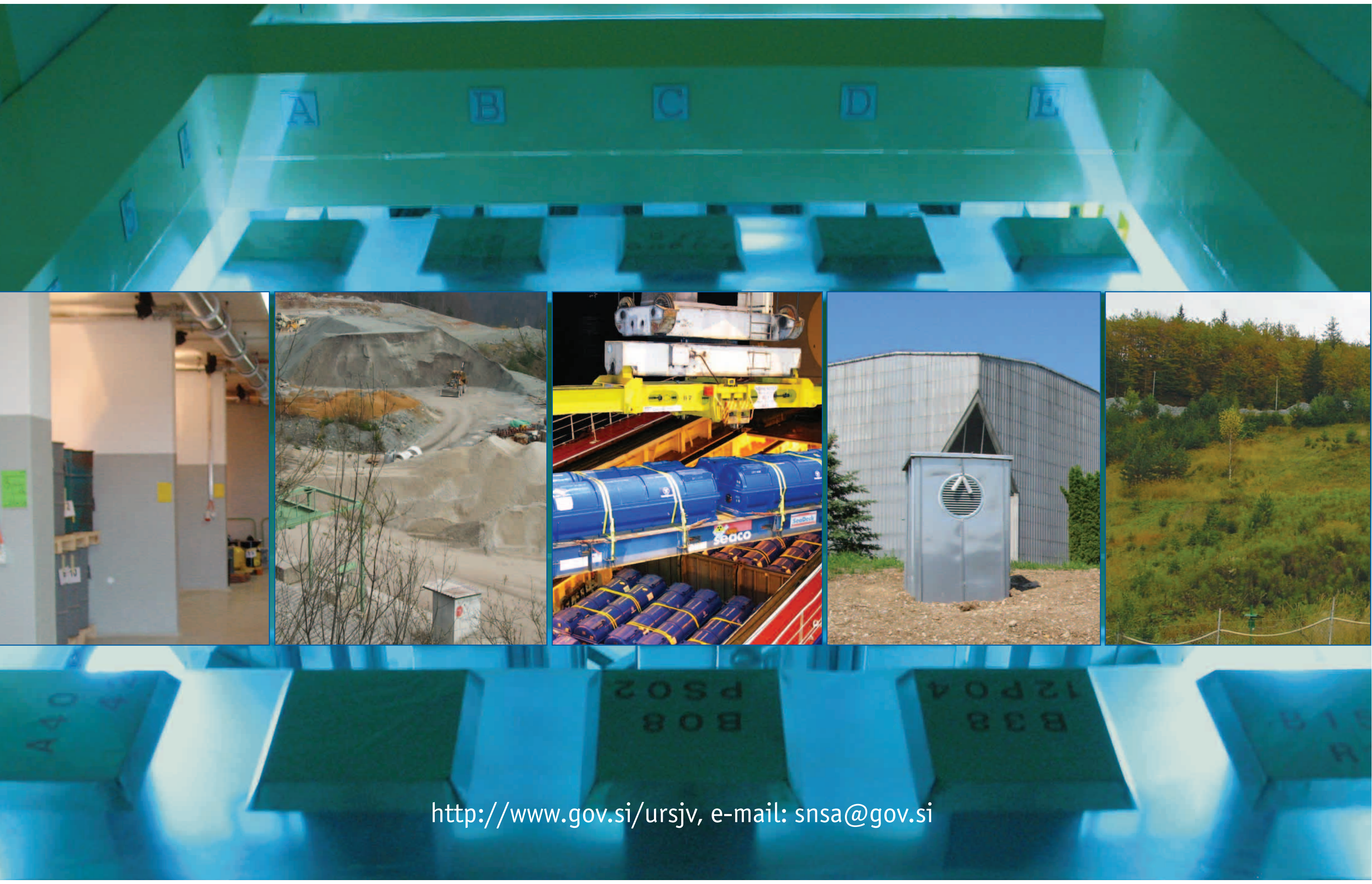
REPUBLIC OF SLOVENIA
**MINISTRY OF THE ENVIRONMENT AND SPATIAL PLANNING**
**SLOVENIAN NUCLEAR SAFETY ADMINISTRATION**

## Second 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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# 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 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 on 6 September 2005.

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3. Ionising Radiation Protection and Nuclear Safety Act (consolidated text - Official Gazette RS, No. 104/2004) - unofficial translation.
4. Regulation Z-3 "On the method of collecting, accounting, processing, storing, final disposal and release of radioactive waste into the environment" (Official Gazette SFRY, No. 40/86).

# 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 |
| 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 |
| 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 Interim Storage 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 Water Reactor with power of 676 $MW_e$. It is designed to operate until the end of 2023. The Krško NPP was built as a joint project of the electrical utilities of the Republic of Slovenia and those of the neighbouring Croatia.

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 plant is owned by state-owned Slovenian and Croatian electrical power companies, ELES GEN d.o.o. and Hrvatska Elektroprivreda d.d., respectively. It is operated by the public enterprise Krško NPP d.o.o.

**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 in the vicinity of Ljubljana. The main purpose of the center 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 an IAEA project 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, for production of isotopes for medicine and industry and 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 LILW.

The research reactor is operated by the Jožef Stefan Institute, a public research institution that is financed within the national budget through 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 corresponding to 452.5 tons ($U_3O_8$ equivalent) of yellow cake. Both the mine and the mill are undergoing decommissioning and remediation of waste piles of 1,548,000 tons of mine waste and red mud and 593,000 tons of mill tailings.

The Žirovski Vrh Uranium Mine terminated its regular operations in 1990. This was influenced by economic reasons, since the yellow cake production was no longer 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 (Act on Permanent Closeout of Uranium Ore Exploitation and Prevention of Mining Consequences in the Žirovski Vrh Uranium Mine (Official Gazette RS, No. 36/92)). The financial resources for decommissioning and restoration are provided through the national budget.

**The Central Interim Storage for Radioactive Waste in Brinje**, situated at the IJS Reactor Infrastructure Centre, about 15 km north-east of Ljubljana, 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 interim storage was transferred from the IJS to the Agency for Radioactive Waste Management (ARAO).

The ARAO is a non-profit organisation of the Slovene 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 polices in the area of safety of spent fuel management and safety of radioactive waste management are set in comprehensive nuclear legislation comprised of domestic Acts, regulations 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 Žirovski Vrh Mine d.o.o., a public enterprise for the decommissioning of uranium production sites (1992).
- Establishment of the Fund for the Decommissioning of the Krško NPP (1995).

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

**The Resolution on the National Energy Programme** adopted by the Slovene 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 2012 on the basis of an evaluation programme which shall start in 2008.

**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:

- 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 shall, according to the Agreement, establish its own fund for the management and collection of financial resources for its share of decommissioning and radioactive waste disposal costs.

On the fifth session of the Bilateral Commission established by the Agreement held on 1 April, 2004 the representatives of the Agency for Radwaste Management of Slovenia and the Croatian Agency for Special Waste presented the Decommissioning Programme and the optimal scenario of decommissioning and of the management of low and intermediate level waste and spent nuclear fuel. After approval of the Decommissioning Plan, the Slovenian Government decided to increase the contribution to the Slovenian fund for financing half of decommissioning and radioactive waste disposal cost through the levy of 0.30 Euro cent per $kWh_e$.

**The National Programme for Radioactive Waste and Spent Fuel Management**, which shall be adopted by the Slovene Parliament, according to the Ionising Radiation Protection and Nuclear Safety Act (consolidated text - Official Gazette RS, No. 102/2004 - hereinafter referred to as the 2002 Act). The technical basis for the National Programme for Radioactive Waste and Spent Fuel Management, together with a detailed description of the measures relating to the reduction of radioactive waste generation, its pre-disposal treatment and disposal, as well as the measures relating to the treatment and disposal of spent fuel, was prepared and communicated to the ministry competent for the environment by the ARAO. Based on this, the National Programme for Radioactive Waste and Spent Fuel Management is being prepared. The National Programme for Radioactive Waste and Spent Fuel Management will be adopted through a resolution of the Slovene Parliament.

## Siting of the LILW repository

In June 2004, ARAO forwarded a proposal for siting to the Ministry of the Environment and Spatial Planning. To assure public involvement in the decision-making, the first public hearing was convened in November 2004. In December 2004, an invitation was sent to all municipalities to participate in the site selection process. Until the deadline, end of March 2005, eight municipalities offered to host the site evaluation programme (without any further commitments). Three most favourable sites will be selected for the evaluation programme.

The following internet sites are available for additional information:
- Slovenian Nuclear Safety Administration: *http://www.gov.si/ursjv/*
- 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.gov.si/arao/*
- 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/*

# Secton 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 second report the fulfilment of the obligations in the period 2002 to 2004 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. 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 2004.

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 Slovene Government adopted the Strategy for Long-Term Spent Fuel Management (hereinafter the Strategy).

According to this Strategy, the decision on final solution of spent fuel disposal in the Republic of Slovenia should be adopted by 2020, while the siting and the construction of the repository should be finished by the year 2050. Until then the fuel should be stored in the Krško NPP spent fuel pool or in dry storage at the reactor site.

The Strategy was supplemented in 2004 due to the Agreement which entered into force in 2003. 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 new plan for decommissioning of the Krško NPP and disposal of LILW and high level waste. For the decommissioning and disposal several options were evaluated.

According to the Decommissioning Plan 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, 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 plan in its long-term strategy for spent fuel management foresees a spent fuel storage in dry casks. Such storage will start operation between 2024 and 2030 and will operate 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.

By the end of 2004, a document **Technical bases for the National Programme on Radioactive Waste and Spent Fuel Management** was prepared. In its short-term scenario it is assumed that all spent fuel arising from operation of the Krško NPP will be stored in the reactor spent fuel pool which has sufficient capacity until the end of the designed plant lifetime (2023).

The spent fuel strategy for the TRIGA Mark II research reactor fuel is based on the following facts and principles:

1. present status:
- no spent fuel elements on site, all elements are fresh or only partially used,

2. future options:
- operation with the currently available stock of fuel as long as technically feasible (at least until 2013 but no later than 2016);
- return of all spent fuel to the USA, within the frame of the USA research reactor spent fuel return programme, until 2019;
- in the case of prolonged operation of the TRIGA Mark II research reactor beyond 2016, the TRIGA spent fuel will be managed together with spent fuel from the Krško NPP.

## (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 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 2004, 763 locations were occupied.

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 chemistry specifications. The cooling system consists of three redundant pumps and heat exchangers and 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 (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 $18.4 \cdot 10^4$ $Bq/cm^3$ (ß 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 millimetres by 304.80 millimetres 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, until the decision on a long-term spent fuel management is made. To minimise the amount of spent fuel and reduce fuel costs, the Krško NPP extends the burnup of fuel elements. The average spent fuel burnup in the spent fuel pool is 36.7 GWD/MTU while the last three spent fuel regions had an average burnup of 42.3 GWD/MTU. The trend is growing and will continue so. 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 hall building. It is accessible by the crane through the lid in the reactor hall floor. The pool is 3.5 meters 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 for final disposal and only 94 fresh fuel elements remained for reactor operation. The new pool is maintained operational and prepared for immediate use if necessary.

A detailed criticality analysis of the spent fuel racks design was performed according to the requirements and standards normally applicable to power reactor storage pools (due to the lack of appropriate research reactor spent fuel storage criticality safety standards). 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 National Programme for Radioactive Waste and Spent Fuel Management will be one of the key documents in the field of radioactive waste management. In accordance with the 2002 Act, ARAO prepared the Draft Technical Bases for the National Programme on Radioactive Waste and Spent Fuel Management at the end of 2004, in which 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 are taken into account, considering present and 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 technical bases include the analysis of measures for minimisation of radioactive waste production, its treatment and its conditioning before disposal. The site selection 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. The site for the disposal of LILW has not been decided on yet. According to the 2002 Act, the dates for siting and disposal of LILW are 2008 and 2013, respectively.

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 the 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.

## (iv) Radioactive Waste Management Practices

Within the scope of the Convention, the Central Interim 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 the small producers (IJS Reactor Infrastructure Centre, industry, research and medicine) is managed in the Central Interim Storage for Radioactive Waste in Brinje.

### The Central Interim Storage for Radioactive Waste in Brinje

After receipt from small producers, the radioactive waste is stored in the centralised storing facility for 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 and 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. All old technical components (electric installations, water supply, sewage system, ventilation system and fire protection) were renewed or replaced. The Safety Analysis Report was updated and the application for two years trial operation is pending for approval of the SNSA. The re-packing and conditioning of waste is planned in several steps over the next few years. The first part of characterisation of the stored waste will be done in 2005.

## The Žirovski Vrh Uranium Mine

There are two permanent waste disposal sites: the Jazbec mine waste pile and the Boršt mill tailings site. The temporary mine waste disposal piles contain about 25,000 $m^3$ of mine waste rock that will be relocated to the Jazbec mine waste pile in 2005.

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

Through remediation of the mine, part of the opened galleries, where the stability of the layers above the mine is in question, will be backfilled with mine waste. All horizontal and vertical entrances into the mine will be sealed. Institutional water and air monitoring will be 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 1,828,000 tons of mine waste with average concentration 53 g $U_3O_8$/t and 48,000 tons of red mud from raffinate neutralisation with the specific activity 65 kBq Th-230/kg. The area is 51,000 $m^2$. To divert background and underground water into the culvert, polyethylene, steel and concrete pipelines have been built. Through remedial action the deposited mining debris and the Jazbec mine waste pile will be isolated from rainfall waters with a multilayer cover to prevent/reduce contaminants dissolution and Radon exhalation. The underground culvert will be repaired to assure long-term stability, and intake of the surface hinterland water into the culvert will be prevented. All other mine waste, contaminated soil and ruins from mine objects shall be removed and disposed of to this site by the end of 2005. Institutional monitoring on seepage water, ground water level, air, object surface and stability control will be needed in the future.

The Boršt mill tailing site is situated on a hillside, 535 m to 570 m above the sea level. During the short operational life of the tailing disposal ca. 610,000 tons of mill tailings and 73,000 tons mine waste were deposited there. In 2004 another 38.000 t of mine waste was transported to the

Boršt. The area of Boršt is 41,000 $m^2$. Practically all tailing materials are sands and slimes under 28 mesh (0.5 mm). Average activity of Radium-226 is 8600 Bq/kg. The Radon exhalation rate is 1 - 5 Bq/$m^2$s. Nearly the whole area of the mill tailings site faces a geomechanical stability problem due to possible landslide of the base of the tailing. Slopes and plateaus were temporary covered by soil, and grass was planted to protect the surface against rainfall erosion. Following an extensive study, the project of permanent rehabilitation of the Boršt mill tailings site is in preparation. Technical measures should be provided for: geomechanical stability of the landslide area and the slopes of mill tailings, protection of the mill tailings against background eaters, prevention of the dissolution of the undesired soluble components into the underground waters and into surface waters, coverage of the mill tailings with natural materials in order to prevent excessive Radon exhalation and recultivation of the surface to prevent erosion caused by rainfall waters. The multilayer cover will be composed of a drainage layer (mine waste, crushed stone), compacted clay (sealing layer), local material (protecting layer) and humus with grass. Institutional monitoring on seepage water, ground water, ground water level, air, object surface and stability control will be needed in the future.

