

Table 8: **Radioactive waste inventory in the Decontamination Building - Old steam generators area, on 31 December 2010**

Type of radioactive waste	Number of pieces	Volume [m^3]	Mass [kg]	Activity / Contamination / Dose Rate	Packaging
Steam generators*	2	600	646,000	<3.00E+12 Bq	N/A
Insulation of the steam generators	4	156	20,000	100-1,000 Bq/dm^2	Container
Insulation and platform	1	36	4,000	100 Bq/dm^2	Container
Insulation valves, scrap iron, pipes etc.	1	36	9,000	10,000 Bq/dm^2	Container
Regenerative and refuelling water heat exchanger	2	4	4,500	3.5 mSv/h	Container
Spent fuel pool racks No. 10, 11, 12	3	84	48,000	400-8,000 Bq/dm^2	PE foil
Radlok containers 1, 2, 3, …, 10	10	30	2,000	200 Bq/dm^2	N/A
Rx Seal Ring	1	1	500	2 mSv/h	PE foil
Diving Equipment	2	2	300	500 Bq/dm^2	Box
Bulk items	57	61.4	24,000	100-6,000 Bq/dm^2	N/A
Lead blankets	18	18	24,000	100 Bq/dm^2	Metal box
Packages from Solid Radwaste Storage Facility**	196	39	19,600	<0.2 mSv/h	208 l drums
RCP motor stator	1	4	8,200	500 Bq/dm^2	N/A
Ingots	10	2	5,100	<0.05 mSv/h	N/A
Outage mechanical equipment	2	2	1,900	1 mSv/h	Metal box
Supercompactor cylinder and vacuum pump	4	1	1,000	20,000 Bq/dm^2	PE foil
Rod position system cables	4	4	1,000	500 Bq/dm^2	Wooden box
Compacted old Steam Generator insulation	41	10	4,900	<0.2 mSv/h	208 l drums
TOTAL	**359**	**1,090.4**	**824,000**		

Notes:

* Activity of the steam generators was calculated on 31 December 2000.

** Packages awaiting transport to external incineration facility.

Table 9: **Quantity of stored radioactive sources at the end of the year 2010**

Waste categories	Number of packages	Radionuclides	Activity (Bq)
T1 (solid, compressible, combustible)	86	^{226}Ra, ^{60}Co, ^{241}Am, ^{109}Cd, ^{108}Ag, ^{238}U, ^{57}Co, ^{232}Th, ^{3}H	6.3E+08
T2 (solid, compressible, non-combustible)	121	^{226}Ra, ^{60}Co, ^{241}Am, ^{109}Cd, ^{108}Ag, ^{238}U, ^{3}H, ^{238}U, ^{14}C	1.7E+10
T3 (solid, non-compressible, combustible)	16	^{226}Ra, ^{60}Co, ^{232}Th	2.2E+08
T4 (solid, non-compressible, non-combustible)	176	^{226}Ra, ^{60}Co, ^{109}Cd, ^{137}Cs, ^{108}Ag, ^{238}U, ^{14}C, ^{232}Th, ^{133}Ba	2.7E+11
ZV0 (smoke detectors)	116	^{241}Am, ^{226}Ra	5.7E+09
ZV1 (spent sealed sources with: A≤3,7 GBq)	85	^{226}Ra, ^{60}Co, $^{241}Am/Be$, ^{238}U, ^{232}Th, ^{63}Ni, ^{55}Fe, ^{90}Sr, ^{106}Ru, ^{3}H	6.5E+11
ZV2 (spent sealed sources with: 3,7 GBq<A≤37 GBq)	18	^{226}Ra, ^{152}Eu, ^{60}Co, ^{137}Cs, ^{85}Kr, $^{241}Am/Be$, ^{133}Ba	2.5E+11
ZV3 spent sealed sources with: 37 GBq<A≤370 GBq)	9	^{152}Eu, ^{241}Am, ^{60}Co, ^{133}Ba, $^{241}Am/Be$	1.8E+12
ZV4 (spent sealed sources with: A>370 GBq)	2	^{60}Co	6.3E+11
TOTAL	**629**		**3.2E+12**

