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

Annual Report 2008 on the Radiation and Nuclear Safety in the Republic of Slovenia

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June 2009

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- Slovenian Radiation Protection Administration,
- Administration for Civil Protection and Disaster Relief of the RS,
- Ministry of the Interior,
- Ministry of Agriculture, Forestry and Food and
- Ministry of Economy.

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CONTENT

TABLES

FIGURES

1 INTRODUCTION

In the year 2008 there were no events that would present a radiological threat to the population. There were no particularities in relation to services of radiation practices and operators of radiation facilities. However, intense media broadcast on a small damage at the Krško Nuclear Power Plant extremely upset the general public of Slovenia and the whole Europe. The incident at the Krško NPP did not impose any threats to the environment.

The Krško Nuclear Power Plant (NPP) operated without outage and it produced 6.27 TWh of electrical energy in total, and the availability of the power plant was 98,68%.

The monitoring of radiological contamination of the environment in Slovenia did not show any deviation from normal values. There were only minor difficulties with the licensees carrying out practices involving radiation and users of radioactive sources. At the former Žirovski Vrh Uranium Mine remediation works of the tailings on the Jazbec disposal site were finished, due to which environmental radioactivity of radon essentially decreased.

The process of siting of the repository for low and intermediate level radioactive waste has not been completed yet. In the Krško municipality intense public debates were performed on technical suitability and public acceptance of the Vrbina site. The debates and possible final approval of the local community have been rescheduled for the year 2009. In parallel the process of siting was also going on in the adjacent municipality of Brežice, where these process are lagging behind for several months.

At the beginning of 2008 a Decree on checking the radioactivity for shipments of metal scrap was adopted. A positive outcome of the decree has been already noticed. During the year 86,000 shipments were monitored by the scrap metal importers and metal reprocessors. There were no adverse events presenting a threat to workers or the population.

In the first half of 2008, Slovenia's presidency of the Council of the European Union was successfully completed. In this context Slovenia also chaired the Atomic Questions Working Group (ATO) covering the field of radiation and nuclear safety. Since the end of 2007, Dr. Andrej Stritar, the director of the Slovenian Nuclear Safety Administration (SNSA) has been chairing the High Level Group on Nuclear Safety and Waste Management (HLG, later on named ENSREG) coordinating the efforts of regulatory bodies responsible for radiation and nuclear safety in the EU countries in order to improve common arrangements in the areas of radiation protection and nuclear safety. Preparations of a new nuclear safety directive have been under way since the end of 2008.

This report contains essential data on the status in the areas of radiation protection and nuclear safety in the country, and is aimed at a wider group of interested public. At the same time an extended version in the Slovenian language has been prepared which would be of interest to a narrower group of professionals. It is available in electronic form on the web page of the SNSA (www.ursjv.gov.si).

2 OPERATIONAL SAFETY

2.1 Operation of Nuclear Facilities

According to the Act on Ionizing Radiation Protection and Nuclear Safety, a nuclear facility is defined as a »facility for the processing or enrichment of nuclear materials or the production of nuclear fuel, a nuclear reactor in critical or sub-critical configuration, a research reactor, a nuclear power-plant and heating plant, a facility for storing, processing, treating or depositing nuclear fuel or highly radioactive waste, and a facility for storing, processing or depositing low or medium radioactive waste«. Three nuclear facilities operated in 2008 in Slovenia: the Nuclear Power Plant Krško, the Research Reactor TRIGA of the Jožef Stefan Institute and the Central Interim Storage for Radioactive Waste at Brinje.

2.1.1 Nuclear Power Plant Krško

2.1.1.1 Operation and Performance Indicators

In 2008, the Krško Nuclear Power Plant produced 6,272,813.7 MWh (6.3 TWh) gross electrical energy on the output of the generator, which corresponds to 5,972,030.5 MWh net electrical energy delivered to the grid. The annual production was 1.39% more than planned (5,890,000 MWh). The reactor was critical for 8,678.90 hours or 98.80% of the total number of hours in this year. The thermal energy production of the reactor was 17,239,672.30 MWh.

The Krško NPP staff is responsible for safe operation of the plant, while the Slovenian Nuclear Safety Administration (SNSA) carries out regulatory and inspection supervision. In 2008, the SNSA's inspectors performed 47 regular, two unannounced and one special inspection surveys.

The unannounced inspection surveys were routine and included works connected with the main control room and walk-downs of the technological part of the NPP. The special inspection survey was carried out on 5 June 2008 following the unusual event on 4 June, when the plant was manually shut down due to the leakage of the isolation valve of the reactor coolant temperature measuring system.

The Krško NPP is also supervised by the Slovenian Radiation Protection Administration (SRPA) in the field of radiation protection of exposed workers. The SRPA performed 3 inspection surveys in 2008 related to radiation protection education, individual exposures of exposed workers and radiation protection provisions.

In 2008 an event demanding an urgent inspection action occurred. Based on the inspection survey dated 2 October 2008 the use of modification 459-BD-L (Isolation of Blow Down in the case of Blow Down High Energy Line Break) was forbidden until the completion of the licensing process and issuance of the SNSA's positive decision. The inspection's decision was taken into consideration by the Krško NPP, thus the modification was used as an operable function only after the SNSA approved it.

The most important performance indicators are shown in the Tables below, while their changes through the years are shown in the following parts of this report. The performance indicators confirm the stable and safe operation of the power plant.