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

## Krško NPP

The Radioactive waste management programme, approved by the management of the Krško NPP, was issued and was followed by a technical report. The Krško NPP considers this document as a valuable source of input for future decision making and long-term planning in the area of operational radioactive waste management. The generation rates based on the present situation and future options are predicted. The available storage capacity for radioactive waste at the Krško NPP is extrapolated. 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.

### 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 sites. 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, an evaporator 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 (ALARA).

The Liquid Waste Processing System also collects and processes potentially radioactive waste for recycling or release. This system consists mainly of two sub-systems. The liquid radioactive waste arising from the reactor coolant system is processed with the Boron Recycling System. Liquid waste is released from the liquid waste monitoring tanks into the discharge channel. The discharge valve is interlocked with a process radiation monitor and closes automatically when the activity concentration in the liquid discharge exceeds a pre-set limit.

The blow-down water from the steam generators is purified separately. The radioactivity of the water discharged into the Sava river is substantially lower than the maximum permissible concentration.

All solid radioactive waste generated during plant operation, maintenance activities and servicing, is collected in the Solid Radioactive Storage Facility. Used ion exchangers, evaporator concentrates, 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. Solid radioactive waste, including spent resins, is processed by the **Solid Radioactive Waste Processing System**, which is designed to provide the means of conditioning of radioactive spent resins or boric acid solid waste generated by the Krško NPP, to provide adequate equipment shielding for the preparation and storage of conditioned waste pending for shipment to an appropriate disposal facility, and to provide the means of conditioning of miscellaneous dry radioactive waste. The solid radioactive waste processing system is designed for packaging all solid waste in standard-size 208 l stainless steel drums. Spent resins, evaporator bottoms and chemical drain tank effluents are encapsulated in the drums, while solid compressible waste is compressed directly in the drums. Incompressible waste is packed in the drums without further processing.

### 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 is additionally reduced.

An aggressive approach to work practices in the radiologically controlled area resulted in a decrease of solid radioactive waste generation in terms of activity. The bringing in of potential radioactive waste materials into the radiologically controlled area is supervised and optimised. Segregation techniques are used for collecting non-contaminated materials separately, which allow waste streams to be processed separately. A variety of decontamination techniques are used, followed by exemption/clearance of decontaminated materials. Metal materials exceeding exemption/clearance levels are stored onsite awaiting melting. The plant personnel and the subcontractors working in the radiologically controlled area are given comprehensive training on the reduction of radioactive waste generation.

To reduce the volume of solid radioactive waste to be stored, two 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 and volume reduction process for spent resins takes place in the drying tank. 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. During the process the solid waste product is formed directly inside the heavy 200 l stainless steel drums. The Krško NPP has started using an external service for the incineration of combustible waste.

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 preferred final package and as a drum overpack in the plant radioactive waste storage facility. Any new type of radioactive waste resulting from a new technology applied is evaluated, approved by the SNSA and incorporated into the Safety Analysis Report.

### Safety Review

At the Krško NPP, a clearly determined Periodic Safety Review was accomplished in 2004, with the aim to verify that the operation of the NPP remains safe when judged against the current safety objectives and practices and that adequate arrangements are in place to maintain an acceptable level of safety.

The Krško NPP radioactive waste storage operation is appropriate according to the findings of the Periodic Safety Review. 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.

## 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 (2002 Act and Governmental Ordinance, 1999). The national waste management agency ARAO is authorised to perform this public service. 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 for 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 Interim 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 in a special 20 $m^3$ decay tank. After measuring the isotope concentration and activity, the liquids are, when they reach the prescribed limits, 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, more than 120 different organisations possessed about 600 sealed sources at the end of 2004. Not all of them are in use. Spent and disused radioactive sources were either returned to the suppliers or shipped to the Central Interim Storage for Radioactive Waste in Brinje. There are still some tens (80-100) of spent sources pending for the transfer to the central storage.

Requirements for use and storage of disused radioactive sources and waste are set in the 2002 Act, Articles 9 to 16. Prior to the beginning 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.

- **Radioactive Waste Management in Medicine**

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

The Institute of Oncology imported (among other sources) 0.64 TBq of I-131 and the Ljubljana

University Medical Centre - Department for Nuclear Medicine imported 0.6 TBq of I-131 in 2004. All other users together imported 0.235 TBq of I-131. The Institute of Oncology uses decay storage tanks in order to control releases of radioactive effluents. The Ljubljana University Medical Centre releases the effluents directly into sewage systems. Patients from other hospitals are not hospitalised. It is estimated that around 0.3 TBq of I-131 is released annually into the environment.

The short-lived radioactive waste (residues, contaminated with I-131, Mo-99, Tl-201, In-111 or Ga-67) which is produced during medical practice, is stored locally at the users' locations. After decay, the material is transferred to the municipal disposal sites. Solid radioactive waste (in total about 0.1 TBq of Cs-137 and Ir-192 for brachyradiotherapy) are temporarily stored at a local storage site at the Institute of Oncology. Disused teleradiotherapeutic Co-60 sources (about 100 TBq) are in most cases returned to the manufacturers. If not, they are transferred to the Central Interim Storage for Radioactive Waste in Brinje. Other small amounts of solid radioactive waste containing Co-57 (in total less than 1 GBq) are temporarily stored at local sites and periodically transported to Brinje.

## (v) Criteria used to define and categorise radioactive waste

Categorisation of radioactive waste is specified by Regulation Z-3 "On the method of collecting, accounting, processing, storing, final disposal and release of radioactive waste into the environment" (Official Gazette SFRY, No. 40/86) as follows: "Solid radioactive waste are materials with specific activity greater than $10^8$ Bq/m$^3$ for beta and gamma emitters, and greater than $10^7$ Bq/m$^3$ for alpha emitters or, alternatively, with the surface contamination greater than 5000 Bq/m$^2$ for beta/gamma emitters, and greater than 500 Bq/m$^2$ for alpha emitters". Liquid and gaseous radioactive waste according to Regulation Z-3 are "waste and gaseous state containing radionuclides in the amount greater than the derived concentrations for air and drinking water for groups of members of the public.

With regard to the specific activity, radiotoxicity and processing technology, **solid and liquid radioactive wastes** are categorised as shown in Table 1.

Table 1: Solid and liquid radioactive waste categorisation

| Category of radioactive waste | | Specific activity $A_{sp}$ [Bq/m$^3$] | Description of the category |
|---|---|---|---|
| I.<br>High-level | | $A_{sp} > 5 \cdot 10^{14}$ | • high beta/gamma and significant alpha activity<br>• high radiotoxicity<br>• high heat output (cooling is necessary) |
| II.<br>Intermediate-level | with alpha emitters | $5 \cdot 10^{14} > A_{sp} > 5 \cdot 10^{9}$ | • intermediate beta/gamma<br>• significant alpha<br>• intermediate radiotoxicity<br>• low heat output |
| | with beta/ gamma emitters | $5 \cdot 10^{14} > A_{sp} > 5 \cdot 10^{7}$ | • intermediate beta/gamma<br>• insignificant alpha<br>• low/intermediate radiotoxicity<br>• insignificant heat output |
| III.<br>Low-level | with alpha emitters | $5 \cdot 10^{9} > A_{sp}$<br>$\frac{A_i}{IK_i} \geq 1$ | • low/intermediate beta/gamma<br>• low alpha<br>• low/intermediate radiotoxicity<br>• insignificant heat output |
| | with beta/ gamma emitters | $5 \cdot 10^{7} > A_{sp}$<br>$\frac{A_i}{IK_i} \geq 1$ | • low beta/gamma<br>• insignificant alpha<br>• low radiotoxicity<br>• insignificant heat output |

$A_i$ is the measured specific activity of a single radionuclide and $IK_i$ (Bq/m$^3$) is the derived radionuclide concentration in drinking water for the group of members of the public.

With regard to the specific activity, radiotoxicity and processing technology, gaseous radioactive wastes are categorised as shown in Table 2.

Table 2: Gaseous radioactive waste categorisation

| Category of radioactive waste | Specific activity $A_{sp}$ [Bq/m$^3$] | Description of the category |
|---|---|---|
| I. | $\sum_i \frac{A_i}{IK_i} > 10^4$ | may not be released into the environment without treatment |
| II. | $1 < \sum_i \frac{A_i}{IK_i} \leq 10^4$ | may not be released into the environment without treatment |
| III. | $\sum_i \frac{A_i}{IK_i} \leq 1$ | may be released into the environment |

$A_i$ is the measured specific activity of a single radionuclide in air.

The categorisation is the same for all radioactive wastes, both those generated in connection with the use of nuclear energy and by small producers.

The new subsidiary regulations on radioactive waste management and classification of radioactive wastes which are being drafted consider, with some modifications, the Radioactive Waste categorisation as recommended in the "EC Recommendation on a Classification System for Solid Radioactive Waste".

In 2004, a new governmental decree was adopted addressing the removal of very low contaminated materials generated inside the radiologically controlled areas of nuclear facilities.

The Decree on activities involving radiation (Official Gazette RS, No. 48/2004) addresses the conditional 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 Interim Storage for Radioactive Waste in Brinje.

The 2002 Act does not stipulate any special legal provision for the spent fuel or radioactive waste that occur within military or defence programmes. Therefore the same legal provisions are applicable to such waste. However, it should be noted that the amount of radioactive waste which occurs in the defence programme is very small in 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 732 spent fuel assemblies in the spent fuel pool at the end of 2004. The fuel batches of spent fuel assemblies with corresponding region numbers can be seen 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 four 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. There are 355 such assemblies in the spent fuel pool.
- Vantage 5 fuel type including fuel batches No. 15 and No. 15B are spent. As a result there are 248 such spent fuel assemblies in the spent fuel pool.
- 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 and 20, with average burnup higher than 40 GWD/MTU, which are in the spent fuel pool, are considered as spent fuel. There are 131 such spent fuel assemblies.

### 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 new 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 Interim 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 Interim 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 useful capacity of the storage is about 500 $m^3$, and the remaining 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 more active spent sources.

The facility is equipped with a ventilation system for reducing radon concentration and air contamination in the storage facility. The water and sewage collecting system is designed as a closed system to retain all liquids from the storage facility in the sump. Liquids are discharged after the measurements of the 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 an alarm system which is 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. The steep slopes of the pile are temporarily covered with soil; the thickness of the soil is up to 0.3 m.

On the Jazbec mine waste pile the following wastes were disposed:

- mine waste with low uranium content,
- uranium ore with low uranium content,
- red mud from raffinate neutralisation,
- radioactive contaminated waste (debris, rubble) from dismantling of processing buildings, crushing structures, contaminated technological equipment,
- contaminated soil due to mine activities.

## 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 m. During the operation and construction of the Boršt mill tailings site, some mine waste was used to consolidate the surface used for construction of the roads for mill tailings transportation. The mill tailings are temporarily covered with soil; the thickness of the soil is up to 0.3 m.

In 1991, a few months after a heavy rain, 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 at a length of nearly 600 m was constructed together with vertical drainage wells. Consequently, according to the measurements, the sliding stopped in 1995.

## Krško NPP

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

**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 fork-lift or an electric-powered cart using a special shield when necessary.

**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. Total area is 1470 $m^2$; 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 (super-compaction, incineration, melting, clearance after decay of radionuclide) or disposal at a later time.

**Decontamination Building**, an interim storage, built for decay storage for two old steam generators and radioactive waste produced through 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 LILW storage. The outer wall and the roof slab design were governed by the radiological shielding requirements.

## (iv) Inventory of Radioactive Waste

### Central Interim Storage for Radioactive Waste in Brinje

Currently around 70 $m^3$ of radioactive waste is kept in the storage with an estimated total mass of 65 to 75 tons. According to the type of package, the waste is divided into three categories: waste packed in drums, contaminated or activated bulky items and spent sealed sources.

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.

The total activity of the waste at the end of 2004 was estimated at 3,900 GBq. It is expected that during normal operation the Central Interim Storage for Radioactive Waste will receive approximately 2 $m^3$ of radioactive waste annually. The list of radioactive wastes is enclosed in Section L, Annex (e), Table 12.

### 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 13 and Table 14, presenting the state at the end of the year 2004.

### Krško NPP

See Section L, Annex (e), Tables 9, 10 and 11.

## (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) Safety of Spent Fuel and Radioactive Waste Management

The main Act of the Republic of Slovenia in this area is the Ionising Radiation Protection and Nuclear Safety Act (the 2002 Act, see Addenda 3 to the Report). As defined in the first article of this Act, its main purpose is "to regulate ionising radiation protection, with the aim of reducing the detrimental effects on health and reducing to the lowest possible level radioactive contamination of the environment due to ionising radiation resulting from the use of radiation sources, while at the same time enabling the development, production and use of radiation sources and performing radiation practices". It also regulates radioactive waste and spent fuel management.

The amendments to the 2002 Act were adopted on 25 February 2003 and 21 April 2004. The amendments were mainly related to the accession of Slovenia to the EU and to the conclusion of the Agreement with Croatia. They provided time-scales for preparation of the National Programme for the Protection of the Environment as regards radioactive waste and spent fuel management and for the siting and commissioning of a repository for low- and intermediate-level waste.

A comprehensive overview of the legislative and regulatory framework which governs nuclear, radiation, and radioactive waste safety is attached to this report (Section L, Annex (f)).

## (2i) National Safety Requirements and Regulations

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.

The 2002 Act entered into force on 1 October 2002. From that day two previous Acts ceased to apply, namely:

- Act on Radiation Protection and the Safe Use of Nuclear Energy (1984 Act),
- Act on Implementing Protection Against Ionising Radiation and Measures on the Safety of Nuclear Facilities (1980 Act).

The 2002 Act provides that the regulations which have been issued on the basis of the 1984 Acts shall apply until new regulations stipulated by the 2002 Act are issued. Based on the 1984 Act, six regulations in the area of radiation protection and four regulations for carrying into effect nuclear safety provisions are still in force. Seventeen new decrees and regulations have been issued so far on the basis of the 2002 Act.

One of the most important is Regulation Z-3 "On the method of collecting, accounting, processing, storing, final disposal and release of radioactive waste into the environment" (Official Gazette SFRY, No. 40/86).

The radiation protection area is also partially covered within the Health Inspection Act (consolidated text - Official Gazette RS, No. 36/2004 and 47/2004).

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

- Decree on Establishment of a Public Agency for Radioactive Waste Management (Official Gazette RS, No. 5/91, 45/96, 32/99, 38/2001 and 41/2004),

- 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),
- Act governing the Fund for Financing Decommissioning of the Krško Nuclear Power Plant and Disposal of Radioactive Waste from the Krško NPP (consolidated text - Official Gazette RS, No. 47/2003),
- Cessation of Exploitation of the Uranium Mine Act (Official Gazette RS, No. 36/92, 28/2000).

## (2ii) Licensing System

A system of licensing of spent fuel and radioactive waste management is provided in the 2002 Act.

With regard to the prescribed measures on radiation protection and nuclear safety, facilities shall be classified as nuclear facilities, radiation facilities and less important radiation facilities. This shall be done pursuant to a governmental decree which determines the criteria for the classification (Article 55). But the basic classification of facilities, which also includes nuclear 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.