Jazbec mine waste pile at the Žirovski vrh Uranium Mine

Table 10: **Mine waste and other debris at the Jazbec mine waste pile, situation at the end of the year 2010**

Deposited	mine waste and red mud 1982-1990 (mine ore production), contaminated material, technological equipment 1991-2007 (decontamination, demolition)
Final arrangement	2008
Surface, total	67,325 m2 (the area of the mine waste pile inside the drainage channels) 74.239 m2 (the area inside safety fence of the mine waste pile)
Altitude	bottom 427 m, top 509 m (above sea level)
Volume of disposed waste	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 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 crash station, **total volume of disposed material is 1,198,900 m^3**
Amount of disposed waste	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 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 crash station, **total amount of disposed material is 1,910,425 t**
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	0,12 µGy/h (covered with final layer)

Note: most of the ^{230}Th was not contained in the mill tailings, but remained in the so-called red mud as a neutralisation by-product.

Boršt mill tailings site at the Žirovski vrh Uranium Mine

Table 11: **Boršt mill tailings site with basic data, situation at the end of the year 2010**

Deposited	mill tailings 1984-1990 and mine waste 1984-2004, contaminated material 2008-2009
Final arrangement	2010 arrangement of the mill tailings, till 2013 remediation of the mill tailings base rock sliding
Surface, total	42,000 m^2 (mill tailings surface), 67,923 m^2 (surface inside the safety fence of the mill tailings)
Altitude	bottom 535 m, top 565 m (above sea level)
Volume of disposed waste	339,000 m^3 of mill tailings, 70,000 m^3 of mine waste, 6,543 m^3 contaminated materials **total volume of disposed material is 415,543 m^3**
Amount of disposed waste	610,000 t of mill tailings, 111,000 t of mine waste, 9,450 t contaminated materials, **total amount of disposed material is 730,450 t**
Average specific activity of disposed material	78.2 kBq/kg mill tailings, 10.2 kBq/kg mine waste
Total activity of disposed material	**48.8 TBq**
Dose rate, average	0.14 μGy/h (covered with final layer)

Note: Specific activity of contaminated materials has not been measured, however it was low.

f) References to National Acts, Regulations, Requirements, Guidelines, etc.

Besides the 2002 Act and the regulations which cover spent fuel and radioactive waste management (see Article 19 of the Report) the Acts and regulations stated below should also be mentioned.

Nuclear and Radiation Safety, Physical Protection, Safeguards, Quality Assurance

On the basis of the 2002 Act, the following decrees and regulations for carrying into effect radiation protection and nuclear safety provisions are in force:

- Rules on the Specialist Council on Radiation and Nuclear Safety (Official Gazette RS, No. 35/2003),
- Rules on 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, No. 62/2003),
- Rules on the Requirements of Using Ionising Radiation Sources in Healthcare (Official Gazette RS, No. 111/2003),
- Rules on the Requirements and Methodology of Dose Assessment for the Radiation Protection of the Population and Exposed Workers (Official Gazette RS, No. 115/2003),
- Rules on Health Surveillance of Exposed Workers (Official Gazette RS, No. 2/2004),
- Rules on the Obligations of the Person Carrying Out a Radiation Practice and Person Possessing an Ionising Radiation Source (Official Gazette RS, No. 13/2004),
- Rules on Approving of Experts Performing Professional Tasks in the Field of Ionising Radiation (Official Gazette RS, No. 18/2004),
- Rules on the Method of Keeping Records of Personal Doses Due to Exposure to Ionising Radiation (Official Gazette RS, No. 33/2004),
- Decree on the Areas of Limited Use of Space Due to a Nuclear Facility and the Conditions of Facility Construction in these Areas (Official Gazette RS, No. 36/2004 and 103/2006),
- Decree on Activities Involving Radiation (Official Gazette RS, No. 48/2004 and 9/2006),
- Decree on Dose Limits, Radioactive Contamination and Intervention Levels (Official Gazette RS, No. 49/2004),
- Rules on Inputs from and Outputs in the EU Member States and on Import and Export of Radioactive Waste (Official Gazette RS, No. 60/2004 and 80/2005),
- Rules on the Conditions to be Met by Primary Health Care Centres for Breast (Official Gazette RS, No. 110/2004),
- Rules on Physical Protection of Nuclear Materials, Nuclear Facilities and Radiation Facilities (Official Gazette RS, No. 31/2005),