Table 1: The most important performance indicators in 2008

Safety and performance indicators	Year 2008	Average (1983–2008)
Availability [%]	98.68	85.64
Capacity factor [%]	102.08	83.01
Forced outage factor [%]	1.32	1.14
Gross realized production [GWh]	6,272.81	4,936.42
Fast shutdowns – automatic [Number of shutdowns]	0	2.77
Fast shutdowns – manual [Number of shutdowns]	0	0.15
Unplanned normal shutdowns [Number of shutdowns]	1	0.92
Planned normal shutdowns [Number of shutdowns]	0	0.81
Event reports [Number of reports]	7	4.35
Refueling outage duration [Days]	0	46.4
Fuel reliability indicator (FRI) [GBq/m^3]	$3.7{\cdot}10^{-4}$	$7.84{\cdot}10^{-2}$

Table 2: Time analysis of the Krško NPP operation in 2008

	Hours	Percentage
Number of hours in a year	8784	100
Duration of plant operation (on grid)	8667.87	98.68
Duration of shutdowns	116.13	1.32
Duration of the refueling outage	0	0
Duration of planned shutdowns	0	0
Duration of unplanned shutdowns	116.13	1.32

The shutdown and low power operation are shown in Figure 1. It can be seen that there was no refueling outage in 2008. The plant was shut down only once on 4 June 2008, due to the increased leakage of the reactor coolant system.

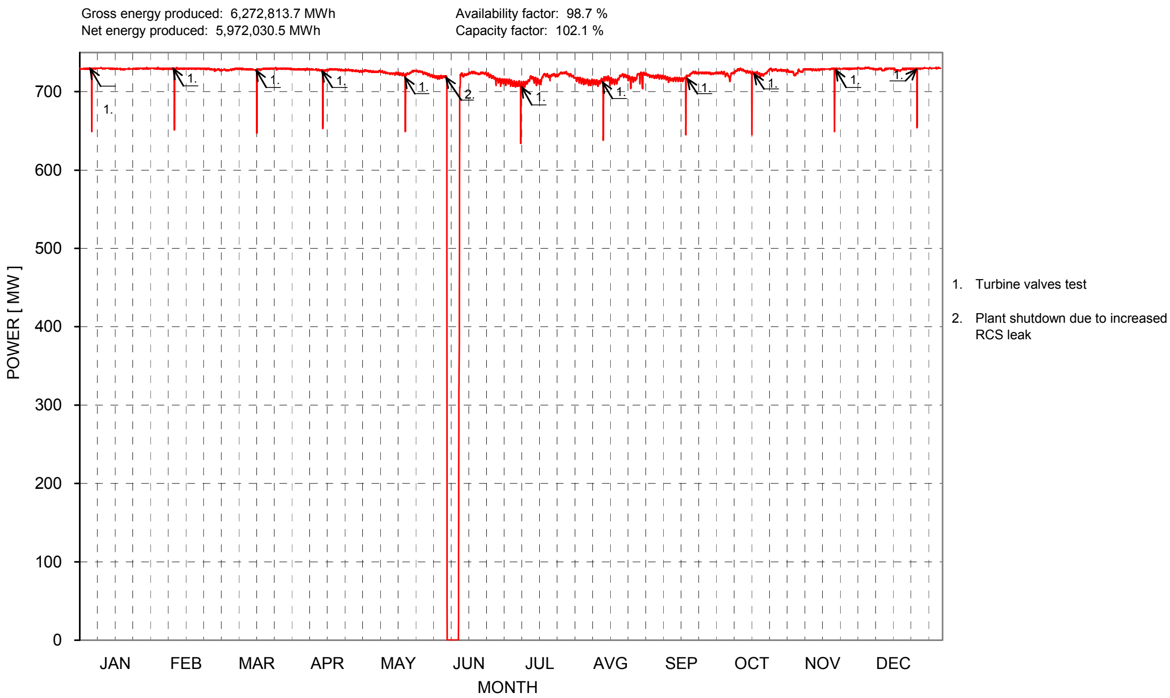


Figure 1: Operating power diagram for the Krško NPP in 2008

In Figure 2, the comparison between the productions of electrical energy in Slovenia produced in nuclear, hydro and thermal power plants is shown. In recent years the production of electrical energy in Slovenia has stabilized at around 13 TWh. In 2008 the production of electrical energy exceeded 14 TWh, mostly due to favorable meteorological conditions and increased production of hydro plants, but also due to the absence of the annual outage in the Krško NPP.

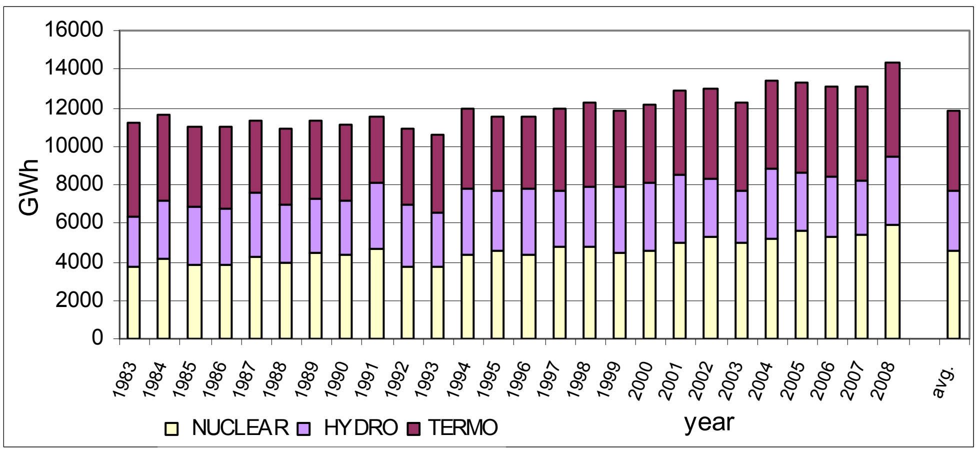


Figure 2: Production of electrical energy in Slovenia

In Figures 3 and 4, the number of reactor shutdowns is shown.