Since the facilities for storing or disposing of spent nuclear fuel and low, medium and high level radioactive waste are defined by the 2002 Act as nuclear facilities, the entire spectrum of licensing requirements (for siting, construction, trial operation, operation, decommissioning and/or closure of the repository) has to be taken into consideration by the applicant (investor or operator of the facility). In the licensing process the investor/operator shall attach to the license application, in addition to the project documentation, a Safety Analysis Report and an independent opinion of a radiation and nuclear safety expert. This requirement holds for each and every radiation or nuclear facility. The 2002 Act also provides specific requirements in the case of an application for the construction of a facility for the disposal of spent fuel or radioactive waste; such project documentation shall contain, in addition to a Safety Analysis Report and an expert opinion, the documentation as provided for in Article 73.

Although the ministry responsible for the environment defines in detail the content of the Safety Analysis Report for repository facilities after the closure thereof, such a report covers, based on the provision of the 2002 Act itself (Article 73), the assessment of:

- all possible risks due to the spent fuel or radioactive waste,
- exposure of the population after the closure,
- exposure of the workers working in the repository during the maintenance thereof and during the long-term supervision of the repository facility.

The long-term supervision plan of the repository facility 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 carrying out maintenance work at the repository shall be made dependent on the results of the operational monitoring referred to above and on inspection.

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 state-owned public service for radioactive waste management,
- on the state-owned public service for the disposal of waste from energy producing nuclear facilities,
- on repositories of mining and hydro-metallurgical tailings,
- on state-owned public commercial 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 Regulation on the Method of Collecting, Accounting, Processing, Storing, Final Disposal and Release of Radioactive Waste into the Environment (Regulation Z-3, Official Gazette SFRY, No. 40/86) remains in force. Regulation Z-3 (see Addenda 4 of the Report) contains the following (detailed) provisions:

- on categorising of radioactive waste,
- on collecting of radioactive waste,
- on accounting of radioactive waste,
- on processing of radioactive waste,
- on storing and final disposal of radioactive waste,
- on release of radioactive waste,
- on labelling of radioactive waste.

As described earlier, in 1999 the Government of the Republic of Slovenia passed a 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). This Decree contains 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 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 Radioactive Waste Management - Official Gazette RS, No. 5/91, 45/96, 32/99, 38/2001 and 41/2004).

## (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. The 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 300,000 and 90,000,000 Slovenian tolars (EUR 250 to 375,000) shall be imposed on the legal entity which violates the above stated prohibition; in addition to this a financial penalty between 30,000 and 3,000,000 Slovenian tolars (EUR 125 to 12,500) 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 300,000 and 45,000,000 Slovenian tolars (EUR 1,250 to 187,500) 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,
- order to terminate radiation practices or use of a radiation source in the case when the inspector finds that a proper license was not issued, or if there is a failure in following 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 general Inspection Act (Official Gazette RS, No. 56/2002) prescribes the general principles of inspection, its organisation, status, the rights and duties of inspectors, inspection measures and other issues in relation with 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.

## (2vi) Allocation of Responsibilities

As described above, the legislative framework (especially the 2002 Act and the Governmental Decree of 1999) 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 documentation and reporting.

The Minister of Environment and Spatial Planning shall classify radioactive waste with regard to the level and type of radioactivity, and determine the radioactive waste and spent fuel management, and the extent of reporting on radioactive waste and spent fuel.

A comprehensive overview of the legislative and regulatory framework which governs nuclear, radiation, transport and radioactive waste 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/arrangements) to which the Republic of Slovenia is a party.

# 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 institution within the Ministry of the Environment and Spatial Planning (herein after 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 six divisions. These are (the number in brackets denotes the number of staff in the respective division):

- Division of Nuclear Safety (12),
- Division of General Affairs (5),
- Division of Radiation Safety and Materials (14),
- Division of Analysis and Consulting (5),
- Inspection (6),
- Division of International Co-operation (5).

The staff of the SNSA is interdisciplinary, consisting of employees with different educational backgrounds: physicists, mechanical, electrical, chemical, civil and mining engineers, metallurgists, geologists, lawyers, political scientists, linguists, librarians, economists and administrative workers.

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 it's 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 2004 is shown in Table 3.

Table 3: SNSA budget for 2004

| **Structure** | | **in million SIT** | **in million USD*** |
|---|---|---|---|
| Salaries | | 317,960 | 1.693 |
| Material Expenses | | 73,570 | 0.392 |
| Investments | | 19,272 | 0.103 |
| Membership fees (IAEA, OECD/NEA membership, USNRC programs) | | 62,000 | 0.330 |
| Outsourcing | Nuclear Safety | 63,569 | 0.338 |
| | Radiation safety | 37,537 | 0.200 |
| PHARE Assistance | | 302,088 | 1.609 |
| **Total** | | **875,996** | **4.665** |

* exchange rate as of January 2004

## 2. Other Regulatory Bodies

The 2002 Act gives the competence in the area of radiation practices and use of radioactive sources in heath and veterinary care to the Slovenian Radiation Protection Administration (SRPA), which was established in March 2003 within the Ministry of Health. The SRPA responsibilities and competencies are also generally defined in the above mentioned Governmental 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.

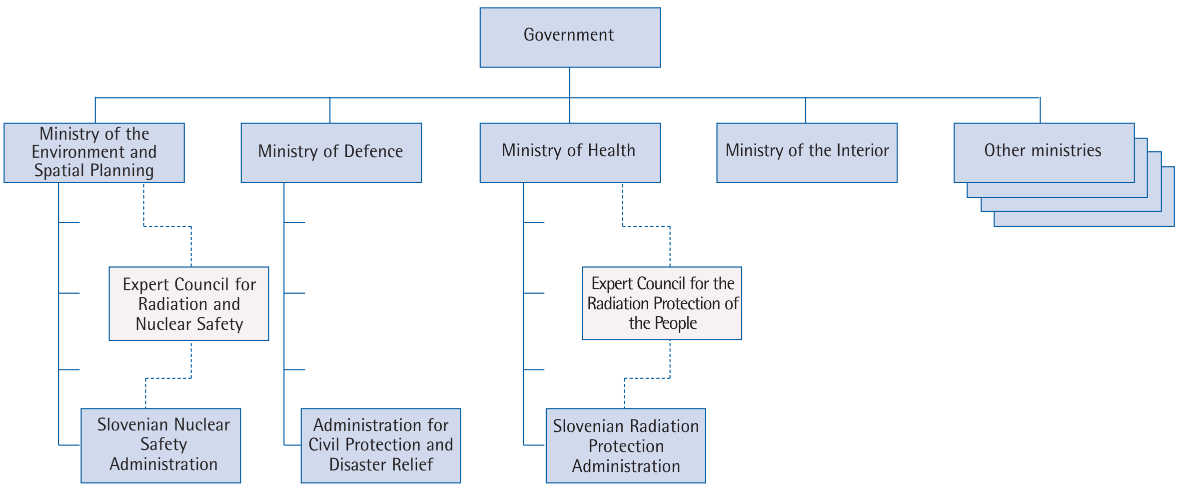
Besides the SNSA and the SRPA, some other administrations, ministries and organisations are also entrusted with the implementation of the 2002 Act, in particular:

- 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 Mining Directorate (within the Ministry of Economy),
- The Agency for Radwaste Management,
- The Fund for Decommissioning of the Krško NPP,
- The Nuclear Insurance and Reinsurance Pool,
- Technical Support Organisations.

Based on the 2002 Act, the Expert Council for Radiation and Nuclear Safety was appointed in mid 2003 as an advisory body to the Ministry of the Environment and Spatial Planning and the SNSA, and 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 2.

Figure 2: **The SNSA and the SRPA within the governmental structure**



## 3. Effective independence

The SNSA is a part of the state administration. Based on the Public Administration Act (Official Gazette RS, No. 97/04) the SNSA is an independent body within the Ministry of the Environment and Spatial Planning in administrative decisions. 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 de iure assured independence of the SNSA.

# Section F: Other General Safety Provisions

## Article 21: Resposibility 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 furthermore 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 cease 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 with the national or international codes, standards and experience. Article 73 of the 2002 Act requires the following for the disposal of spent fuel and radioactive waste:

"If an application for approval refers to the construction of a facility for the disposal of spent fuel or of radioactive waste, the investor shall, in addition to the project documentation and the Safety Analysis Report, attach the following:

- a Safety Analysis Report relating to the period after the closure of the repository facility,
- the opinion of an authorised expert for radiation and nuclear safety,
- financial warranties for carrying out all the necessary tasks until the closure of the repository,
- financial warranties for the payment of the costs of long-term supervision of the repository after the closure thereof,
- a statement on the free-of-cost transfer of the ownership over the land occupied by the repository to the state and the plan of transfer".

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. It has several divisions, including the Technical Division, which is responsible for operating, maintenance and technical services, the Engineering and Nuclear Oversight Division, responsible for design, engineering, configuration management, licensing, procurement engineering, project management and independent safety assessments, the Quality Systems Division, the Administrative Division and the Financial Division. At all positions, qualified personnel performs all the different activities needed for radioactive waste and spent fuel management. At the end of 2004, 598 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 nuclear fuel management. Handling processes themselves are 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 introduction 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 to the personnel permanently working in a controlled area or with systems that contain radioactive material. Specialist health physics personnel 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 income from the sale of electricity is sufficient to cover the operating expenses. The Krško NPP invests in continuous adjustment of the safety level of its installation, to account for the development of the state of the art in science and technology over the entire operating life.

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, ELES GEN 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 on the Fund for Financing Decommissioning of the Krško NPP and of Radioactive Waste Disposal from the Krško NPP (consolidated text - Official Gazette RS, No. 47/2003). 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 plan in 2004 the levy was in 2005 increased to 0.30 Euro cents per $kWh_e$ delivered to the Slovenian electric utility ELES GEN 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. So far the Fund has not been established and no assets have been collected.

The Decommissioning Plan considered several possible methods for its implementation as well as for financing and scheduling. Due to the above Agreement it was updated in 2004.

## Jožef Stefan Institute Reactor Infrastructure Centre

### (i) Human Resources

The 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 and a secretary) are responsible for spent fuel and radioactive waste handling and management. The staff are appropriately trained and equipped.

The TRIGA Mark II operation staff are responsible for and trained to perform the following specific tasks in spent fuel management and radioactive waste management:

- handling of fresh fuel,
- safeguarding and inspection of fresh fuel,
- in-core and in-reactor handling of irradiated fuel,
- handling and transportation of irradiated fuel inside the reactor hall,
- handling of (irradiated) fuel in the spent fuel pool,
- handling and work with sealed and open radioactive sources,
- decontamination,
- identification and packing of LILW.

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 source for storage.

### (ii) Financial Resources

The financial resources for maintaining the safety of spent fuel and radioactive waste at the reactor 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 final responsibility to assure financial resources for proper decommissioning and spent fuel management.

## Agency for Radioactive Waste Management

### (i) Human Resources

At present the ARAO has a staff of twenty people. It is organised into four units: planning and development, disposal, operations and joint services.

The educational structure of the ARAO reflects its professional attitude towards its responsibilities. 60% of employees have graduate degrees, 25% postgraduate and only 15% secondary school education. The personnel cover different fields: physics, biology, chemistry, geology, hydro-geology, metallurgy, law and economics. 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 participate regularly in various training courses, workshops and seminars. The preparation of lectures, papers and other contributions is also regarded as part of the learning process.

### (ii) Financial Resources

The ARAO's activities are financed from three different sources:

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

The annual budget varies, depending on planned activities for the current year. In the last five years the income has gradually increased from 0.75 million EUR to 3.2 million EUR in 2004.

## 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 basic activities of the public company are:

- to prepare plans for closing down and to close down the uranium mine,
- to prepare plans and to carry out environmental protection,
- to prepare measures against the consequences of the uranium mine exploitation,

- to carry out other activities required for the closure of the uranium mine.

The Žirovski Vrh Mine d.o.o. has an adequate and experienced staff of 38 people, the majority of whom are workers, miners and managerial staff. It is standard practice that additional expertise and production of plans as well as major remedial activities are contracted on a commercial basis.

### (ii) Financial Resources

Adequate financial resources are available to support the safety of radioactive waste management during the decommissioning.

Until the year 2002 functioning of the Žirovski Vrh Uranium Mine was assured through the national budget. Such financing was not sufficient to perform capitally intensive tasks. For this reason the Government of the Republic of Slovenia in the year 2002 secured sufficient financial resources through a loan from the European Investment Bank. The budget will assure the completion of work by the end of 2009. The financial resources for institutional monitoring will be provided by the Government of the Republic of Slovenia.

## 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, 5 radiological engineers, 1 maintenance worker). In the near future (this or next year), another radiopharmacist will be employed. In case of introduction of any new nuclear medicine techniques, the number of staff will be increased.

### (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 65 persons are employed at the department (12 medical doctors, 4 radiopharmacists, 1 biologist, 1 physicist, 2 electrical engineers, 9 radiological engineers, 6 senior hospital nurses; the others are technicians and administration and maintenance personnel). The staff working with radioisotopes at this department have appropriate education and experience as required by the national legislation.

### (ii) Financial Resources

Functioning of the University Medical Centre - 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.*

The 2002 Act explicitly requires 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

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. It is also the policy of the Krško NPP to comply with the requirements of Appendix B to Title 10, Part 50 of the United States Code of Federal Regulations (10 CFR 50) concerning the operating license and the applicable codes, standards and guidelines.

The Krško NPP Quality Assurance Programme is implemented and maintained to comply with the following codes and standards:

- 10CFR50, Appendix B,
- ANSI N 18.7-1976,
- ASME B&PV Code, Section III, NCA-4000,
- ANSI/ASME NQA-1,
- IAEA 50 C QA,
- Regulation E-1 from the year 1988.

The QA policy for the Krško NPP is established by the Management Board and is defined in the Statement of Policy and Authority, which is a part of the Krško NPP QA Plan. This policy is implemented through the Krško NPP QA Plan and procedures for the operation phase of the plant. The QA Programme, which includes the Statement of Policy and Authority, the plan and the procedures, constitutes a part of the Krško NPP Manual.

Revision 4 of the Quality Assurance Plan of 1 April 1999 was the basis for the review within the scope of the Periodic Safety Review (PSR) project. Besides updating the Plan so as to be in compliance with the new organisation, the issues identified by an independent review of the PSR Chapter 4.2. Quality Assurance were also taken into account. The Krško Quality Committee, with the responsibility of advising the Management Board by providing an independent review and audit of QA implementing practices, and the Krško Safety Committee auditing of the QA Programme were introduced. The new Revision 5 was prepared and approved by the Management Board with the effective date 15 August 2003.

During the OSART mission at the Krško NPP in 2003, one recommendation was issued in the area of quality assurance, which aims at plant senior management and requests them to take actions to ensure that the quality assurance functions provide an effective barrier to a potential decline in plant performance. The recommendation further states that "all quality assurance functions should be covered and there should be a common understanding of these functions across the plant".

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.

### Agency for Radwaste Management

A QA system has been implemented in the ARAO for several years. It is documented by a quality manual including administrative and working procedures, covering all aspects of waste management in the Central Interim Storage for Radioactive Waste in Brinje and radiation protection dealing with waste. In 2004, a new quality manual was prepared which integrates quality management system (ISO 9001:2000), the environmental management system (ISO 14001) and IAEA 50-C-QA, rev 1. The introduction of the ISO 14001 standard for the Central Interim Storage for Radioactive Waste in Brinje was implemented in 2004 with the corresponding preparatory procedure, starting with an emphasis on environmental planning.