- Rules on the Conditions for Workers Who Carry out Physical Protection of Nuclear Materials, Nuclear Facilities or Radiation Facilities and on the Conditions for Workers Who have Access to Nuclear Materials as well as on other Conditions with Respect to Physical Protection (Official Gazette RS, No. 36/2005 and 64/2005),
- Regulation on Conditions to be Fulfilled by Workers Performing Safety-Significant Tasks at Nuclear or Radiation Facilities (Official Gazette RS, No. 74/2005),
- Program on Systematic Monitoring of Working and Residential Environment and Raising Awareness about Measures to Reduce Public Exposure Due to the Presence of Natural Radiation Sources (Official Gazette RS, No. 17/2006),
- Rules on the Use of Radiation Sources and on Activities Involving Radiation (Official Gazette RS, No. 27/2006),
- Rules on Radioactive Waste and Spent Fuel Management (Official Gazette RS, No. 49/2006),
- Rules on Authorised Experts on Radiation and Nuclear Safety (Official Gazette RS, No. 51/2006),
- Decree on the implementation of Council Regulations (EC) and Commission Regulations (EC) on the radioactive contamination of foodstuffs and feedstuffs (Official Gazette RS, No. 52/2006 and 38/2010),
- Rules on the Monitoring of Radioactivity (Official Gazette RS, No. 20/2007 and 97/2009),
- Decree on Safeguarding of Nuclear Materials (Official Gazette RS, No. 34/2008),
- Decree on Checking the Radioactivity for Shipments of Metal Scrap (Official Gazette RS, No. 84/2007),
- Rules on the Transboundary Shipment of Nuclear and Radioactive Substances (Official Gazette RS, No. 75/2008),
- Rules on Transboundary Shipments of Radioactive Waste and Spent Fuel (Official Gazette RS, No. 22/2009),
- Rules on Operational Safety of Radiation and Nuclear Facilities (Official Gazette RS, No. 85/2009),
- Rules on Radiation and Nuclear Safety Factors (Official Gazette RS, No. 92/2009),
- Rules on the Use of Potassium Iodine (Official Gazette RS, No. 59/2010).

On the basis of the 1984 Act, the following regulation for carrying into effect radiation protection and nuclear safety provisions is still in force:

- On Maximum Permitted Levels of Radioactive Contamination of Human Environment and on Decontamination (Official Gazette SFRY, No. 8/87, 27/90), Regulation Z-9 – approximately half of the provisions of the regulation have been derogated, the other half are still in force.

Third Party Nuclear Liability

- Act on Liability for Nuclear Damage (Official Gazette RS, No. 77/2010),

- Ordinance on determining the persons to whom the conclusion of the insurance of liability for nuclear damage is not obligatory (Official Gazette RS, No. 110/2010),
- Third Party Liability for Nuclear Damage Act (Official Gazette SFRY, No. 22/78 and 34/79) - The Act shall cease to apply on the day Act on Liability for Nuclear Damage enters into force (4 April 2011), except the provision of Article 20 which shall apply until a full application of the Act on Liability for Nuclear Damage,
- Act on Insurance for Nuclear Damage Liability (Official Gazette RS, No. 12/80 and 17/91) - The Act shall cease to apply on the day Act on Liability for Nuclear Damage enters into force (4 April 2011),
- Decree on Establishment of the Amount of Limited Operator's Liability for Nuclear Damage and on Establishment of the Amount of Insurance for Liability for Nuclear Damage (Official Gazette RS, No. 110/2001) – The Decree shall apply until a full application of the Act on Liability for Nuclear Damage.