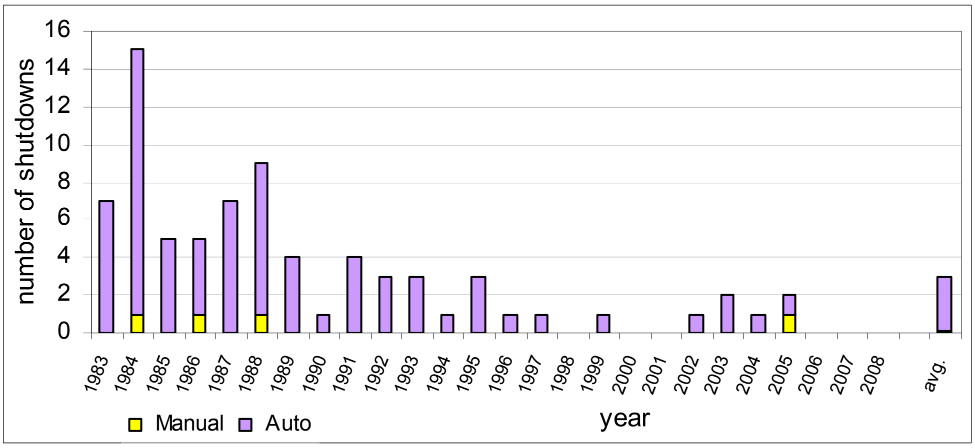


Figure 3: Fast reactor shutdowns – manual and automatic

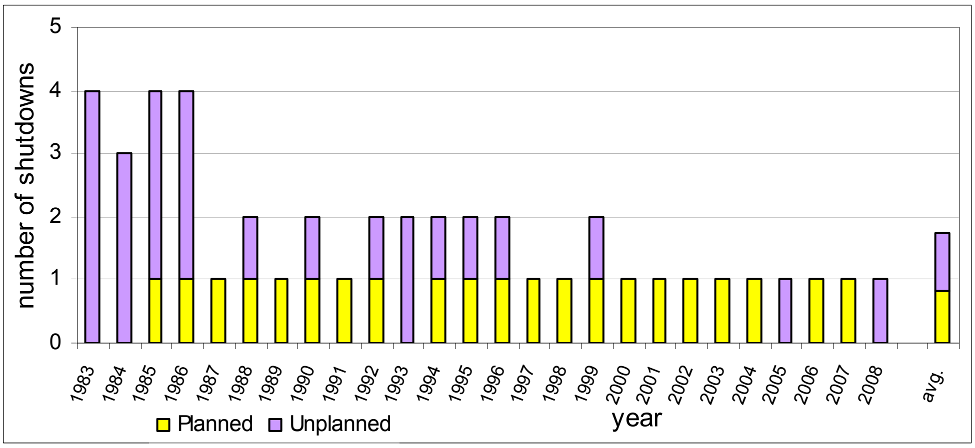


Figure 4: Normal reactor shutdowns – planned and unplanned

There are two types of reactor shutdowns: fast and normal. Fast reactor shutdowns are caused by the reactor protection system actuation, which can be activated manually or automatically. With normal reactor shutdowns the reactor power reduces gradually. Normal shutdowns are divided into planned and unplanned. Outage is a special type of a normal, planned reactor shutdown.

In Figure 3 we can notice gradual stabilization of fast reactor shutdowns (in the last decade the average is less than one per year). In the year 2008 there were no fast reactor shutdowns.

In Figure 5 the forced outage factor is shown. This factor is a ratio between the hours of duration of unplanned shutdowns and the number of hours in a year. In 2008 there was one forced shutdown with duration of 116.31 hours, thus the value of this factor is 1.32%.

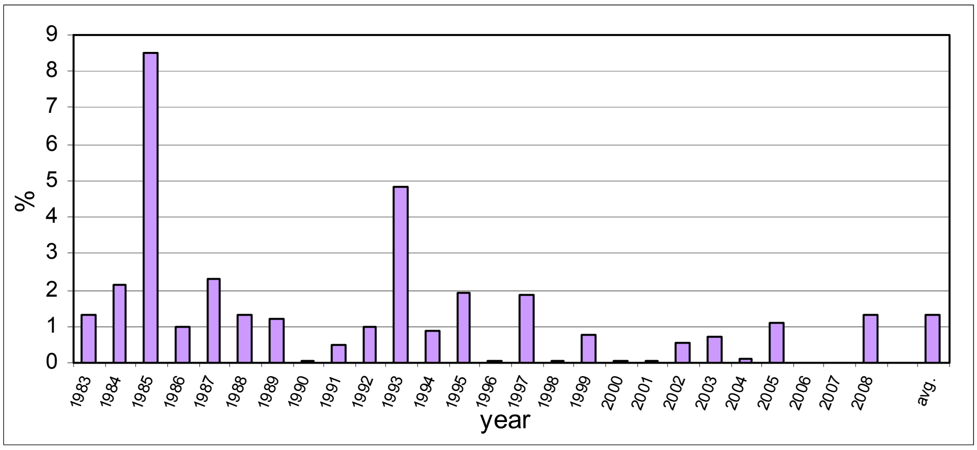


Figure 5: Forced outage factor

The collective exposure to radiation is shown in Figure 6. For 2008 it was 146 man mSv, which is less than the target value of the Krško NPP (150 man mSv for the year 2008). This low value of collective exposure to radiation is mostly a consequence of the absence of the annual outage activities, which contribute most to the value of this indicator.

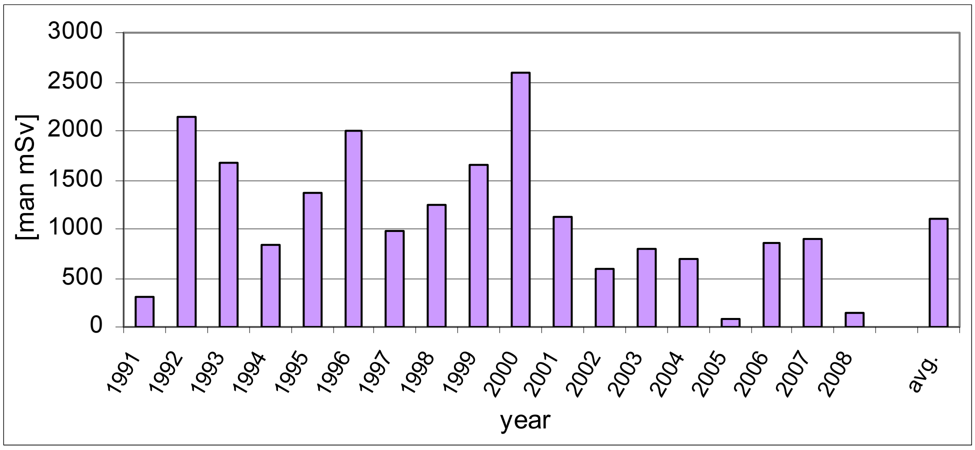


Figure 6: Collective exposure to radiation in the Krško NPP

Figure 7 shows the number of unplanned actuations of the high pressure safety injection system. In the year 2008 there were no unplanned actuations of this system.