### Slovenian Nuclear Safety Administration

Based on the programme of the Government on Management for Excellence in State Administration, supported by the 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, Vienna, 1996; ISO 9001, "Quality Management Systems - Requirements", Third Edition, 2000 and IAEA-TECDOC-1090 "Quality assurance within regulatory bodies" IAEA, June, 1999, the SNSA is establishing and implementing its Quality management system.

The commitment of the SNSA management to the development and implementation of the quality management system is reflected in adjusting the organisational structure by adding the function of a quality manager who reports on the subject of quality management directly to the director.

In order to describe its processes, the SNSA has defined, besides its mission, which is based on its legislated mandate, the vision and values as the top of the quality management system documentation. The SNSA quality management system is built around processes and is defined in quality management documentation in the form of a process approach and it clearly defines organisation, responsibilities and authorities, resource management, the processes and measurement, analysis and improvement. The quality management documentation which is in preparation consists of a quality manual, management procedures, working procedures and records. The quality manual as a first level documentation consists of the quality policy and the quality management system description. Management procedures as a second level documentation refer to the existing main processes and supporting processes. Meanwhile, the working procedures as a third level documentation describe in detail the performance of particular process activities.

The SNSA is in the phase of documenting and at the same time improving the existing processes. Simultaneously, the third level documentation is also prepared when particular activities have to be prescribed. It is planned that the Quality Manual will enter into force in the year 2005.

## 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 is regulated by the 2002 Act and new subsidiary regulations and decrees, published in 2003 and 2004, which are based on EU Directives 96/29/Euratom and 90/641/Euratom.

The subsidiary regulations concerning control of discharges, monitoring of radioactivity in the environment and categorisation of sources and radioactive waste are still based on the previous Act on Radiation Protection and Nuclear Safety from 1984. Some new provisions regarding radiation protection of workers and public are already a part of the 2002 Act, such as for example intervention criteria and levels.

The two competent authorities for radiation protection are the Ministry of the Environment and Spatial Planning, and the Ministry of Health. According to the 2002 Act the Ministry of the Environment and Spatial Planning is competent for licensing and inspections in industry, research and education (including nuclear facilities) while the Ministry of Health has adequate competence for sources used in medicine and veterinary medicine. The licensing process of the 2002 Act prescribes the handling and use of a specific source. The facilities with radiation sources and nuclear facilities are categorised in the 2002 Act as well.

According to this, the design, planning, subsequent use and operation of sources, and handling shall be performed in a way to ensure that exposure is as low as reasonably achievable (ALARA), taking into account economic and social factors. In order to implement the radiation protection standards through licensing, the technical support organisations are authorised to perform radiological surveillance. These institutions support regulatory authorities and users of radiation sources by performing safety assessment plans, dose calculations and individual monitoring, monitoring of radioactivity of the environment etc. Two such technical support organisations are authorised to perform specific tasks regarding radiation protection of workers and the public. Five medical institutions are authorised for health surveillance of workers.

The prescribed annual effective dose limit 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 the contractors. In total, about 6800 workers, (together with the contractors) have been registered, with an average of around 1000 workers per year in the nuclear fuel cycle.

The limit for the annual effective equivalent 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.

### 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. A person carrying out a practice involving radiation who manages a radiation or a nuclear facility shall ensure the establishment of a 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 should be nominated by the licensee. The individual dosimetry is based on the TL dosimetry and/or monitoring of workplaces, as appropriate. The dosimetry services are authorised by the Ministry of Health.

According to Article 124 of the 2002 Act and Regulations Z-2, Z-9 (based on the 1984 Act) operational monitoring of radioactivity shall be ensured by the radiation or nuclear facility to protect the public and the environment. Operational monitoring of radioactivity shall entail:

- monitoring of the radioactive discharges from a radiation facility or nuclear installation into the environment,
- monitoring of environmental radioactivity and monitoring of the radioactivity of drinking

water, foodstuffs and animal feed as the result of radioactive releases.

Radioactive discharges are monitored at regular intervals and annual public exposure is estimated. The operator shall also carry out the 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 control of discharges in normal operation are the 2002 Act, Article 124 (Operational monitoring of radioactivity) and the Regulation Z-2 (1986).

According to the 2002 Act two levels of the 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 performed regularly during the period of their operation. The discharge limits for nuclear installations were set by the SNSA in relation to the dose constraints of population exposure. Monitoring of radioactive discharges from nuclear installations in the Republic of Slovenia started in the early eighties with the extant programmes: at the Krško NPP (1981), at the Žirovski Vrh Uranium Mine (1985), at the IJS Reactor Infrastructure Centre (1986) and at the Central Interim Storage for Radioactive Waste in Brinje (1986). Discharges from nuclear medicine departments are not regularly monitored and only some rough estimates have been made based on the purchased and applied activity of radioisotopes.

The SNSA is establishing a comprehensive database on post discharges and environment monitoring on the basis of annual reports. The computerised database is designed to present statuses and trends as well as graphic visualisation of historic records. The annual data on gaseous and liquid radioactive discharges are the input data for modelling radiation exposure assessment of the members of critical groups.

### b) Environmental monitoring of radioactivity

1. Monitoring of environmental radioactive contamination in the surrounding of the nuclear facilities has been performed by technical support organisations. Population exposures to the critical groups have been estimated based on measured data and modelling.

Monitoring of radioactivity in the environment is performed in accordance with the Regulations Z-1 and Z-2 (1986). 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.

2. An automatic radiation monitoring system on the territory of the Republic of Slovenia was developed soon after the Chernobyl accident. All the data coming from different networks are currently collected at the SNSA. At the moment, the entire system comprises on-line data of dose-rate measurements (42 stations) and aerosol radioactivity measurements (3 stations). The control of airborne activity was realised partly through an IAEA technical co-operation project and partly with the support of the Austrian Government.

3. 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 Article 25: Emergency Preparedness.

## Measures Taken by the License Holders

### Krško NPP

#### a) Radiation Protection

In accordance with the 2002 Act, all nuclear installations shall have a special radiological protection unit. The Radiological Protection Unit at the Krško NPP was organised in order to implement radiation protection measures including measurements, assessment and 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 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 area under constant radiological surveillance (controlled area) comprises: 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 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 electronic alarm dosimeters and thermoluminiscent personal dosimeters (TLD) in addition to regular protection equipment. Internal contamination is measured by a whole-body counter before and after 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).

Administrative procedures and installed systems provide effective protection of individuals, society and the environment. ALARA planning is a common approach to work in radiological controlled areas. 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 accidental conditions. The committee is responsible for adopting and reviewing of ALARA programmes. The reduction of personal and collective doses is the primary guideline when preparing procedures for spent fuel management. During the ALARA planning procedure, radiological conditions are analysed, personal protection equipment is defined, radiological control determined, so that all key elements are taken into account.

In 2004, the SNSA approved 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. The Krško NPP has updated the modelling of dispersion of radioactive contamination in accidental situation with the state-of-the-art Lagrangean model.

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 keeps 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 Krško NPP has its own service for personal dosimetry, which was authorised by the Ministry of Health. The reported exposures comprise both external and internal doses.

The exposures of workers to ionising radiation in the Krško NPP are relatively low. In the year 2003 the collective effective dose of workers involved in the processing of radioactive waste in the Krško NPP was 15.38 man mSv, which represents about 2% of the total collective dose. In the year 2004 the total Krško NPP collective dose was 688.52 man mSv and 14.52 man mSv was related to the processing of radioactive waste. Only one worker involved in the processing of radioactive waste received an annual dose exceeding 5 mSv (6.8 mSv) in the years 2003-2004.

In 2003, the average individual effective dose of the workers was 1.01 mSv, and 0.88 mSv in 2004, which is about 5.05 % and 4.40 % respectively of the annual dose limit for occupational exposure according to the governmental decree (2004) which is in compliance with IAEA-BSS Safety Standards No. 115. From 2000 onwards, after modernisation of the plant and steam generators replacement, the annual collective doses showed a decreasing trend.

### b) Liquid and Gaseous Discharges

The limits of radioactive flow into the environment are authorised by the license for operation of the Krško NPP No. 31-04/83-5, issued on 6 February 1984 by the former Energy Inspectorate of the Republic of Slovenia.

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 about discharges of radioactive materials into the environment by the Krško NPP 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: H-3, Co-58, Co-60, and some dissolved noble gases. Even though the activity of tritium is high compared to other radionuclides, due to its low radiotoxicity its radiological impact is insignificant. The activities of Cs-134, Cs-137, Fe-59 and Sb-125 are up to two to three orders of magnitude lower. The main contribution to the dose is made by the radionuclides of caesium and cobalt. The dose to the critical group due to liquid discharges is assessed to be below 0.1 μSv per year.

Radioactive gases from the Krško NPP are released into the atmosphere mainly from the reactor building stack and through the vent of the condenser in the secondary coolant loop. The radiation monitoring system continuously measures and monitors the concentrations of individual radioactive elements at both discharge points. The maximum calculated dose at a 500 meters distance from the reactor is estimated at 0.85 μSv per year due to inhalation and external radiation caused by gaseous releases.

Table 4: **Radioactive liquid and gaseous discharges from the Krško NPP in 1999-2004**

| **Liquid discharges** | **Authorised limit** [Bq] | **Released activity** [Bq] | | | | | |
|---|---|---|---|---|---|---|---|
| | | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** |
| Total released activity (without H-3, noble gases) | 200 E+09 | 4.74 E+08 | 5.76 E+08 | 1.13 E+09 | 9.39 E+08 | 3.59 E+08 | 2.41 E+08 |
| H-3 | 20 E+12 | 1.08 E+13 | 1.07 E+13 | 7.75 E+12 | 1.33 E+13 | 1.03 E+13 | 1.08 E+13 |
| Noble gases | - | 5.33 E+09 | 7.12 E+09 | 7.76 E+08 | 1.05 E+09 | 5.00 E+07 | 2.51 E+08 |
| | | | | | | | |
| **Gaseous discharges** | **Authorised limit** [Bq] | **Released activity** [Bq] | | | | | |
| | | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** |
| Noble gases (Xe-133 equiv.) | 110 E+12 | 1.44 E+12 | 2.29 E+12 | 2.11 E+12 | 6.08 E+11 | 1.45 E+11 | 1.51 E+11 |
| Iodines (I-131 equiv.) | 18.5 E+09 | 5.46 E+06 | 52.3 E+06 | 0.13 E+06 | 1.19 E+07 | 3.57 E+05 | 8.40 E+06 |
| Aerosols | 18.5 E+09 | 16.7 E+03 | 1.06 E+06 | 2.83 E+06 | 7.56 E+05 | 3.23 E+04 | 3.35 E+05 |
| H-3 | - | 1.16 E+12 | 1.20 E+12 | 0.86 E+12 | 1.25 E+12 | 1.22 E+12 | 2.42 E+12 |
| C-14 | - | 0.12 E+12 | 0.12 E+12 | 0.11 E+12 | 8.38 E+10 | 1.10 E+11 | 1.23 E+11 |

Conservatively estimated individual exposures for the member of the public dose 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 one μSv/year for an adult. Dose assessment showed that exposures to members of critical groups have been well below the regulatory limit of 50 μSv/year and less than 0.1% of exposure due to natural radiation.

## Central Interim Storage for Radioactive Waste in Brinje

### a) Radiation Protection

Radiation protection in the Central Interim Storage for Radioactive Waste in Brinje covers workers and the public and includes occupational radiation protection and monitoring of radioactivity in the vicinity 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 approved dosimetry service. The effective collective dose was 0.21 man mSv in the year 2002, 0.27 man mSv in the year 2003 and 1.60 man mSv in the year 2004. The average dose per worker in the year 2004 was 0.2 mSv/year.

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

Conservatively estimated radiation exposure of the public due to the operation of the Central Interim Storage for Radioactive Waste in Brinje is far below the general prescribed limit of 1 mSv/year. The annual effective dose (Radon inhalation and direct exposure) for the most exposed non-radiation worker working in the vicinity of the storage site for a part of his routine job does not exceed 10 μSv/year.

### b) Liquid and Gaseous Discharges

The radioactivity monitoring programme in the environment of the Central Interim Storage for Radioactive Waste in Brinje was conceived in accordance with Regulation Z-2. The scope of monitoring covers emissions (measurements of gaseous and liquid discharges) and environmental concentrations of radioactivity. During normal operation there were no liquid discharges from the storage. The steady state emission of radon into the environment is approximately 52 Bq/s. This amounts to a yearly release of 1.64 GBq.

In June 2001, the ARAO was authorised by the SNSA to carry out a radium sources conditioning (repackaging). In addition, in 2003, the cobalt spent sources were repacked and collected into two drums with lead and concrete shielding. After carrying out the repackaging activities the level of external radiation in the storage was lowered substantially.

In dose assessment of the public, only radon progeny inhalation as well as external exposure were considered. Several critical groups have been identified. The employees working in the nearby research institute receive about 4 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 0.15 μSv.

## Jožef Stefan Institute Reactor Infrastructure Centre

### a) Radiation Protection

At the Research Reactor Infrastructure Centre of the Jožef Stefan Institute radiation protection is implemented and performed by the Radiation Protection Service of the Institute. Altogether 25 persons from the Reactor Department, from the service, and from the Radiochemical Laboratory were exposed to ionising radiation with an average annual dose of 0.039 mSv in 2004 (not taking into account the neutron dose). The collective annual dose in 2004 was 0.97 man mSv.

### b) Liquid and Gaseous Discharges

The radioactivity monitoring programme in the environment of the IJS Reactor Infrastructure Centre was carried out in accordance with Regulation Z-2 and was approved by the SNSA Decision. The liquid discharges originated mostly from the radiochemical laboratory using reactor activation products. The annual reactor discharge of Ar-41 is proportional to the time of reactor operation and is estimated to be typically about 1 TBq.

For exposure evaluation of the population only two exposure pathways were considered: external exposure due to Ar-41 immersion and ingestion of contaminated water. In the year 2004 the total dose received by the public was estimated to be 0.3 μSv/y. There are no authorised dose limits for the operation of the research reactor; thus the general limit for members of the public is applied (1 mSv/year).

Table 5: Discharges from the IJS Reactor Infrastructure Centre in the period of 1999-2004

| **Liquid emissions** | **Released activity** [Bq] | | | | | |
|---|---|---|---|---|---|---|
| | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** |
| Total released activity | 2.5 E+06 | 8.7 E+06 | 0.51 E+06 | 1.6 E+06 | 0.9 E+06 | 0.22 E+06 |
| | | | | | | |
| **Gaseous emissions** | **Released activity** [Bq] | | | | | |
| | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** |
| Ar-41 | 0.9 E+12 | 0.9 E+12 | 1.0 E+12 | 1.1 E+12 | 0.9 E+12 | 0.8 E+12 |

## 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.

Exposure of workers to ionising radiation is assessed by the radiological protection unit based on the following measurements:

- measurements of radon and potential alpha energy of radon progeny in the air,
- measurements of long lived alpha activity in the air,
- external radiation is measured with TLDs on a quarterly basis except the doses of the workers in the laboratory where TLDs are replaced monthly.

Dose assessments are based on these data and on the time records for the individual worker relating to his/her work at different workplaces.