Civil Protection and Disaster Relief

- Protection Against Natural and Other Disasters Act (consolidated text - Official Gazette RS, No. 51/2006 and 97/2010),
- Decree on the Contents and Drawing up of Protection and Rescue Plans (Official Gazette RS, No. 3/2002, 17/2002 and 76/2008).

Administrative

- Public Administration Act (consolidated text - Official Gazette RS, No. 113/2005, 126/2007 and 48/2009),
- Inspection Act (consolidated text - Official Gazette RS, No. 43/2007),
- General Administrative Procedure Act (consolidated text - Official Gazette RS, 24/2006, 126/2007, 65/2008, 47/2009 and 8/2010).

Energy and Environmental

- Energy Act (consolidated text - Official Gazette RS, No. 27/2007, 70/2008 and 22/2010),
- Decree on the Transformation of the Krško NPP, p.o. into the Public Limited Company NPP Krško, d.o.o. (Official Gazette RS, No. 54/98, 57/98, 59/2002 and 10/2003),
- Environment Protection Act (consolidated text - Official Gazette RS, No. 39/2006, 49/2006, 66/2006, 112/2006, 33/2007, 57/2008, 70/2008 and 108/2009),
- Decree on the Categories of Activities for which an Environmental Impact Assessment is Mandatory (Official Gazette RS, No. 78/2006 and 32/2009),
- Decree on the Criteria for the Determination of the Compensatory Amount due to the Limited Use of the Environment in the Area of a Nuclear Facility (Official Gazette RS, No. 134/2003 and 100/2008),

- Instruction on the Methodology of Preparing Reports on Environmental Impact (Official Gazette RS, No. 70/96),
- Permanent Cessation of Exploitation of the Uranium Ore and Prevention of Consequences of the Mining in the Uranium Mine at Žirovski vrh Act (consolidated text - Official Gazette, RS, No. 22/2006),
- Decree Determining the Area and of the Compensatory Amount due to the Limited Use of the Environment in the Area of Žirovski vrh Uranium Mine (Official Gazette RS, No. 22/2008 and 50/2009),
- Decree on the Content of Report on the Effects of Intended Activity to the Environment and Method of its Preparation (Official Gazette RS, No. 36/09),
- Fund for Financing Decommissioning of the Krško Nuclear Power Plant Krško and Disposal of Radioactive Waste from the Krško NPP Act (consolidated text - Official Gazette RS, No. 47/2003 and 68/2008).

Transport, Export and Import

- Act on Transport of Dangerous Goods (consolidated text - Official Gazette RS, No. 33/2006, 41/2009 and 97/2010),
- 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. 9/2003, 66/2003, 9/2005, 9/2007, 125/2008 and 97/2010).

Export of dual-use items

- Act Regulating the Exports of Dual-Use Goods (Official Gazette RS, No. 37/2004 and 8/2010),
- Regulation on Procedures for Issuing Authorisations and Certificates and on Competence of the Commission for the Control of Exports of Dual-Use Items (Official Gazette RS, No. 34/2010),
- Decree on Restrictive Measures against Iran and on Implementation of Council Regulation (EU) No 961/2010.