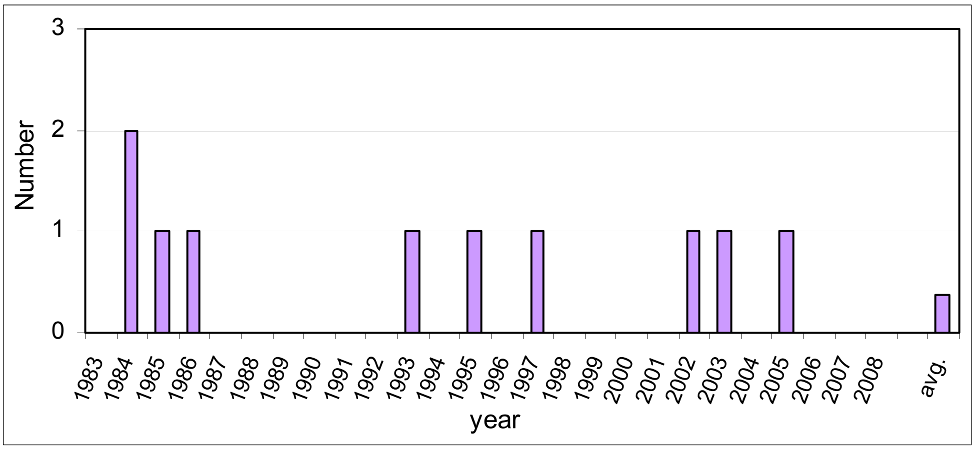


Figure 7: Number of unplanned safety injection system actuations

2.1.1.2 Regulatory Approach through Safety and Performance Indicators

At the end of 2007, the SNSA followed the conditions through its own set of 46 safety and performance indicators which show the state of nuclear safety and operation of the NPP Krško. Some of the indicators are identical to the Krško NPP indicators, while the other indicators were selected deliberately for the regulatory use. The input data for the indicators are submitted from the Krško NPP once per month. The SNSA set of indicators was set up to look for potential weaknesses that might lead to the degradation of nuclear safety. A presentation of the current indicators status is available on the SNSA intranet using arrows and colors that enable quick identification of potential problems.

In the year 2008 the SNSA safety and performance indicators approach became a good practice as a communication tool between the SNSA and the Krško NPP. The SNSA sends monthly reports to the Krško NPP, which gives them a possibility to take the necessary corrective measures.

2.1.1.3 Abnormal Events in the Krško NPP

Event reporting is defined by the regulation, which also defines the types of abnormal events. In 2008 the Krško NPP reported 6 abnormal events, none of which caused an unplanned shutdown or degradation of nuclear or radiological safety. Besides the mentioned events, the Krško NPP was forced to perform a normal shutdown due to an excessive primary system leakage. Although the event means a threat to nuclear and radiological safety, there were no negative consequences or any radiological releases to the environment. The course of the event was under control all the time therefore an automatic safety system actuation was not required.

All events and the proposed actions to correct the consequences of these events were followed by the SNSA. Five of the events were analyzed by the SNSA with engineering judgments, while the analysis of two other events will be finished in 2009.

Non-operable electric driven fire protection pump

After the successfully performed monthly test on 2 February 2008, the ability of the electric driven fire protection pump to operate could not be assured. The pump stand-by position was disabled due to dirtiness on the valve steam that prevented the check valve to close completely. For this reason the pressure on the pressure side of the pump could not be maintained. The pump was declared operable after cleaning the valve approximately 3 hours later.

Unsuccessful start of diesel generator

During the monthly test, on 28 February 2008, the diesel generator reached its nominal data in 10.63 seconds, which was more than maximum allowed time (which is 10 seconds), due to a disabled breaker of the electrically driven generator. The reason was the consequence of incompatible contacts on relays, caused by maintenance activities on the nearby equipment during the last outage. The relays were reaffixed and after the successfully performed post-maintenance test 7 hours after the first test, the diesel generator was declared operable.

Unwanted activation of the fire protection system

Two events with the fire protection system actuation on the main transformer were registered on 6 March, and on 4 and 5 October 2008, despite the absence of fire. Both activations were caused by strong wind that directed hot exhaust air form transformer coolers to the fire enunciators.

After the first event the Krško NPP scheduled as a long term corrective action relocation of the fire enunciators in the nearest vicinity of the transformer. After the second event, this action was implemented.

Loss of the diesel generator room air cooling unit

On 27 March 2008, during the monthly test of a diesel generator, the diesel generator room air cooling unit tripped at the start due to a low setting point of breaker magnetic protection. The breaker was replaced with a new one during the last outage. The new breaker operates more precisely, therefore the old setting responded undesirably to the electric current impulse at the start of the air cooling fan operation. The testing of the diesel generator went on for 34 minutes; meanwhile the room temperature at 3 meters above the room floor rose to 41 degrees Celsius. The administrative room temperature limit of 40 degrees Celsius was exceeded but that did not cause any operational malfunction of the diesel generator. A new setting point was set on the breaker and the non-operability of the diesel generator due to the non-operability of the supported system was brought to end after 4 hours and 30 minutes.

Non-operable diesel driven fire protection pump

During the monthly test on 10 April 2008, the diesel motor of the fire protection pump did not start on a low pressure signal in the fire suppression system while the rotation overspeed alarm appeared. The first survey did not reveal any fault, so the test was repeated, this time successfully. After 20 minutes of operation the alarm for overspeed appeared again despite the fact that the motor operated at the nominal speed. The alarm switch was found to be faulty and it was replaced. The diesel driven pump was declared non-operable for almost 5 hours.