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

Table 6: Radiation exposure of workers of the Žirovski Vrh Uranium Mine due to radioactive waste management from 1996-2004

| **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 |

* in the period of regular operation; 1989-2001 effective equivalent dose

** RŽV staff and external

## b) Liquid and Gaseous Discharges

The regular monitoring programme of environmental radioactivity has been running continuously for two decade. The programme is based mainly on the US Regulatory Guide 4.14 (1980) and was approved by the competent regulatory authority. After the cessation of mining and milling, during the current closedown period, the surveillance programme has been running continuously and only some minor changes in the programme and the scope have been made.

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

Table 7: Radioactive discharges at the Žirovski Vrh Uranium Mine in the period of 1999-2004

| Liquid discharges | Released activity [Bq] | | | | | |
|---|---|---|---|---|---|---|
| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
| U-238 | 2.9 E+09 | 3.0 E+09 | 3.1 E+09 | 2.9 E+09 | 2.4 E+09 | 3.5 E+09 |
| Ra-226 | 0.084 E+09 | 0.074 E+09 | 0.056 E+09 | 0.06 E+09 | 0.07 E+09 | 0.08 E+09 |
| | | | | | | |
| **Gaseous discharges** | **Released activity** [Bq] | | | | | |
| | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** |
| Rn-222 | 11.9 E+12 | 11.7 E+12 | 9.4 E+12 | 16.6 E+12 | 16.1 E+12 | 14.2 E+12 |

The impact of the mine discharges extends over an area inhabited by about 320 people. The dose assessment was made for adults in this population group. Inhalation of radon and its progeny from the mine is the main contributing factor to exposure due to the mine. In 2004, the exposure of a member of the public was estimated to be 0.19 mSv/year.

## Isotope Laboratory of the Institute of Oncology

### a) Radiation Protection

Occupational exposure at the Institute of Oncology is monitored through regular individual monitoring with TLDs. It was reported that no worker has exceeded 20 mSv/year during the past 10 years. The annual dose of the majority of workers from the Institute of Oncology has not exceeded 1 mSv in the years 2001-2004. In 2004, the maximum dose was 2.5 mSv. The maximum annual personal dose of 8.8 mSv was received by a medical nurse from the Brachyradiotherapeutic Department in 2001. The above mentioned values include exposures received during handling of sources from and to the storage. No special tasks regarding radioactive waste are performed and no separated doses related to radiation waste are recorded.

### b) Liquid and Gaseous Discharges

Discharges from the nuclear medicine departments are not regularly monitored and only some rough estimates were made. The faecal sludge is collected in a two-vessel container and 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.

## Ljubljana University Medical Centre - Department for Nuclear Medicine

### a) Radiation Protection

Occupational exposure at the University Medical Centre - Department For Nuclear Medicine is monitored through regular individual monitoring with the TLDs. All staff are under dosimetric control. In the year 2004 the annual dose did not exceed 1 mSv for 71% of workers. The effective dose between 1 and 2 mSv was received by 23% of workers and between 2 and 3 mSv by 6% of workers. The above values are the result of overall individual exposures, not related only to waste management.

### b) Liquid and Gaseous Discharges

Liquid discharges have not been regularly monitored or collected. Discharges were estimated from the administered activities. It is estimated that around 0.3 TBq of I-131 is released annually into the environment.

Other small departments of nuclear medicine in the country deal with essentially lower activities of pharmaceuticals. No special decay tanks for these kinds of release are in place, so discharges are estimated in the same way as above.

## Article 25: Emergency Prepareness

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 Protection against Natural and Other Disasters Act (Official Gazette RS, 64/94, 33/2000, 87/2001, 52/2002 and 41/2004) 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 more in detail in the First national report.

Concerning safety, the most important Act is the 2002 Act, which 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 Decree on Preparation of the Emergency Plans (Official Gazette RS, 3/2002) stipulates that the nuclear emergency plan should be prepared on a national level, and the national nuclear emergency plan 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.

## 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. In January 2004, the new revision of the National Protection and Rescue Plan in the Case of a Nuclear Accident (henceforth referred to as the Plan) was adopted by the Slovenian Government.

The content and the essence of the Plan in principle remained unchanged, while the names of ministries and their responsibilities were changed, along with some other changes which were made in order to put the Plan in line with the EU acquis. The content of the Plan was described in the First national report and has not been changed.

In Slovenia, there is also an Ecological Laboratory with a Mobile Unit, which is a special unit for radiological and emergency response on a national level. It would assist in any radiological emergency. It performs radiation measurements and interventions in the case of lost or dispersed radioactive material.

## On-site Radiological Emergency Response Plan

### Krško NPP

The Krško NPP has competency and full responsibility for on-site emergency preparedness and response. The principles and requirements of the legislation on protection against natural and other disasters as well as on nuclear safety in the Republic of Slovenia are being incorporated into the Krško NPP on-site emergency preparedness and response plan.

The Krško NPP has a Radiological Emergency Response Plan which meets the requirements of 10 CFR 47 NUREG-0654. Therefore, the radiological emergency response plan satisfies all the requirements for on-site emergency planning of the spent fuel pool and radwaste facilities.

The objectives of the Krško NPP Radiological Emergency Response Plan 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,
- 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. In 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 a chemical plant in the vicinity of the Reactor Infrastructure Centre).

The spent fuel of the TRIGA Mark II research reactor is to be stored in the reactor pools which are empty. The most severe operational accident (loss of coolant in the pool) would not significantly affect the spent fuel, which is stored in the reactor pool only. The off-site consequences of the gap release from damaged spent fuel elements are negligible. Since 1993, when the emergency procedures were introduced, there have been no events that would require their application.

## Central Interim Storage for Radioactive Waste in Brinje

The emergency response plan for the Central Interim 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 Interim 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,
- other similar emergency situations.

A new revision of the emergency response plan is in preparation, which will take into consideration all modifications of the responsibilities of competent authorities and will also include instruction and procedures for effective response.

### Žirovski Vrh Uranium Mine

Radiological emergency situations at both disposal sites, Jazbec and Boršt, are not expected. As part of the monitoring programme, the surface of the Jazbec mine waste pile and the Boršt mill tailings site is 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 once a year.

### Slovenian Nuclear Safety Administration

The SNSA Emergency Plan is synchronised 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 is mainly focused on accidents in a NPP (the procedures mostly address the Krško NPP but also NPPs abroad). For emergencies at the spent fuel and radioactive waste management, the SNSA assists in the emergency response by providing expert advice, on-site inspection and measuring equipment.

In 2004, a complete revision of the SNSA internal emergency procedures was finished and some new procedures were written, which provided more specific guidance to the emergency staff and strengthen the requirements for checking and testing the emergency equipment.

## Exercises

The regime of the exercises was described in the First national report. In accordance with the legislation one national nuclear exercise shall be organised in a five year period.

Emergency exercise NEK-2002 was organised as a national exercise. The progress of events demanded a classification from the lowest to the highest emergency class. The exercise proved that an effective system of response to a nuclear accident had been established.

In October 2003, an unannounced emergency exercise "NEK-2003" was carried out, with the Krško NPP and the SNSA participating.

The professional fire brigade of Ljubljana ARAO regularly organises trainings and practical exercises for the professional firemen at the Central interim storage facility. The specialised intervention vehicle of the fire brigade was equipped with portable electronic dosimeters, in addition, the firemen also received training on radiation protection.

## 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 and Hungary on the early exchange of information in the event of a radiological emergency.

In 2002 and 2003, the British Department of Trade and Industry carried out an assistance program for the SNSA. In the framework of this programme the SNSA received equipment and technical support in training for its emergency preparedness.

# 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. In order to assess the contribution to the decommissioning fund, a decommissioning plan for the Krško NPP was prepared.

## 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 Plan has to be made at least every five years.

### (i) Staff and Financial Resources

The Slovenian share of assets for decommissioning of the Krško NPP are collected and managed by the Fund for decommissioning of the Krško NPP. Due to the revision of the Decommissioning Plan, 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 operating facilities are applicable to the nuclear facilities in the overall decommissioning process.

### (iii) Emergency Preparedness

As there is no decommissioning being performed presently, there is no need for an Emergency Preparedness plan. It will be prepared during the process of licence approval 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 has been carried out. It has been estimated that not more than 10 tons of LILW would be produced in decommissioning. However, complete dismantling is not the most economical option after the closing of the reactor. Converting the reactor structures and the building for other research or commercial activities (e.g. gamma irradiation facility) or sealing it for an intermediate period prove to be more economical solutions than immediate dismantling after its closing. Currently, no plans have been adopted for decommissioning and dismantling of the Research reactor.

## Žirovski Vrh Uranium Mine

Properly qualified staff are available to perform all tasks of decommissioning of the Žirovski Vrh Uranium Mine. Adequate financial resources are available to support the safety of radioactive waste management during the decommissioning. For this purpose the Ministry of the Environment and Spatial Planning assures financial means from the national budget and also through a loan from the European Investment Bank.

The funds necessary for institutional controls 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 decommissioning of the Jazbec mine waste pile and the Boršt mill tailings site is ensured by the process of licence approval similar as for other nuclear facilities.

## Central Interim Storage for Radioactive Waste in Brinje

No plans have been adopted so far for the decommissioning of the Central Interim Storage for Radioactive Waste in Brinje.

# 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 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 management and spent fuel are adequately addressed in the 2002 Act through the approval of the Safety Analysis Report by the SNSA. The Minister of the Environment and Spatial Planning will issue the regulation where the detailed content of the Safety Analysis Report is determined.

The requirement that the 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 the radioactive substances occur in the smallest possible quantities.

The interdependencies among the different steps in spent fuel management and radioactive waste management shall be addressed through the National Programme of Radioactive Waste and Spent Fuel Management. The provisions of Article 98 of the 2002 Act prescribe the preparation of such a programme that shall be adopted by the Slovene Parliament as a part of the National Programme for the Protection of the Environment. 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 interdependencies among different steps in spent fuel and radioactive waste management are addressed also in the draft regulation on radioactive waste management that is pending for approval.

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 main pillar is the 2002 Act and its subsidiary regulations which are in preparation. The subsidiary regulations will be set through Government decrees and the regulations prescribed by the Minister of the Environment and Spatial Planning and the Minister of Health, respectively. In the preparation of the subsidiary regulations the internationally endorsed criteria and standards are being taken in due consideration.

Until the new subsidiary regulations enter into force, the 14 regulations of the old 1984 Act, prepared and adopted in the 80s, shall be in force. These regulations respected the international practice and standards at the time of their adoption, and therefore need to be replaced.

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 facility and disposal facility. The content of documentation that is subject to licensing shall be covered within 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 management 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 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 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 of this paragraph are the Central Interim Storage for Radioactive Waste in Brinje, and the Boršt mill tailings site and the Jazbec mine waste pile at the Žirovski Vrh Uranium Mine.

The Central Interim 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) got a license for the use of this facility on the basis of the Act on Construction. 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 meet 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. It is expected that the ARAO shall meet the licensing requirements in 2005.

The following works have been performed:

- refurbishment and renewal of the facility and its installations to meet the highest safety requirements, finished in 2004,
- re-packing and re-arrangement of the inventory with the aim of improving the utilisation of the storage and to provide sufficient storage capacity for future storing of waste, will be completed by the end of 2005,
- modernisation of the storage aimed at providing the missing processing waste capacities, will be implemented to a limited extent by the end of 2005.

The refurbishment of the Central Interim Storage for Radioactive Waste in Brinje and the licensing have been performed in compliance with the 2002 Act.

The remediation of the Žirovski Vrh Uranium Mine has been in progress since the termination of operation in 1990. 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 Act on Mining. This situation has been changed by the 2002 Act. According to Article 76 of the 2002 Act, the construction of mining or ore processing waste repositories is approved on the basis of SNSA consent. The key document is the Safety Analysis Report.

## Article 6: Siting of Preposed 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 in the Republic of Slovenia is the siting and construction of the facility for management and disposal of LILW. According to the 2002 Act and its amendment, the final site will be selected by 2008 and will obtain an operating license not later than 2013. The decision on siting and construction of the facility for management and disposal of spent fuel has been deferred according to the Programme of Krško NPP Decommissioning and Spent Fuel and Low and Intermediate Level Waste Disposal. At present, spent fuel management is part of operation of the Krško NPP and the TRIGA Mark II research reactor at the IJS Reactor Infrastructure Centre.

Evaluation of all relevant site-related factors likely to affect the safety of the repository of LILW during its operating lifetime and evaluation 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 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 effects of the operation of the facility on the population and the environment.

Article 67 (preliminary approval of radiation and nuclear safety) of the 2002 Act determines that for the siting of a nuclear or radiation facility, preliminary consent of the SNSA is a condition for the land use approval by the body that is responsible for the issuing of environmental protection approvals.

The Environment Protection Act (Official Gazette RS, No. 41/2004) forms the basis for the Environmental Impact Assessment. The Decree on Categories of Projects for which an Environmental Impact Assessment is Mandatory (Official Gazette RS, No. 66/96, 12/2000, 83/2002 and 41/2004) 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.

The particulars regarding environmental assessment and public participation/review of new sites in the licensing procedure for a nuclear installation can be found in the Environment Protection Act and in its subsidiary regulations, the Decree on Categories of Projects for which an Environmental Impact Assessment is Mandatory and the Instruction on the Methodology of Preparing Reports on Environmental Impact.

Information on the safety of such a facility is available to members of the public through the licensing process (issued environmental protection approval). The Environmental Protection Act, Article 6, stipulates that the participating parties (stakeholders) in the process of environmental protection shall be: the State, local communities, polluters, environmental protection organisations and non-governmental environmental protection associations, and citizens.

## Siting of 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 is intensely involved in the re-initiated site selection process for a LILW repository.

The following two main criteria were taken into consideration when deciding on the site selection approach:

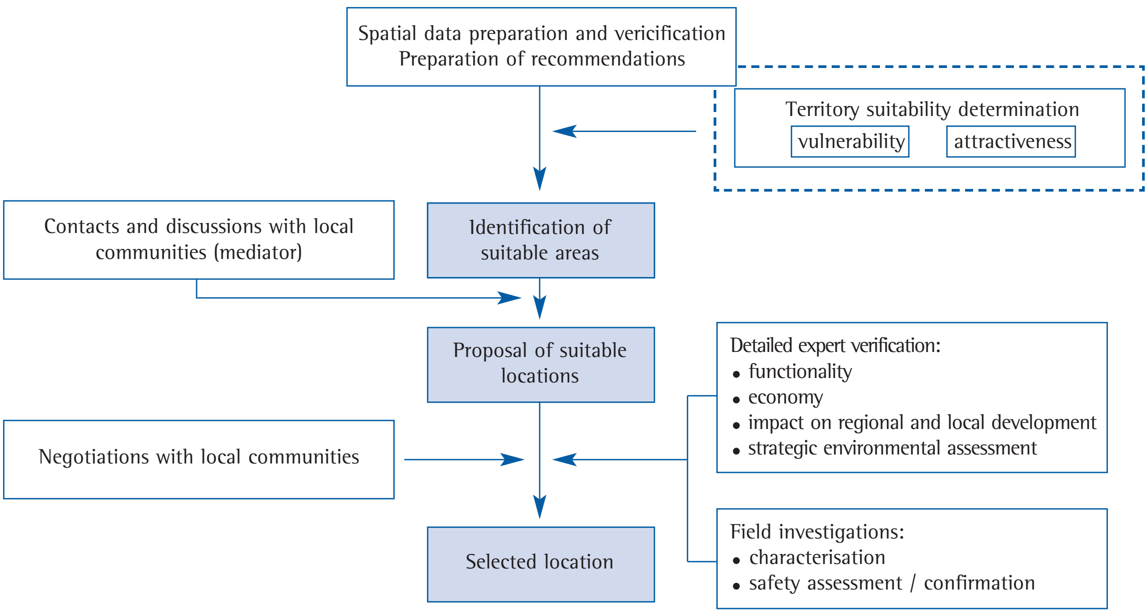
- the location together with the repository should provide a safe disposal solution which must be proven by the safety assessment,
- the site selection must be performed in agreement with the local community.