General

- Decree on Administrative Authorities within Ministries (Official Gazette RS, No. 58/2003, 45/2004, 86/2004, 138/2004, 52/2005, 82/2005, 17/2006, 76/2006, 132/2006, 41/2007 and 64/2008, 63/2009 and 69/2010),
- Maritime Code (consolidated text - Official Gazette RS, No. 120/2006 and 88/2010),
- The Criminal Code (Official Gazette RS, No. 55/2008, 39/2009 and 55/2009),
- Minor Offences Act (consolidated text - Official Gazette RS, No. 3/2007, 29/2007, 58/2007, 16/2008, 17/2008 and 76/2008, 108/2009, 109/2009 and 45/2010),
- Spatial Planning Act (Official Gazette RS, No. 33/2007, 108/2009 and 80/2010),

- The Act regarding the siting of Spatial Arrangements of National Significance in Physical Space (Official Gazette RS, No. 80/10 and 106/10),
- Construction Act (consolidated text - Official Gazette RS, No. 102/2004, 92/2005, 93/2005, 111/2005, 120/2006, 126/2007, 57/2009, 108/2009 and 61/2010),
- Decree on the Detailed Plan of National Importance for Low and Intermediate Level Waste Repository at Vrbina in the Krško Municipality (Official Gazette of Republic of Slovenia, No. 114/09),
- Decree on Establishment of a Public Agency for Radwaste Management (Official Gazette RS, No. 5/91, 45/96, 32/99, 38/2001, 41/2004 and 113/2009),
- Decree on the Method and Subject of and Conditions for Performing a Public Utility Service of Radioactive Waste Management (Official Gazette RS, No. 32/99 and 41/2004),
- Standardisation Act (Official Gazette RS, No. 59/99).

Multilateral and Bilateral Treaties, Conventions, Agreements / Arrangements

Based on the Constitution of the Republic of Slovenia all announced and ratified international treaties also constitute an integral part of the Slovenian legislation and can be applied directly. The following international instruments to which the Republic of Slovenia is a party should be mentioned:

Multilateral Agreements

- Statute of the International Atomic Energy Agency (including the Amendment of Article VI and XIV),
- Agreement on the Privileges and Immunities of the International Atomic Energy Agency,
- Convention on the Physical Protection of Nuclear Material,
- Convention on Early Notification of a Nuclear Accident,
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency,
- 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 the 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 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 (SNSA) of the Republic of Slovenia and the Institute for Environmental Protection and Research (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,
- Arrangement between the Nuclear Safety Administration of the Republic of Slovenia and the Council for Nuclear Safety of South Africa for the Exchange of Technical Information and Co-operation in the Regulation of Nuclear Safety,
- Arrangement between the Nuclear Safety Administration of the Republic of Slovenia and the Ministry of Science and Technology of the Republic of Korea for the Exchange of Information and Co-operation in the Field of Nuclear Safety,
- Arrangement between the Slovenian Nuclear Safety Administration and the Directorate for Nuclear Safety of the French Republic on the Exchange of Information and Cooperation 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 Investment, Exploitation and Decommissioning of the Krško NPP,
- Agreement between the Republic of Slovenia and the United States of America concerning Cooperation in the Prevention of the Proliferation of Weapons of Mass Destruction,
- Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Canada for Co-operation in the 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 which 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

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] European Commission; Nuclear Safety

and the Environment. Brussels; Luxembourg: Office for Official Publications of the European Communities, 1999.

h) References to Reports on International Review Missions Performed at the Request of a Contracting Party

- CASSIOPEE, *Study on Radioactive Waste Management Schemes in Slovenia*: Final Report, Services Contracts 97-0289.00, 97-0379.00, PHARE: ZZ 9423/0301, ZZ 9528/0301. December 1998.
- *End of Mission Report on "Decommissioning of the Žirovski vrh Mine Complex (RUŽV)":* Radiation Safety during 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 Remediation Programme and Planned Remediation of Žirovski vrh Mine, (SLO/3/002-02). IAEA, March 17-22, 1997.
- GLENDON W. GEE.: *End of Mission Report on "Geotechnical Engineering/Soil Science Assessment"*: Remediation of Žirovski vrh Uranium Mine and Milling Site, (SLO/3/002-03). IAEA, July 7-13, 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 Mission on "Decommissioning of the Žirovski vrh Mine Complex (RUŽV)", IAEA/TCA, (SLO/3/002-01). February 10-15, 1997.
- OSART Mission (IAEA), October 17 to November 20, 2003 and Follow-up Visit, November 7 - 11, 2005.
- WANO Peer Review Mission, March 12 - 30, 2007.
- WATRP IAEA Mission, Review of ARAO’s Documentation and Technical Programme for the Development of the Slovenian National Repository for Low and Intermediate Level Radioactive Waste, January 21-25, 2008.