Plant shutdown due to increased primary system leakage

On 4 June 2008 at 15:07 hours the operators in the control room detected increased primary system leakage. The approximate calculated leakage value of 3 m^3/h was above the allowable leakage of 0.227 m^3/h as limited by the plant technical specification. The leakage was confirmed by level increase in the reactor coolant drain tank and increased radiation monitoring values in containment. The operators began to reduce power at 16:50. The plant was shut down at 19:50 hours. In the meantime the plant did not enter into a condition that would require automatic safety system actuation.

The next day the staff entered the containment and found the leakage spot on the seal seat of the valve that isolates temperature manifold 2 inch line on the primary loop. The valve was replaced with a new one. The compartments and the equipment that was exposed to the leaking primary coolant were cleaned and checked within the scope of the plant corrosion program.

On 9 June 2008 at 5:20 the reactor was critical again. During the whole event about 70 m^3 of primary coolant was released into the containment. There was no radiological release to the environment. The received doses of the staff that performed corrective actions were within the legislative limits. On the INES scale the event was estimated with the lowest grade 0 – no safety significance.

The event caused a considerable public media response, see Chapter 6.1.

2.1.1.4 Nuclear Fuel Integrity and Reactor Coolant Activities

The year 2008 comprises a part of cycle 23, which started on 6 November 2007 and should last 18 months, until the refueling outage in the year 2009.

The condition of fuel assemblies in the reactor (fuel cladding integrity) is monitored indirectly through the measured specific activities of the reactor coolant. Convenient for this purpose are volatile isotopes of iodine and cesium, as well as noble gases. Fuel cladding leakage is indicated by isotopes of xenon, krypton and iodine. The size of fuel damage and contamination of the coolant can be determined from iodine isotopes activities. Burnup of leaking fuel can be assessed from activities of cesium isotopes. The frequency of specific activities measurements for different isotopes depends on plant operational conditions and on fuel conditions. Four action levels are defined according to the fuel conditions and these determined more precisely the required measurement frequency together with corrective and preventive measures to preserve the fuel integrity.

Until September 2008 there was no fuel rod leakage in the core of cycle 23. Isotope activities in general followed the changes in reactor power. From 12 September onwards the specific activities began to rise due to a loss of fuel rod integrity. Based on specific activities of isotope ^{133}Xe it was estimated that there was at least one fuel rod leaking in the reactor core at the end of the year 2008. Relatively low values of iodine isotopes specific activities indicated that this fuel rod failure is of tight nature. Coolant specific activities reached less than 1 percent of the authorized limit.

Fuel integrity is monitored by the Fuel Reliability Indicator (FRI), which represents specific activity of ^{134}I corrected for the contribution of ^{134}I by tramp uranium from the reactor coolant system, and is normalized to a constant value of the reactor coolant purification rate. The FRI that is below the value of $5 \cdot 10^{-4}$ μCi/g ($2 \cdot 10^{-2}$ GBq/m^3) represents fuel with no failure according to an internationally adopted criterion. The FRI values rose in the last three months of 2008 but, remained small enough, reflecting the low specific activities of iodine isotopes. At the end of the year 2008 the FRI reached 9.8 percent of the criterion for undamaged fuel. The FRI values are shown in Figure 8 for individual fuel cycles.

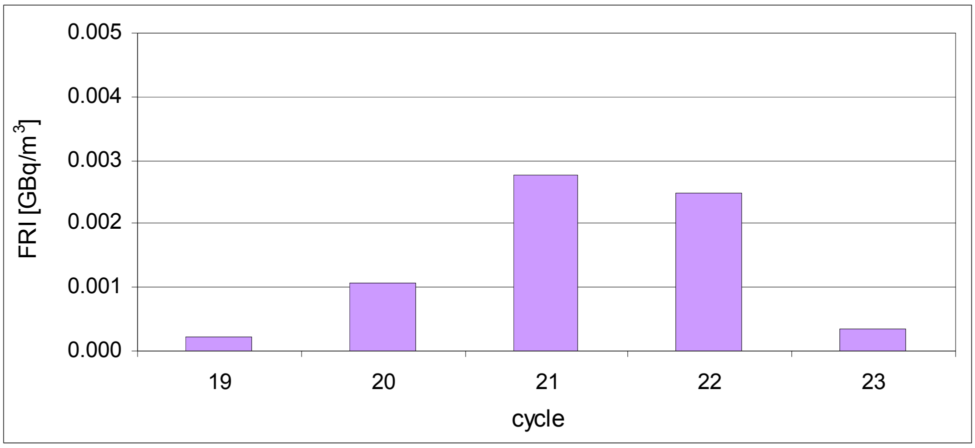


Figure 8: Fuel Reliability Indicator (FRI) (when less than 0.02 GBq/m^3, the fuel is without failures)

The Krško NPP and Westinghouse performed a project of fuel assemblies reconstitution in a spent fuel pool. Individual extracted fuel rods were inspected to determine the cause for their damage or leakage. Ultrasonic inspection of fuel assemblies was performed as well as inspection of fuel rods by Eddy Current Testing and visual examination. Fuel grid conditions were examined using a fiberscope inspection technique. Leaking fuel rods were found in six fuel assemblies. One fuel assembly leakage was caused by debris from the reactor coolant that damaged two fuel rods of which only one was leaking. The cause for the damage of the other fuel rods was total wear through the cladding at the contact point with the fuel assembly grid. Partial wear of fuel rod cladding in contact with the grid was observed also on some other inspected fuel rods that were not leaking. The damaged fuel rods extracted from fuel assemblies were replaced by stainless steel dummy rods. The extracted damaged fuel rods are stored in a special fuel rods storage basket in the spent fuel pool. All other undamaged fuel rods extracted for inspections were reinserted into their original fuel assemblies.