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

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

The mixed mode site selection process is presented schematically in Figure 3.

Figure 3: **Schematic presentation of the mixed mode site selection process**




Special attention was devoted to the involvement of the local community in the site selection process. For communication with the local community(ies) an independent mediator was recruited to conduct the negotiations between the community and the investor. The mediator represents the link between the two parties and facilitates the communication and negotiations between the investor and the local community.

In 2001, an important phase of the area survey stage was completed. In the geological suitability assessment, the required natural suitability (prerequisites) of Slovene territory was evaluated in order to locate geologically suitable formations. The assessment of natural conditions of the system was based on consideration of the main geological, hydro-geological and seismotectonic conditions. The results are compiled in a map which shows potential areas for underground and surface disposal of LILW in the Republic of Slovenia.

At the end of 2003, a 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) was adopted. It determines the financial compensation to the local communities during the investigation phase, and for the community which will be selected to host the LILW repository.

At the end of 2004, the official administrative procedure for the siting of the repository was set. The Ministry of the Environment and Spatial Planning, together with ARAO, carried out the First Spatial Planning Public Hearing. The Program for the preparation of the national location plan for the LILW repository was accepted, and ARAO invited local communities with a clear offer on how to participate in further determination of potentially suitable sites. By the end of the first bidding period several positive reactions to the invitation were received. It is planned that after the evaluation of the offers, local partnerships will be established with maximum 3 local municipalities.

The final confirmation of site suitability will be gained through detailed field investigations through the site characterisation and site confirmation stages. The progress will strongly depend on the response of local communities where potentially suitable areas are identified, and on the successfulness and efficiency of the mediator in conducting negotiations with local communities.

According to an amendment to the 2002 Act, the final site will be selected by 2008 and the repository would obtain an operating license not later than 2013.

## 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.*

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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 (consolidated text - Official Gazette RS, No. 102/2004); 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 a 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 contents of the project documentation and other conditions shall be prescribed by the Government. 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 by the SNSA.

Chapter III of Regulation E-1 "Conditions for the Construction of a Nuclear Facility" sets requirements for analyses and input data for the preparation of the design documentation, equipment and facilities necessary for the physical protection of the nuclear facility and materials, the design of the process, safety, protection, containment, and other systems and radiation protection criteria.

## 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.*

## Article 8: 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.

The Safety Analysis Report shall present the following information:

- basic safety and design approaches,
- location of the facility including its analysis,
- technical characteristics of the facility including a description of radioactive substances or nuclear materials and other sources of radiation,
- protection against ionising radiation including the evaluation of the protection of exposed workers against radiation,
- an assessment of the exposure of the population and the environment,

- organisation of work, including programmes of technical training and the organisation of radiation protection,
- radioactive waste and spent fuel management,
- physical protection of the facility,
- plan of protection and rescuing of the facility in accordance with the regulations on the protection against natural and other accidents, or a special plan of protection and rescuing of the facility in the case of a facility for which pursuant to the regulations on the protection against natural and other accidents, it is not necessary to draw up a plan of protection and rescuing of a facility,
- in the case of the construction of a facility, programmes of trial operation,
- in the case of a nuclear facility, a safety analysis,
- operational conditions and limitations for safe operation during the period of trial operation and during regular operation,
- quality assurance,
- anticipated discharge of radioactive substances into the environment,
- programme of meteorological measurements and operational monitoring of radioactivity,
- in the case of a repository, a long-term supervision plan.

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 is completed, every nuclear facility shall undergo a period of trial operation. Prior to the start of the trial operation of a nuclear facility it is mandatory to obtain the consent of the SNSA. An application for the 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 or authorised organisation for radiation and nuclear safety and other prescribed documentation.

Chapter IV of Regulation E-1 "Conditions for the Commissioning of a Nuclear Facility" sets detailed requirements for the trial operation of a 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 negative consent for the start of a trial operation.

## 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 dis-*

*posal 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 Act on the Construction of Facilities, 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 approved expert for radiation and nuclear safety and other prescribed documentation. 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.

## Operational Limits and Conditions

In accordance with Article 34 of Regulation E-1 and 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 application for an operating license.

Article 35 of Regulation E-1 and Appendix 1 of Regulation E-2 define the contents of the Technical Specifications. Operational limits and conditions for the operation of a nuclear facility include:

- safety limits,
- limiting settings for safety systems,
- limiting conditions for normal operations,
- surveillance requirements,
- requirements for the operator of a nuclear facility related to reporting.

It is also required that the operating staff should be familiar with the contents and objectives of the Technical Specifications.

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 the 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.

The regulation, issued by the Minister of the Environment and Spatial Planning, shall define the methodology to determine the class of changes to the Safety Analysis Report and the method of notification and application for acknowledgement and approval of changes.

## Operation, maintenance, monitoring, inspection and testing

In accordance with Article 34 of Regulation E-1, the documentation submitted for the application for an operating license shall also contain a list of prepared operating procedures and rules together with the plant start-up report, the QA programme report, the technical specifications, the Safety Analysis Report, etc. In the process of reviewing the Safety Analysis Report for licensing purposes, operating procedures are used as additional referenced documentation (Article 16 of Regulation E-2).

### 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 has to 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.

### Exceptional review of 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, ARAO and the Žirovski Vrh Uranium 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 and 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 Article 8 of Regulation Z-3, the license holder shall collect radioactive wastes, classify them by categories, groups and compressibility, keep records accounting 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 defects which could cause an emergency, emergencies and measures taken for the mitigation of the consequences of the defects or emergencies,
- errors 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.

The regulations on the method and frequencies for keeping records, for reporting to the regulatory body by the authorised technical support organisations and by the organisations operating nuclear facilities (Official Gazette RS, No.12/81), prescribe 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 experiences gained during operational events) the operator of a radiation or nuclear facility shall ensure that programmes of recording and analysing operational experiences at nuclear facilities are implemented.

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 previous 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 the decommissioning of a nuclear facility are similar to those for licensing of siting and construction and are defined in Article 71 of the 2002 Act, which prescribes that an investor intending to construct or decommission a radiation or nuclear facility shall attach to an application for the approval and to the project documentation a Safety Analysis Report and the opinion of an authorised expert for radiation and nuclear safety (the content of documentation and the content of the Safety Analysis Report are described hereinabove).

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 (consolidated text - Official Gazette RS, No. 47/2003), and the Cessation of Exploitation of the Uranium Mine Act (Official Gazette RS, No. 36/92, 28/2000). 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 on 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 closure permit a Safety Analysis Report, an opinion from an approved 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.

# 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

In the strategy of long-term spent fuel management, a deferred final decision has been adopted as a reasonable solution in the present situation. The final decision will be adopted before the end of the lifetime of the Krško NPP in 2023.

## Jožef Stefan Institute Reactor Infrastructure Centre

At present, no spent fuel from the TRIGA Mark II research reactor is planned for disposal. The IJS has the possibility for shipment and permanent disposal of 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 solved jointly with the spent fuel disposal of the Krško NPP.

# Section 1: 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.*

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Through the new regulations (the 2002 Act and the Regulation on Shipments from and into EU Member States and on Import and Export of Radioactive Waste (Official Gazette RS, No. 60/2004)), the Republic of Slovenia has substantially improved the area of transboundary movement of nuclear and radioactive substances, including waste. This issue is covered in the following articles of the 2002 Act, subparagraph 4.9 "Shipments from and into EC member states, the import, export and transit of nuclear and radioactive substances and radioactive waste":

- Article 101 - approval for the shipments from and into EU member states, the import, export or transit of nuclear waste and spent fuel,
- Article 102 - issuing an approval,
- Article 103 - financial warranties and other conditions.

To summarise the main requirements:

It is necessary to obtain SNSA approval for shipments from and into EU member states, the import, export or transit of radioactive waste and spent fuel. Issuing the approval, the SNSA evaluates the measures related to radiation and nuclear safety throughout duration of the transport of radioactive waste and spent fuel from the place of origin to the place of final destination.

Shipments from EU member states and export (A), shipments into member states of EU and import (B) or transit (C) approvals are issued by the SNSA if:

- (A) a consent to the consignment of the radioactive waste or spent fuel has been given by the competent body in the destination country as well as by the competent bodies in the countries the consignment is supposed to travel across, and if all the conditions pertaining to the exporter or person who has the responsibility for managing the shipment of radioactive waste within the member state with regard to receiving the radioactive waste or spent fuel in case of the consignment being refused, have been fulfilled.
- (B) the importer proves that the radioactive waste or spent fuel is guaranteed to be handled in line with the regulations, and if the importer has the approval from the country of origin for returning the consignment to the place of origin in case the consignment is refused, and when the SNSA has obtained all the consents from the competent bodies in the country of origin and the countries across which the consignment is supposed to travel.
- (C) all the consents from the competent bodies in the country of origin and in the destination country as well as the countries through which the consignment is supposed to travel have been given and if the sender of radioactive waste or spent fuel has an approval from the country of origin for the return of the consignment to the place of origin in case the consignment is refused by the consignee.

When the SNSA has issued an approval for shipments from and into EU member states, the export, import or transit of a consignment of radioactive waste or spent fuel, it shall give the competent bodies in the countries of origin or the destination country a notification of this, and obtain the consent of the competent bodies in the countries the consignment is supposed to travel through.

A person who has the responsibility for shipments from a member state or an exporter of radioactive waste or spent fuel shall report to the SNSA the delivery of a consignment at the latest within two weeks of the arrival of the consignment at the point of delivery.

An approval for the shipments from and into EU member states, the import, export or transit of radioactive waste or spent fuel is issued for one or more consignments for a maximum of three years.

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.

The issue of an approval for shipments from and into EU member states, the import, export or transit of radioactive waste or spent fuel and the issue of an approval for shipments from and into EU member states, the import or export of nuclear and radioactive substances, shall not affect any other responsibility regarding radiation or nuclear safety in line with this Act on the part of the holder, carrier, owner or consignee or any other person involved in the transport of a consignment.

The shipment of radioactive waste and spent fuel with the intention of disposing it at a location south of longitude 60° South is prohibited.

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

- the refusal of the consignment by the competent body in the destination country,
- the handling ordered by the SNSA if it has concluded that there is no assurance for the shipments from EU member states of radioactive waste and imported radioactive waste being handled in the manner pursuant to this Act.

The conditions for the transport of radioactive waste are set in the Act on Transport of Dangerous Goods (Official Gazette RS, No. 79/99, 96/2002 and 2/2004).

The shipments of radioactive waste from and into EC member states and to the third countries are also regulated by the Regulation on Shipments from and into EC Member States and on Import and Export of Radioactive Waste. These regulations are harmonised with the Commission Decision of 1 October 1993, establishing the standard document for the supervision and control of shipments of radioactive waste referred to in Council Directive 92/3/Euratom of 3 February 1992 on the supervision and control of shipments of radioactive waste between Member states and into and out of the Community.

# 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 state institutions (customs, police, etc.).

Licensing is required for all activities dealing with sealed sources: for purchase and use, for shipments from and into EC member states, for import or export, for transport or transit - the latter based mainly on the type of package and activity. The competent authorities (the SNSA and the Slovenian Radiation Protection Administration) 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 ministry competent for health. The contents of the registers are described in Article 131 of the 2002 Act.

When the sealed sources are no longer in use, they become radioactive waste. Since 1986, disused sealed sources from small producers are stored in the Central Interim Storage for Radioactive Waste in Brinje. In 1999 the national public service for managing the waste from small producers was established by a Governmental Decree (Official Gazette RS, No. 32/99). The ARAO, being assigned to perform this public service, became responsible for operating the storage and managing the waste from small producers.

Until 2000, the acceptance of waste for storing was free of charge. Since then, according to the "polluter pays" principle, each waste producer pays for the acceptance of waste by the Central Interim 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 the future disposal of the waste.

It is also the ARAO's responsibility to accept and provide proper further management of waste when its producer 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 occasionally produces sources for the domestic market (no such source produced since the last report under the Convention), therefore the return of exported sources is only a hypothetical issue.

Figure 4: **Disused sealed source Cs-137**

Early 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 hundred of such disused sealed sources were transferred, appropriately treated and safely stored at the Central Interim Storage for Radioactive Waste in Brinje.

# Section K: Planned Activities to Improve Safety

## Krško NPP

To avoid accumulation of a big quantity of compressible waste in the Solid Radwaste Storage Facility, a supercompactor will be installed permanently onsite. Accumulation of uncompressed waste is limited with the remaining free capacity of the Solid Radwaste Storage Facility.

## Jožef Stefan Institute Reactor Infrastructure Centre

At present, the Republic of Slovenia has no facility for classifying and processing radioactive waste and spent sealed radioactive sources from small producers. The hot cell at the IJS Reactor Infrastructure Centre could be used for the characterisation, treatment, and conditioning of radioactive waste. However, this complex needs complete refurbishing. The determination of a renovation plan for this hot cell, the purchase and installation of the relevant equipment (e.g. compactor, cutting devices, equipment for measurement of the contamination level in air and liquid effluents) constitute the main content of a PHARE project. The refurbishment will be implemented in the year 2005.

## The Central Interim Storage for Radioactive Waste in Brinje

### Characterisation of radioactive waste

In order to better assess compliance with the acceptance criteria, part of the inventory needs to be categorised, treated and repacked. There are approximately 70 $m^3$ of radioactive waste stored in the facility. A significant part of this waste is historical waste, with very poor information on their chemical and radiochemical characteristics. The project features three main components:

- logistic activities (transfer of waste packages from one zone to another),
- preparatory works for waste characterisation,
- radiation protection measures.

The project will be partially financed through the PHARE programme and will be implemented in the year 2005.

## Siting and Construction of the LILW Repository

One of the major tasks in the area of radioactive waste management in the Republic of Slovenia is the siting and construction of the LILW repository. The Slovene Parliament made a decision to have an operational LILW repository by the year 2013. The organisation authorised to perform this task is the ARAO. In the past years of research and development in this area, the ARAO collected comprehensive information on possible sites for the repository. The funds for the project are sufficient and will be available through the Fund for Decommissioning of the Krško NPP. The National Programme for Radioactive Waste and Spent Fuel Management and a Parliamentarian resolution on radioactive waste management are being prepared and will be submitted by the Government to Parliament by the end of 2005. Meanwhile the ARAO is negotiating the siting of the LILW repository with several local communities that are willing to offer their territory for the site characterisation programme.