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 operating in autumn of 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 MW_e and the net output is 696 MW_e. The previously installed capacity of 676 MW_e net electrical output was updated due the low pressure turbines replacement in 2006. In 2004, the Krško NPP started operating with eighteen-month fuel cycles.

Figure 20: **The Krško NPP**

The Krško NPP was designed and operates in accordance with the Slovenian safety regulations and the operating license. 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 were divided into the following categories:

- 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, IEEE industrial standards,
- IAEA standards and guidelines,
- The existing Acts and standards of the former SFRY and the Republic of Slovenia.

The bases for using these regulations are derived from the contract with Westinghouse, from the licenses issued and from the agreement between the IAEA and the SFRY (on the Krško NPP project).

Table 12: **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
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 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 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

All principal structures of the Krško NPP are located on a solid reinforced concrete platform which is situated upon 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 Systems are installed, consists of the inner cylindrical steel shell and the 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 Component Cooling Building, the Fuel Handling Building, the Diesel Generator Building and the Turbine Building are located adjacent to the Reactor Building.

Cooling water and essential service water intake structures are located on the bank of the Sava River above the Sava River dam, which maintains the adequate water level. The cooling water discharge structure is below the Sava River dam. In addition, cooling towers are provided for cooling circulating waters in case of low water flow of the Sava River.

Reactor Coolant System

The Westinghouse pressurised light water reactor with two cooling loops consists of the reactor vessel with its internals and head, two steam generators, two reactor coolant pumps, pressurizer, piping, valves, and reactor auxiliary systems. Demineralised water serves as reactor coolant, neutron moderator and for dilution of the boric acid solution. In the steam generator the reactor coolant gives up its heat to the feedwater on the secondary side of the steam generator to generate steam. Reactor coolant pressure is maintained by the pressurizer, which is supported by electrical heaters and water sprays which are supplied with water from the cold leg of the reactor coolant. The data necessary for reactor control and reactor protection are provided by the neutron flux, reactor coolant temperature, flow rate, pressurizer 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 by means of boric acid concentration change in the reactor coolant.