2.1.2 Modifications in the NPP Krško

According to the Act on Ionizing Radiation Protection and Nuclear Safety (paragraph 83) the SNSA approved 14 modifications and agreed to 16 modifications. During the preliminary safety evaluation, the NPP Krško found out that there was no open safety issue for 12 modifications. Therefore, the NPP only informed the SNSA about the changes. There were 42 modifications altogether. 14 modifications were connected with the documentation, while physical changes of the systems had to be made for the other 28 modifications.

In the year 2008, the Krško NPP issued the 15th revision of the Updated Safety Analysis Report, considering all modifications confirmed until 1 November 2008.

2.1.3 Environmental Influence at the Krško NPP

There are some objects in the vicinity of the Krško NPP which are in the process of inclusion in the national spatial plan. These new objects could affect the nuclear safety of the Krško NPP.

The Ministry of Defense is planning an **expansion of the Cerklje airport** and increase of its air traffic. The guidelines for the preparation of the national spatial plan for the Cerklje airport prepared by the SNSA require that the changed activities on the airport shall not influence the safety of the Krško NPP. Submitters of the national spatial plan have prepared an analysis that shows a less than minimal influence of the increased air traffic at the airport on the Krško NPP safety.

In July 2007 the Slovenian Government adopted a decision to start the preparation process for the **national spatial plan for the Brežice hydro power plant**. Guidelines were collected in May 2008. The SNSA as one of the institutions performing spatial planning prepared its guidelines for the spatial development in cooperation with the Krško NPP. The guidelines focus on the requirements for assurance of flood protection for the Krško NPP, the preservation of the ultimate heat sink for cooling of the Krško NPP safety systems, the assurance of the Krško NPP external power supply, the restriction of interventions in the area of limited use of space around the Krško NPP, the assurance of cooling of the Krško NPP condensers with the Sava river, and the prevention of the Sava river quality deterioration due to operation of the HPP chain.

In the frame of preparation of the national spatial plan for the HPP Krško and the national spatial plan for the HPP Brežice, the Ministry of the Economy ordered preparation of studies to determine the mutual impacts of the HPP chain and the Krško NPP, as well as some other studies connected with the Sava river and the groundwater on the Krško-Brežiško polje. The results of the **Probable Maximum Flood** study show that the nuclear safety of the Krško NPP could be threatened since the design bases for the external flood protection of the Krško NPP site have been exceeded. The design for the Krško NPP flood protection is established by means of flood protection dikes along the Sava river that are designed to protect the site against a ten-thousand-year flow of 4272 m^3/s. The flow that would exceed the ten-thousand-year flow would overflow into the area on the right bank of the Sava river up to the flow of probable maximum flood, which amounts to 10.139 m^3/s.

The **High-flow waves** study assessed the transfer of waves through the HPP chain. The results reflect the velocity of wave traveling through the HPP chain and the highest flow. The study warned of the fact that the HPP Brežice pool bank spillovers are not sufficient for draining the high-flow waves of 3860 m^3/s onto the flooding area.

The results of the **Dam failure waves** study show that these waves can reach a higher flow in the case of dam gates opening due to human error than in the case of dam gates damage due to natural causes (earthquake).

The study **Hybrid hydraulic model** downstream of Krško HPP is in preparation and its results should determine the water levels that correspond to the values of the Sava river flow on the Krško-Brežiško polje.

In response to all mentioned changes and findings, the Krško NPP has committed itself to prepare an action plan for efficient flood protection in these new conditions by the end of the year 2009.

In the frame of the **national spatial plan for the economic centre Feniks**, the SNSA warned that the railway line to Feniks could interfere with the area of limited use of space around the Krško NPP and the planned repository for the radioactive waste, as well as the possible site for a new NPP nearby. The flooding threat to the Krško NPP could also be affected by a planned route of a new road, which is to be built on top of flood protection dikes of the Krško NPP along the river Sava. This new road is being prepared in the **national spatial plan for the connecting road from Krško to Brežice.**

2.2 TRIGA Research Reactor

The TRIGA Mark II research reactor of the Jožef Stefan Institute operated for 128 days and released 179.894 MWh of heat in 2008. A total of 1295 samples were irradiated in the carrousel (1071) and the pneumatic post (224). There were no irradiations in the fast pneumatic post since there was no demand for that from its users. The reactor was mostly used as a neutron source for the neutron activation analysis, performed by the Environmental sciences department and the Experimental particle physics department of the Jožef Stefan Institute. The reactor was also used for training of 13 members of the Krško NPP staff, as part of the NPP technology course.

The Jožef Stefan Institute prepared a program for reactor decommissioning according to the SNSA inspection note from December 2007. The Jožef Stefan Institute did not submit an application for the program of periodic safety review as it was required in the inspection note mentioned above.

The reactor operated only in stationary mode. There were no changes to the reactor core. There were no emergency events. There were two forced (automatic) shutdowns in 2008, caused by loss of external power supply.

There were no changes to the number of fuel elements on site in 2008. On 31 December 2008 a total of 84 fuel elements were located in the reactor (59) and in the fresh fuel storage (25). There were no spent fuel elements. All fuel elements were of the standard type with 12 percent of uranium content and 20 percent enrichment. The radiation monitoring system in the reactor building and the reactor coolant activity measurements showed that there were no leaking fuel elements.

There were no design modifications of the TRIGA reactor in 2008 and there were no non-routine and first time tests. The staff performed periodic surveillance and control of the systems, structures and components that were important for safe operation of the reactor.

The TRIGA reactor staff did not change in 2008 and consisted of the head of the reactor centre (1/3 of full employment), four operators (rank shift supervisors) and a secretary (1/2 of full employment).

A new organizational unit OVC (hot cell facility) was established as part of the reactor centre. The OVC unit consists of the head of the facility with responsibility over the hot cells, two operators and a radiation protection technician. The OVC unit head is a subordinate of the reactor centre head.