## Žirovski Vrh Uranium Mine

The basic objectives of the programme of permanent closure of the Žirovski Vrh Uranium Mine and the prevention of consequences of uranium mining and milling are as follows:

- managing of the performance of permanent closure of the facilities: the mine and accompanying surface facilities, the Jazbec mine waste pile (Figure 5) and the Boršt mill tailings site (Figure 6), taking into consideration acts and regulations,
- 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,
- long-term assurance of supervision and protection of the environment and,
- assurance of social security to workers and maintenance of economic vitality of the location, in co-operation with the entities responsible for environmental development.

The design of final remediation of the Jazbec mine waste pile was concluded in the year 2004. The SNSA has issued a consent to the plans and the work will start in 2005. The design of final remediation of the Boršt mill tailings site and the Safety Analysis Report are in preparation. It is envisaged that all approvals will be obtained by the end of 2005 and the work will start in mid 2006.

Figure 5: **Jazbec mine waste pile**

Figure 6: **Boršt mill tailings site**

According to the new plans, the remediation of the Boršt mill tailings site shall be finished in the year 2009, and of the Jazbec mine waste pile in the year 2007.

The funds for the implementation of the project will be assured from various sources: from the budget of the Republic of Slovenia, a loan of the European Investment Bank and to a minor extent from other sources.

## Ljubljana University Medical Centre - Department for Nuclear Medicine

The University Medical Centre - Department for Nuclear Medicine has started with a project of construction of containers for collecting faecal water containing I-131 with the intention to arrange the discharges of I-131.

## Isotope Laboratory of the Institute of Oncology

The Institute of Oncology strives to transfer all non-short lived disused radioactive sources to the Central Interim Storage for Radioactive Waste in Brinje. All Cs-137 sources for brachyradiotherapy are planned to be transferred to Brinje immediately after the last clinical case. The storage for waste sources in the old building will be closed after replacing the Isotope Laboratory and the Department of Brachyradiotherapy into a new building (end of 2005 or first quarter of 2006). All sources (waste and in-use), will be moved to the new building or to the Central Interim Storage for Radioactive Waste in Brinje.

Short-lived sources (half life less than 8 days) are treated as follows: disposed water from the Iodine I-131 therapy rooms is collected in storage tanks and later released according to legislation. All other material (injections, gloves, etc.), which occurs during the process of isotope applications, is stored in special plastic bags and is collected and locked in a special place in the new building. The storage of radioactive waste in the new building will be considerably better than now.

# 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 Interim 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 8: The number, the average burn-up and 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 | 16335.0 |
| 2 | 40 | 24.3 | 15788.4 |
| 3 | 40 | 30.9 | 15613.2 |
| 4A | 25 | 30.7 | 9767.4 |
| 4B | 16 | 34.3 | 6258.0 |
| 5A | 40 | 32.6 | 15666.8 |
| 5B | 2 | 30.2 | 780.1 |
| 6A | 4 | 38.7 | 1563.6 |
| 6B | 1 | 36.7 | 390.6 |
| 6C | 36 | 39.5 | 14036.0 |
| 7A | 24 | 35.9 | 9463.0 |
| 7B | 2 | 36.4 | 785.5 |
| 7C | 20 | 33.7 | 7913.3 |
| 8A | 16 | 44.9 | 6246.4 |
| 8B | 8 | 44.8 | 3122.3 |
| KWU | 40 | 34.8 | 14980.1 |
| 9 | 12 | 41.7 | 4694.9 |
| 10A | 8 | 40.5 | 3119.2 |
| 10B | 12 | 43.3 | 4656.6 |
| 10C | 8 | 47.3 | 3090.3 |
| 11 | 40 | 40.1 | 15646.9 |
| 11B | 20 | 40.2 | 7832.8 |
| 12 | 24 | 44.4 | 9317.3 |
| 12B | 7 | 43.5 | 2724.9 |
| 13 | 40 | 43.0 | 15598.0 |
| 14 | 35 | 43.0 | 13628.6 |
| 14B | 4 | 44.5 | 1554.2 |
| 15 | 24 | 46.4 | 9290.9 |
| 15B | 12 | 37.1 | 4702.6 |
| 16 | 16 | 45.0 | 6224.6 |
| 16B | 8 | 46.6 | 3107.9 |
| 17 | 20 | 45.4 | 7776.1 |
| 17B | 3 | 40.2 | 1176.7 |
| 18 | 28 | 43.7 | 10741.6 |
| 19 | 28 | 43.5 | 10795.6 |
| 20 | 28 | 45.1 | 10845.0 |

### 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 9: Radioactive waste inventory in the Krško NPP Solid Radwaste Storage Facility on 31 December 2004

| Type of waste | No. of drums | Volume [m³] | Net weight [kg] | Total activity [Bq] | Specific activity [Bq/m³] | LLRW* | ILRW* |
|---|---|---|---|---|---|---|---|
| Ashes | 49 | 10.2 | 10061 | 1.32E+09 | 1.29E+08 | 20 | 29 |
| Blowdown Resins | 48 | 9.6 | 7338 | 2.44E+09 | 2.54E+08 | 8 | 40 |
| Compressible Waste | 571 | 118.8 | 63238 | 2.47E+10 | 2.08E+08 | 200 | 371 |
| Evaporator Bottom | 251 | 52.2 | 50684 | 3.44E+10 | 6.59E+08 | 8 | 243 |
| Filters | 114 | 23.5 | 43631 | 3.90E+11 | 1.66E+10 | 1 | 113 |
| Other | 701 | 145.8 | 75792 | 2.33E+10 | 1.60E+08 | 473 | 228 |
| Supercompacted Waste (SC) | 617 | 197.4 | 181763 | 2.72E+10 | 1.38E+08 | 313 | 304 |
| Spent Resins | 689 | 143.3 | 197886 | 3.27E+12 | 2.28E+10 | 7 | 682 |
| Supercompacted Waste (ST) | 1765 | 1525.0 | 1881537 | 1.01E+13 | 6.62E+09 | 261 | 1504 |
| TI | 73 | 63.4 | 37567 | 5.11E+12 | 8.06E+10 | 3 | 70 |
| **TOTAL** | **4878** | **2289.2** | **2549497** | **1.90E+13** | **8.29E+09** | **1294** | **3584** |

* ILRW and LLRW mean Intermediate and Low Level Radioactive Waste according to the classification described in Article 32, Paragraph 1(v).

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

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 drum.
- 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 SS No. 6 Regulation for the Safe Transport of Radioactive Material, 1985 Edition.
- 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 SS No. 6.
- 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.

Table 10: **Radioactive waste inventory in the Krško NPP Decontamination Building – Decontamination area, on 31 December 2004**

| **Type of radioactive waste** | **Number of pieces** | **Volume** [$m^3$] | **Mass** [kg] | **Contamination** [$Bq/dm^2$] | **Packaging** |
|---|---|---|---|---|---|
| Lead blankets | 2 | 2 | 3000 | 400 $Bq/dm^2$ | Metal box |

Table 11: Radioactive waste inventory in the Krško NPP Decontamination Building – Old steam generators area, on 31 December 2004

| Type of radioactive waste | Number of pieces | Volume [m³] | Mass [kg] | Activity/ Contamination/ Dose Rate | Packaging |
|---|---|---|---|---|---|
| Steam generators | 2 | 600 | 6.46E+05 | < 3.00E+12 Bq | N/A |
| Insulation of the steam generators | 4 | 156 | 2.00E+04 | 100-1000 Bq/dm² | Container |
| Insulation and platform | 1 | 36 | 4.00E+03 | 100 Bq/dm² | Container |
| Insulation valves, scrap iron, pipes etc. | 1 | 36 | 13.00E+03 | 10000 Bq/dm² | Container |
| Regenerative exchanger | 1 | 4 | 4.50E+03 | 3.5 mSv/h | Container |
| Spent fuel pool racks No. 10, 11, 12 | 3 | 84 | 48.00E+3 | 400-8000 Bq/dm² | PE foil |
| Radlok containers 1,2,3 | 3 | 9 | 900 | 200 Bq/dm² | N/A |
| Rx Seal Ring | 1 | 1 | 500 | 2 mSv/h | PE foil |
| Diving Equipment | 2 | 2 | 300 | 500 Bq/dm² | Box |
| Bulk items | 22 | 20 | 9.80E+03 | 300-4000 Bq/dm² | N/A |

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

## Central Interim Storage for Radioactive Waste in Brinje

Table 12: Quantity of stored radioactive sources at the end of the year 2004

| Waste type | Stored until the end of 2004 | Main radionuclides | Estimated activity at the end of 2004 [GBq] |
|---|---|---|---|
| Drums | 256 | Co-60, Cs-137, Ra-226, Eu-152 | 70-90 |
| Special bulky items | 149 | Co-60 | 2400 |
| Disused sealed sources | 326 | Co-60, Cs-137, Kr-85, Sr-90 | 1500 |
| Historical waste * | 30 | no data | no data |
| **Total** | **761** | **-** | **app. 3990** |

* Sources with poor or no data.

## Jazbec mine waste pile at the Žirovski Vrh Uranium Mine

Table 13: Mine waste and other debris at the Jazbec mine waste pile, situation at the end of the year 2004

| | |
|---|---|
| **Deposited** | mine waste and red mud 1982-1990 (mine ore production), contaminated material, technological equipment 1991-2005 (decontamination, demolition) |
| **Final arrangement** | 2007 (planned) |
| **Surface, total** | 51,000 $m^2$ (17,000 $m^2$ slopes, 32,000 $m^2$ plateau, 2,400 $m^2$ roads) |
| **Altitude** | bottom 460 m, top 505 m (above sea level) |
| **Volume of disposed waste** | 1,013,000 $m^3$ of mine waste,<br>125,000 t of uranium ore,<br>34,000 $m^3$ of red mud,<br>800 $m^3$ of technological equipment from uranium ore processing facilities and crash station,<br>**total volume of storage material is 1,172,500 $m^3$** |
| **Amount of disposed waste** | 1,626,000 t of mine waste contaminated soil and ruins from uranium ore processing facilities and crash station demolition, filter cake,<br>200,000 t of uranium ore,<br>48,000 t of red mud,<br>1,200 t of technological equipment from uranium ore processing facilities and crash station,<br>**total amount of storage material is 1,876,000 t** |
| **Average specific activity of disposed material** | 7.7 kBq/kg mine waste (53 g $U_3O_8$/t),<br>65 kBq/kg red mud (Th-230 97 %),<br>34.4 kBq/kg filter cake (236 g $U_3O_8$/t),<br>29.2 kBq/kg uranium ore (200 g $U_3O_8$/t),<br>< 2 kBq/kg contaminated soil and ruins |
| **Total activity of disposed material** | **21.5 TBq** |
| **Dose rate, average** | < 0.4 µGy/h (mine waste),<br>< 0.1 µGy/h (ruins, contaminated soil, protective soil layer) |

Note: most of the Th-230 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 14: Boršt mill tailings site with basic data, situation at the end of the year 2004

| | |
|---|---|
| **Deposited** | mill tailings and mine waste 1984-1990 |
| **Final arrangement** | 2009 (planned) |
| **Surface, total** | 41,000 $m^2$ (15,000 $m^2$ slopes, 26,000 $m^2$ plateau, 10,000 $m^2$ roads) |
| **Altitude** | bottom 535 m, top 570 m (above sea level) |
| **Volume of stored waste** | 339,000 $m^3$ of mill tailings,<br>70,000 $m^3$ of mine waste |
| **Amount of stored waste** | 610,000 t of mill tailings,<br>111,000 t of mine waste |
| **Average specific activity of stored material** | 78.2 kBq/kg mill tailings,<br>10.2 kBq/kg mine waste |
| **Total activity of stored material** | 48.8 TBq |
| **Dose rate, average** | 2.5 µGy/h (mill tailings, not covered with soil layer, < 2% of the mill tailings),<br>< 0.5 µGy/h (mill tailings, covered with 0.2-0.3 m of soil layer) |

## 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 Radiological 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:

- Regulation on the specialist council on radiation and nuclear safety (Official Gazette RS, 35/2003),
- Regulation 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, 62/2003),
- Regulation on the requirements of using ionising radiation sources in healthcare (Official Gazette RS, 111/2003),
- Regulation on the requirements and methodology of dose assessment for the radiation protection of the population and exposed workers (Official Gazette RS, 115/2003),
- 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, 134/2003),
- Regulation on health surveillance of exposed workers (Official Gazette RS, 2/2004),
- Regulation on the obligations of the person carrying out a radiation practice and person pos-

sessing an ionising radiation source (Official Gazette RS, 13/2004),
- Regulation on approving of experts performing professional tasks in the field of ionising radiation (Official Gazette RS, 18/2004),
- Regulation on the method of keeping records of personal doses due to exposure to ionising radiation (Official Gazette RS, 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, 36/2004),
- Decree on practices involving radiation (Official Gazette RS, 48/2004),
- Decree on dose limits, radioactive contamination and intervention levels (Official Gazette RS, 49/2004),
- Regulation on inputs from and outputs in the EU member states and on import and export of radioactive waste (Official Gazette RS, 60/2004),
- Regulation on the conditions to be met by primary health care centres for breast (Official Gazette RS, 110/2004),
- Regulation on the use of potassium iodine (Official Gazette RS, 142/2004),
- Regulation on physical protection of nuclear materials, nuclear facilities and radiation facilities (Official Gazette RS, 31/2005),
- Regulation on conditions for workers carrying out physical protection of nuclear materials, nuclear facilities or radiation facilities and on conditions for workers with access to nuclear materials and on other conditions relating to physical protection (Official Gazette RS, 36/2005).

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

- On siting, construction, commissioning, start-up and exploitation of nuclear facilities (with appendix on QA), (Official Gazette SFRY, No. 52/88), **Regulation E-1**,
- On preparation and content of safety analysis reports and other documentation relevant for the assessment of safety of nuclear facilities (Official Gazette SFRY, No. 68/88), **Regulation E-2**,
- On education, experience, examination and certification of personnel conducting specific work at nuclear installations (Official Gazette SFRY, No. 86/87), **Regulation E-3**,
- On material balance areas and the method of keeping records of nuclear raw materials and nuclear materials as well as on the submission of data contained in such records (Official Gazette SFRY, No. 9/88), **Regulation E-4**,
- On places, methods and frequencies of monitoring of contamination with radioactive materials (Official Gazette SFRY, No. 40/86), **Regulation Z-1**,
- On the method, extent, and frequencies of monitoring of radioactive contamination in the surroundings of nuclear facilities (Official Gazette SFRY, No. 51/86), **Regulation Z-2**,
- On the method of collecting, accounting, processing, storing, final disposal and release of radioactive waste into the environment (Official Gazette SFRY, 40/86), **Regulation Z-3**,
- On trading and utilisation of radioactive materials exceeding certain limits, X-ray machines and other apparatus producing ionising radiation as well as measures for the protection from radiation of such sources (Official Gazette SFRY, No. 40/86, 45/89), **Regulation Z-4**,
- On maximum established limits for radioactive contamination of the environment and on decontamination (Official Gazette SFRY, No. 8/87, 27/90), **Regulation Z-9** - cca. half of the provisions of the regulation have been derogated, the other half are still in force,
- On the method of keeping records on sources of ionising radiation and exposures of the pop-

ulation and workers (Official Gazette SFRY, No. 40/86), **Regulation Z-10**,
- On the trade of fodder (Official Gazette SFRY, No. 6/88).