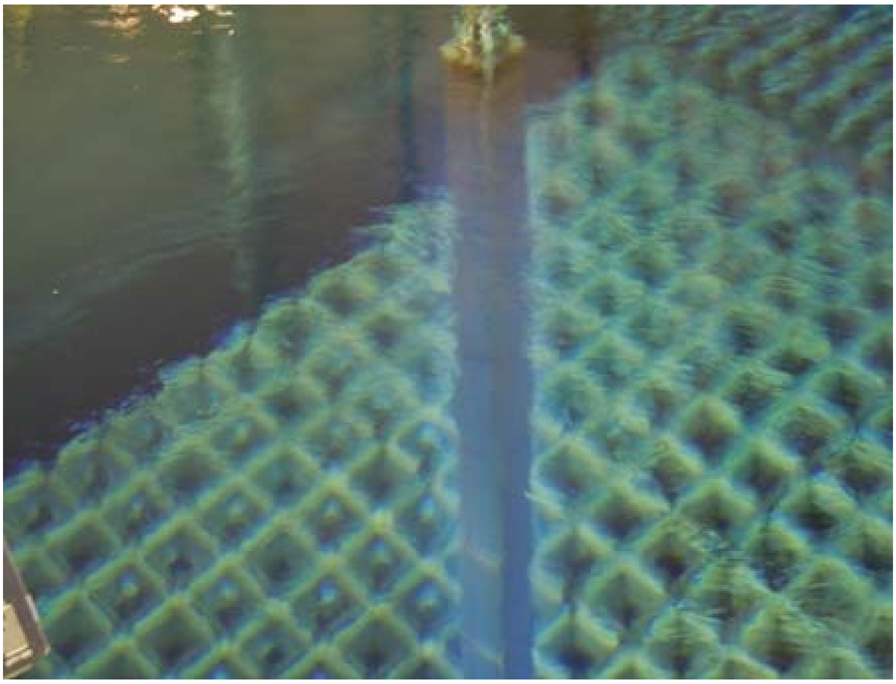
Nuclear Fuel

The reactor core is composed of 121 fuel assemblies. Each fuel element 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 tubes. Uranium oxide fuel is shaped into sintered pellets and is enriched with ^{235}U.

Every 18 months approximately a half of the fuel assemblies are removed and fresh fuel is loaded. Fresh fuel assemblies are kept in the Fresh Fuel Storage.

During refuelling, fuel assemblies are removed from the reactor through the flooded transfer canal penetrating the containment vessel into the spent fuel pool. During refuelling, the reactor is open and the reactor cavity is flooded. The refuelling machine removes the spent fuel assemblies from the reactor core and replaces them with the fresh ones. Fuel assemblies remain in the reactor core for three years. Spent fuel assemblies are kept under water in the spent fuel pool, where they are cooled.

Figure 21: **Krško NPP spent fuel pool**



Performance Indicators of the Krško NPP

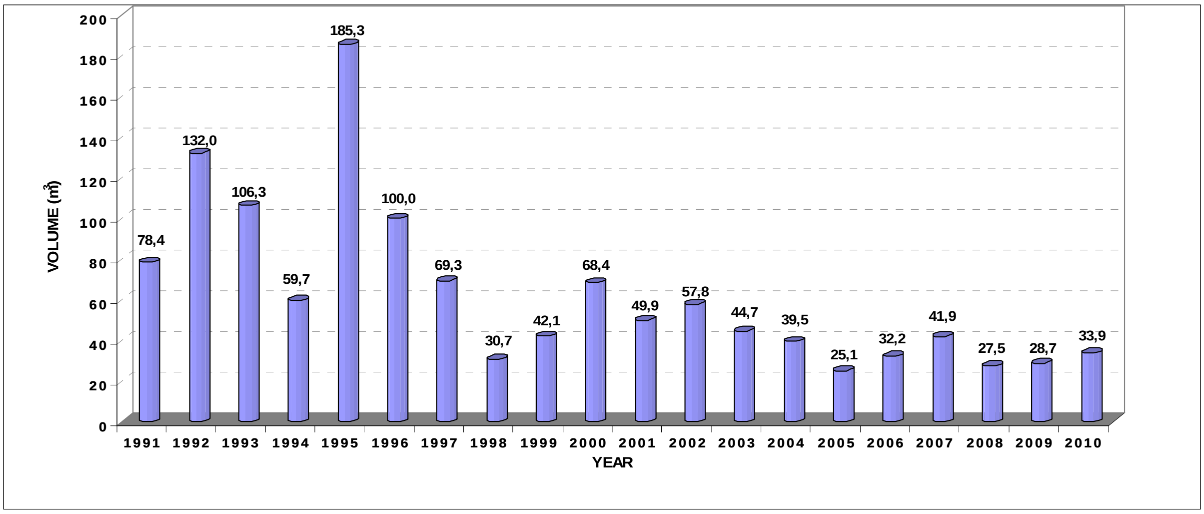
The volume of Low and Intermediate-Level Solid Radioactive Waste is one of the performance indicators of the Krško NPP. The purpose of the Low-Level Solid Radioactive Waste indicator is to monitor progress toward reducing the volume of low-level waste production which will decrease storage, transportation and 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 final form ready for disposal during a given period. The volume of radioactive waste that has not completed processing and is not yet in 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 of produced volume of low-level radioactive waste is positive, i.e. the amount of produced waste is lower from year to year. Contributors to that trend are the 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 introducing the In-drum

Drying System into operation, reconstruction of the Waste and Boron Evaporator Packages and installation of the supercompactor.