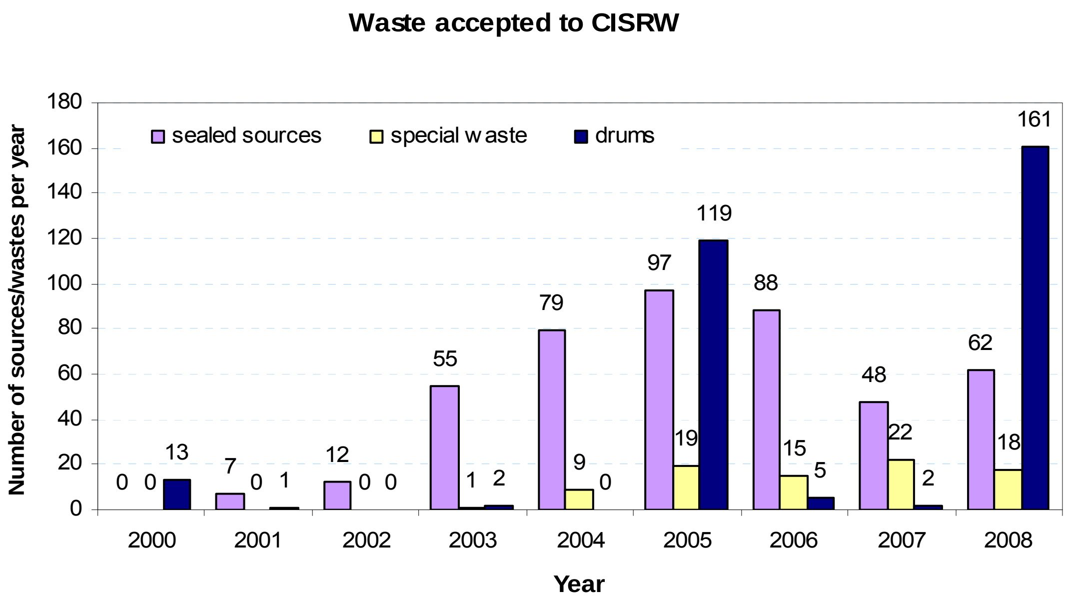
In 2008, by the reactor operation, the works in hot cells and in the radiation controlled area of the Environmental sciences department approximately 200 liters of spent radioactive materials were produced, and were stored in a hot cell at the end of 2008. The radiation protection unit of the Jožef Stefan Institute will perform the radioactive materials characterization and will then submit them to the Central Storage of Radioactive Waste at Brinje.

2.3 The Central Interim Storage for Radioactive Waste at Brinje

The Central Interim Storage for Radioactive Waste at Brinje (CISRW) is operated by the Agency for Radioactive Waste Management (ARAO). After a complete reconstruction of the storage in 2005 the ARAO obtained a license for trial operation and started regularly accepting radioactive waste from small producers. In 2007, the license for trial operation was prolonged for 6 months, until 8 January 2008, and later on until April 2008 because the application documentation was not timely prepared. After completion of the application the operating license was issued which is valid until 18 April 2018.

The ARAO launched the project »Improvement of the Management of Institutional Radioactive Waste in Slovenia«, financed by the EU, during which final and detailed characterization of waste was made. The contractor was the consortium, composed of Belgian companies and the Jožef Stefan Institute. 626 packages of radioactive waste were characterized, consisting of 188 special wastes, 125 drums, 110 packages with smoke detectors and 203 packages with spent sealed sources. After characterization the wastes were packed into 154 drums with radioactive waste, 64 of which contain compressible, 36 uncompressible, 25 flammable and 9 liquid waste. In 13 drums there are smoke detectors and in 7 drums spent sealed sources. An inspection was carried out and ordered that the ARAO has to condition all liquid radioactive waste until the 2009.

In 2008, the ARAO accepted into storage radioactive waste from 37 waste producers, in the form of 62 packaging units of sealed sources, 18 special waste items and 7 drums. The total volume of the waste was 3 m^3. By the end of 2008 a total of 458 packaging units were accepted, among which there were 345 drums, 31 special waste items and 82 sealed sources. In 2008, the new system for labeling of radioactive waste packages was introduced. The total activity of the 80 m^3 waste stored is estimated to be 3.65 TBq.



Remarks:

- In 2001, 1 drum was accepted as a result of repacking of radium sources.
- In 2003, 2 drums were accepted as a result of repacking of cobalt sources.
- In 2005, 95 drums were accepted as a result of the Phare project »Characterization of Institutional Low and Intermediate Level Radioactive Waste in the Central Storage Facility for Waste from Small Producers in Slovenia at Brinje«, 24 drums were accepted from other users.
- In 2008, 154 drums were accepted as a result of the project »Improvement of the Management of Institutional Radioactive Waste in Slovenia« and 7 drums were accepted from other users.

Figure 9: Types and quantities of radioactive waste annually accepted in the Central Interim Storage at Brinje

A new revision of the Radiation Emergency Response Plan that defines the emergency response and detailed working procedures was approved.

2.4 Radiation Practices and the Use of Sources

The Act on Protection against Ionizing Radiation and Nuclear Safety stipulates advanced notification of intention to carry out radiation practice or intended use of a radiation source, the evaluation of radiation exposure of workers and mandatory license to carry out a radiation practice and a license for use of a radiation source.

The nature and extent of radiation risk for exposed workers, apprentices and students based on the evaluation of radiation exposure of workers must be assessed in advance. In addition, based on this assessment, a program for optimization of radiation protection measures in all working conditions is made. The document must be prepared by the applicant, who is obliged to consult an authorized radiation protection expert. The assessment can also be prepared by an authorized expert in this field. The assessment has to be approved by the Slovenian Radiation Protection Administration (SRPA); in 2008, 143 approvals were issued.

During the year 2008, the SNSA Inspection carried out 43 inspections and interventions of 32 legal persons connected with performance of a radiation practice in industry and research, transportation of nuclear goods as well as transportation of goods containing, among others, radioactive materials. Additionally the SRPA Inspection carried out 18 inspections in nuclear facilities and in the area of medicine, veterinary medicine, safety of exposed workers and exposure of population to natural radiation.

The SNSA carried out 20 regular inspections of 20 persons performing a radiation practice and 2 regular inspections were related to transportation of nuclear goods. No major violations were found, however some deficiencies were discovered. They were related to record-keeping of high-activity sealed radioactive sources. In a few cases transfer of disused sealed sources into CSRAO was ordered.