Based on the 1980 Act the following regulations are still in force:

- On the method and frequencies for keeping records and for reporting to the regulatory body by the authorised Technical Support Organisations and by the organisations operating nuclear facilities (Official Gazette RS, No. 12/81).

### Third Party Nuclear Liability

- Third Party Liability for Nuclear Damage Act (Official Gazette SFRY, No. 22/78, 34/79),
- Insurance of Liability for Nuclear Damage Act (Official Gazette RS, No. 12/80 and 17/91),
- 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).

### Civil Protection and Disaster Relief

- Protection Against Natural and Other Disasters Act (Official Gazette RS, No. 64/94, 33/2000, 87/2001, 52/2002 and 41/2004),
- Decree on the contents and drawing up of protection and rescue plans (Official Gazette RS, No. 3/2002 and 17/2002).

### Administrative

- Public Administration Act (consolidated text - Official Gazette RS, No. 52/2002 and 97/2004),
- Inspection Act (Official Gazette RS, No. 56/2002),
- General Administrative Procedure Act (consolidated text - Official Gazette RS, 22/2005).

### Energy and Environmental

- Energy Act (consolidated text - Official Gazette RS, No. 26/2005),
- Act on the Postponement of Construction of Nuclear Power Plants until the Year 2000 (Official Gazette RS, No. 45/87) - the Act ceased to be valid at the end of 2000,
- 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 (Official Gazette RS, No. 41/2004),
- Decree on Categories of Projects for which an Environmental Impact Assessment is Mandatory (Official Gazette RS, 66/96, 12/2000, 83/2002 and 41/2004),
- Instruction on the Methodology of Preparing Reports on Environmental Impact (Official Gazette RS, No. 70/96 and 41/2004),
- Act on Permanent Closeout of Uranium Ore Exploitation and Prevention of Mining Consequences in the Žirovski Vrh Uranium Mine (Official Gazette, RS, No. 36/1992),
- Act on Changes and Amendments to the Act on Permanent Closeout (Official Gazette RS, No. 28/2000),
- Act Governing the Fund for Financing Decommissioning of the Krško Nuclear Power Plant and

Disposal of Radioactive Waste from the Krško NPP (consolidated text - Official Gazette RS, No. 47/2003),
- Cessation of Exploitation of the Uranium Mine Act (Official Gazette RS, No. 36/92, 28/2000),
- Decree on the transformation of the public company for the closure of uranium mine Rudnik Žirovski vrh, p.o., into Rudnik Žirovski vrh, d.o.o. (Official Gazette RS, No. 79/2001).

### Transport, Export and Import

- Act on Transport of Dangerous Goods (Official Gazette RS, No. 79/99, 96/2002 and 2/2004),
- Act Regulating the Exports of Dual-Use Goods (Official Gazette RS, No. 37/2004),
- Decree on the Control of Exports of Dual-Use Goods (Official Gazette RS, No. 46/2004),
- Regulation on Inputs from and Outputs in the EU Member States and on Import and Export of Radioactive Waste (Official Gazette RS, No. 60/2004).

### General

- Decree on Administrative Authorities within Ministries (Official Gazette RS, No. 58/2003, 45/2004, 86/2004 and 138/2004),
- Maritime Code of the Republic of Slovenia (Official Gazette RS, No. 26/2001, 21/2002, 110/2002 and 2/2004),
- Penal Code of the Republic of Slovenia (consolidated text - Official Gazette RS, No. 95/2004),
- Minor Offences Act (consolidated text - Official Gazette RS, No. 23/2005 and 34/2005),
- Spatial Planning Act (Official Gazette RS, No. 110/2002, 8/2003 and 58/2003),
- Construction Act (consolidated text - Official Gazette RS, No. 102/2004),
- 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.

## Bilateral Agreements

- Agreement with the IAEA for the Application of Safeguards in Connection with the Treaty on the Non-proliferation of Nuclear Weapons,
- Protocol Additional to the Agreement between the Republic of Slovenia and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-proliferation of Nuclear Weapons,
- Agreement between the US NRC and the SNSA on Exchange of Technical Information and Co-operation in the Nuclear Safety Matters,
- Agreement between the Governments of the Republic of Slovenia and the Republic of Hungary on Early Exchange of Information in the Event of a Radiological Emergency,
- Agreement between the Governments of the Republic of Slovenia and the Republic of Austria on Early Exchange of Information in the Event of a Radiological Emergency and on Questions of Mutual Interest in the Field of Nuclear Safety and Radiation Protection,
- Agreement between the Governments of the Republic of Slovenia and the Republic of Croatia on 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 Nuclear Safety Administration of the Republic of Slovenia and the Nuclear Installations Safety Directorate of the Republic of France for the Exchange of Technical Information and Co-operation in the Regulation of Nuclear Safety,
- Arrangement between the State Office for Nuclear Safety in the Czech Republic and the SNSA for the Exchange of Information,
- 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.

## 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.

## 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. The generator output was 664 $MW_e$ prior to replacing the steam generator in the year 2000. At the present, the generator output is 707 MW, however, net output is 676 $MW_e$. In 2004, the Krško NPP started operating in eighteen-month fuel cycles. The fuel is replaced, the equipment is overhauled and all the necessary maintenance work is done during the time of an outage.

Figure 7: **The Krško NPP**

The Krško NPP was designed and operates in accordance with US safety regulations and Technical Specifications. The Krško NPP systematically observes the regulations and industrial standards of the USA, which is the supplying country.

The regulations obeyed in design, construction and operation of the Krško NPP are divided into the following categories:

- The US 10 CFR 50 legislative regulations applied 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 these regulations are derived from the contract with Westinghouse, from the licenses issued and from the agreement between the IAEA and SFRY (on the Krško NPP project).

Table 15: **Some technical data on the Krško NPP**

| | | |
|---|---|---|
| Reactor Thermal Power | MW | 1994 |
| Gross Electrical Output | MW | 707 |
| Net Electrical Output | MW | 676 |
| Engineering Minimum | MW | 32 |
| Heat Consumption | kJ/kWh (kcal/kWh) | 10752 (2560) |
| Thermal Efficiency Factor | % | 33 |
| Annual Production at Rated Power and 7000 Operational Hours | TWh | 4.7 |
| **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 | 9021 |
| Pressure | MPa | 15.51 |
| Total Volume | $m^3$ | 182 |
| Temperature at Reactor (Vessel) Inlet | ° C | 288.1 |
| Temperature at reactor (Vessel) Outlet | ° C | 326.7 |
| 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 Lenght | cm | 1.346 |
| Enriched Pellet Lenght | cm | 0.983 |
| Annular Pellet Lenght | cm | 1.173 |
| Standardised Pellet Lenght | cm | 1.27 |
| Total Weight of Nuclear Fuel | t | 49.5 |
| **Control Rods** | | |
| Number of Control Rod Assemblies | | 33 |
| Number of Absorber Rods per Assembly | | 20 |
| Total Weight of Control Rod Assembly | kg | 52.15 |
| 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 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. 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.

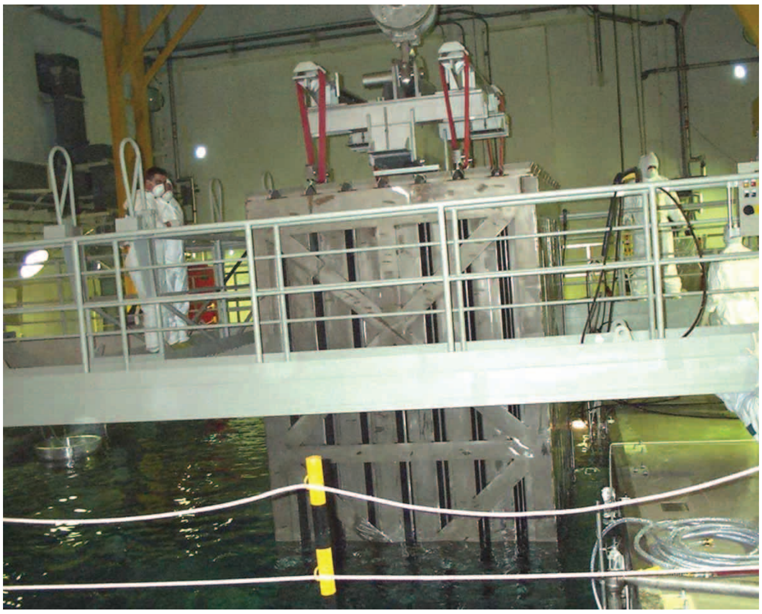
## Nuclear Fuel

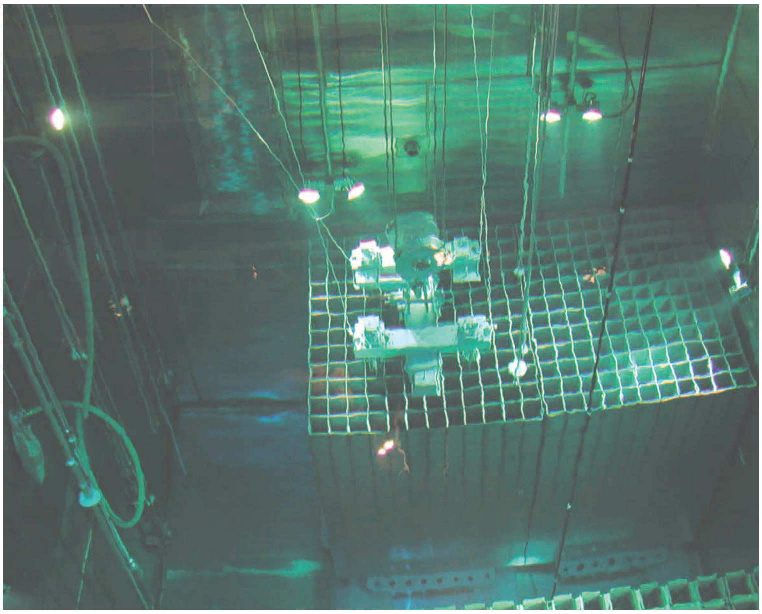
The reactor core is composed of 121 fuel assemblies. Each fuel element consists of fuel rods, top and bottom nozzles, grid assemblies, control rod guide thimbles and instrumentation guide thimbles. The fuel rods contain ceramic uranium dioxide pellets welded into zircaloy-4 or ZIRLO tubes. Uranium oxide fuel is shaped into sintered pellets and is enriched with the U-235.

Each 18 months approximately a half of the fuel assemblies is 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.

Figures 8 and 9: Reconstruction of Krško NPP spent fuel pool





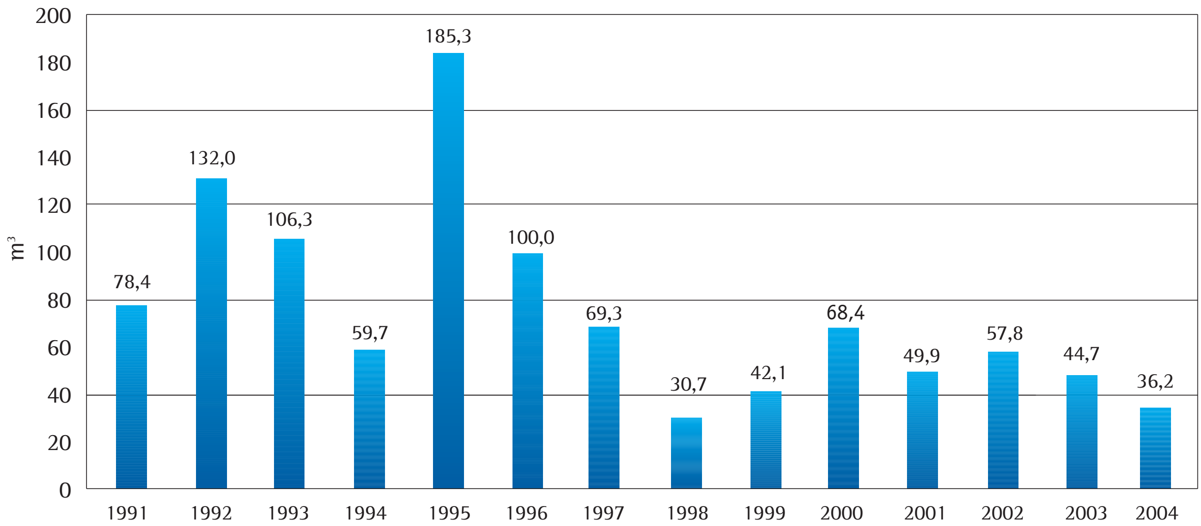
## Performance Indicators of the Krško NPP

The World Association of Nuclear Operators (WANO) set ten performance indicators in the year 1991, which are regularly monitored and analysed at the Krško NPP. The selected indicators cover the quality of operation from the aspect of safety and reliability, production of low and intermediate level waste, to monitoring the quality of secondary chemistry, occupational safety and other aspects of operation.

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.

The INPO goal for this indicator for the year 2005 is not defined, while the Krško NPP goal for the year 2002 is < 40 m$^3$. The total volume of low-level radioactive waste produced in 2002 was above the goal by approximately 28% because of the increased priority of solving problems of solid waste produced during the replacement of steam generators. Nevertheless, 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. Systems for radioactive waste treatment were improved by introducing the In-drum Drying System into operation and reconstruction of the Waste and Boron Evaporator Packages.

Figure 10: 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 11.

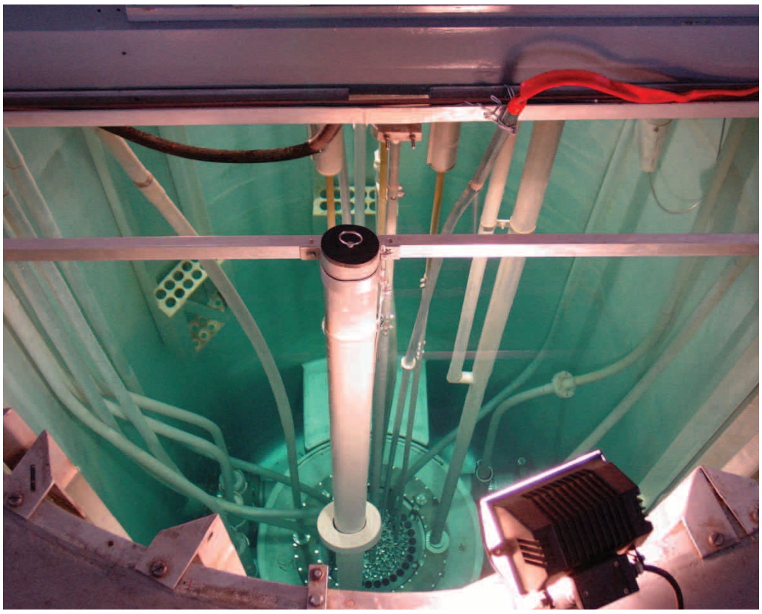
Figure 11: **View of the IJS Reactor Infrastructure Centre**

The reactor is a typical 250 kW TRIGA Mark II light-water reactor with an annular graphite reflector cooled by natural convection.

The core is placed at the bottom of the 6.25 m high open tank with 2 m 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. 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.

Figures 12 and 13: The reactor body and the reactor tank of the TRIGA Mark II research reactor



## 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 16 and Table 17.

Table 16: Data on standard TRIGA fuel element

| **Component** | **Dimension** [cm] | **Material** | **Density** [g/cm³] |
|---|---|---|---|
| **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 17: 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 |