One of the highest priorities in the Krško NPP in the last ten years has definitely been to reduce the volume of produced low-level solid radioactive waste. The Krško NPP goal for the period 2005-2007 was ≤ 45 m^3 and for the period 2008-2010 ≤ 35 m^3. This task was fulfilled as it can be seen from the following chart (**Figure 22**).

Figure 22: **Annual production of LILW at the Krško NPP**



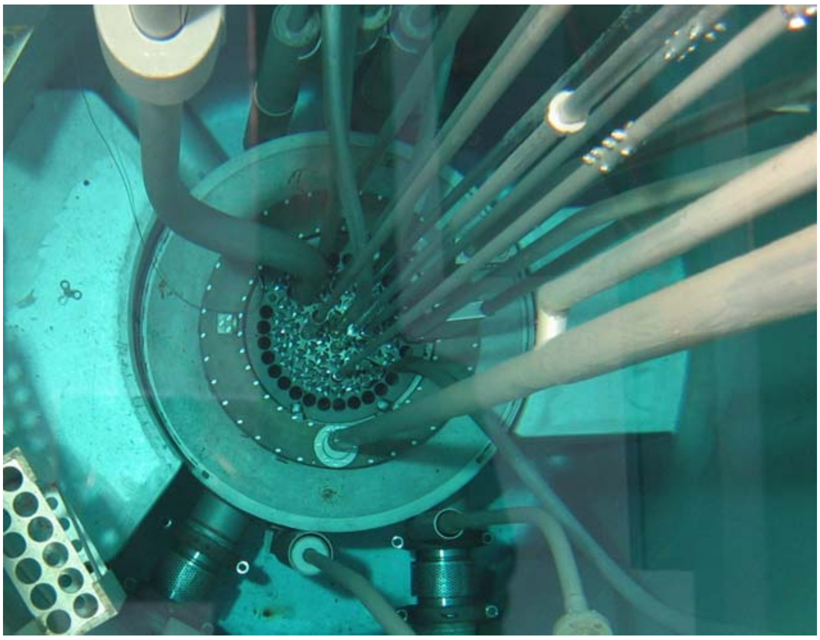
General Description of the TRIGA Mark II Research Reactor

The TRIGA Mark II research reactor is a part of the IJS Reactor Infrastructure Centre. A view of the IJS Reactor Infrastructure Centre is shown in **Figure 23**.

Figure 23: **View of the IJS 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.

Figure 24: **The reactor tank of the TRIGA Mark II research reactor**



The core is placed at the bottom of a 6.25 m high open tank with 2 m in diameter filled with demineralised water. The core has a cylindrical configuration. In total there are 91 locations in the core, which can be filled either by fuel elements or other components such as control rods, a neutron source, irradiation channels, etc. The core lattice has an annular but not 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. The core is supported by a bottom grid plate that in addition provides accurate spacing between the fuel elements. The top grid plate also provides accurate lateral positioning of the core components.

A graphite reflector enclosed in an aluminium casing surrounds the core. There are two horizontal irradiation channels running 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 which is filled by a zirconium rod. Between the fuel meat and the bottom graphite end reflector is a molybdenum disc. The fuel is a homogeneous mixture of uranium and zirconium hydride. The basic data on the TRIGA fuel element is given in **Table 13** and **Table 14**.

Table 13: **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		
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 14: **Standard TRIGA fuel element**

Total mass of uranium [g]	278
Mass of U-235 [g]	55.4
U in U-ZrH [wt.%]	11.9
Enrichment [wt.%]	19.9
H/Zr atom ratio	1.6