Altogether 21 interventions were performed by the SNSA. The SNSA inspections focused on the identification of sources at faculties, state institutions and ministries. 15 inspections were carried out at these institutions, 5 inspections were connected with transportation of radioactive materials and one with personal dosimetry of persons carrying out a radiation practice.

The audit of two laboratories performing environmental monitoring was performed.

In 2008, the SRPA performed 4 inspections of radiation practices regarding the use of X-ray devices in medicine and veterinary medicine and one inspection on the use of open and sealed sources in a medical institution. Three inspections were carried out in the Krško NPP, where no major deficiencies were found. In the area of radon exposure and exposure of population to natural radiation, 8 inspections were performed. In one case a decision was issued referring to appointment of the person responsible for radiation practice, elaboration of assessment of the radiation protection of exposed workers, assessment of exposed workers exposure, medical examination of the workers and training on radiation safety issues. Additionally, two inspections were carried out in the area of exposed workers, one in co-operation with the SNSA's inspector and the other on the request of the Ministry of the Interior Inspectorate.

2.4.1 Use of Ionizing Sources in Industry and Research

In 2008, 61 licenses to carry out radiation practices, 72 licenses for the use of a radiation source, 13 certificates of registration of radiation sources and 5 approvals to external operators of practices involving ionizing radiation were issued.

At the end of 2008, 87 organizations in the Republic of Slovenia were using 185 X-ray devices in industry and research, most of them for industrial radiography, and for cargo and luggage inspection. 744 sealed sources were used in 91 organizations. The majority of sources and X-ray devices were used in technological and automation processes, field measurements of density and humidity, and for calibration and testing of instruments. The devices were used for non-destructive material inspection containing ^{192}Ir radionuclide, devices containing ^{85}Kr, ^{241}Am, ^{60}Co and ^{90}Sr radionuclides in technological and automation processes, and devices containing ^{137}Cs and ^{241}Am/Be radionuclides for field measurements of density and humidity. Some organizations serviced ionizing smoke detectors containing ^{241}Am radionuclide.

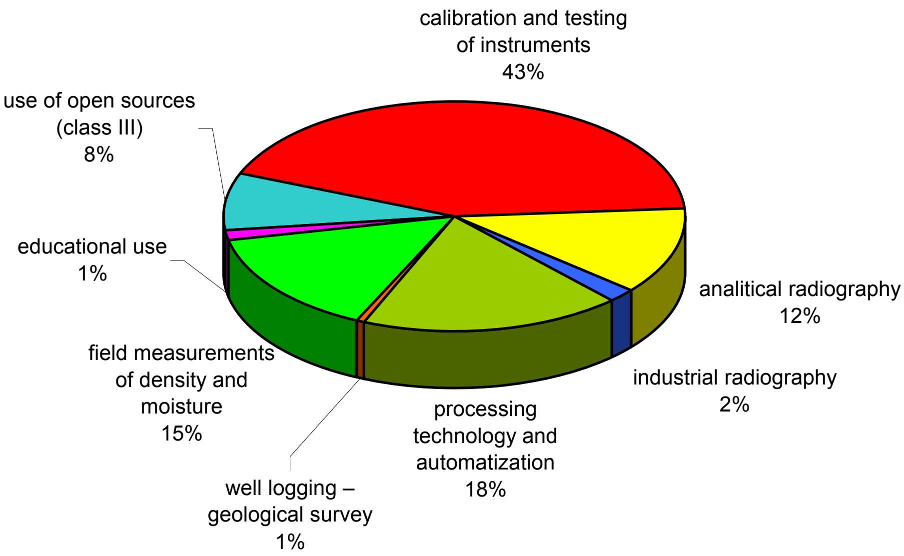


Figure 10: Distribution of application of radioactive sources according to their purpose and mode of use, excluding X-ray devices and ionizing smoke detectors

According to the registry of radiation sources, at the end of 2008 there were 26,311 ionizing smoke detectors used at 297 organizations. In addition there were 1,588 ionizing smoke detectors stored at users' premises.

In 2008 the Institute of Occupational Safety performed 1,112 surveys of radiation sources at holders in the fields of industry, medicine and research, while the Jožef Stefan Institute performed surveys of only 15 radiation sources.

In 2008 altogether 21 interventions were performed by the SNSA, among them 18 inspection examinations. The numbers are comparable to numbers of interventions performed each year in the period from 2004 to 2006.

Two inspections were performed at the *Faculty of Pharmacy* of the University of Ljubljana. The inspection of the SNSA identified the radioactive sources in storages, mainly radioactive chemicals containing uranium or thorium. All sources were stored in the Central Storage for Radioactive Waste except a source containing ^{63}Ni, which was transferred to its producer.

At the *Faculty of Biotechnology* of the University of Ljubljana radioactive chemicals were found in addition to radioactive solutions and an x-ray spectrometer. Radioactive waste which could cause substantial contamination of people and a site was stored in the Central Storage for Radioactive Waste. The faculty started with implementation of measures related to radiation safety.

Altogether 11 inspections were performed at the *Ministry of Defense*, five of them related to the civilian part of the ministry while the others were related to the control of the *General Staff of Slovenian Army*. The inspections were performed at different sites in Slovenia, mostly in Ljubljana. At all sites the identification of radioactive sources took place. The users of sources were not aware that the items were actually radioactive sources. The items originated from activities performed in the former Yugoslavia and other countries, namely Israel, the Soviet Union and the USA. As a rule there were no warning signs informing of the presence of a radioactive source on the items. The inspections set down many requirements due to the fact that radioactive sources were not stored as prescribed in the legislation.

2.4.2 Interventions

In 2008 there were five interventions concerning transport of radioactive materials. Two of them related to the border crossing at Obrežje. At one of these interventions a truck containing scrap metal, namely iron, from Spain caused an increased dose rate. The SNSA informed *Državni zavod za zaštitu od zračenja*, which is situated in Zagreb. At the other intervention, a car with Slovenian registration plates was examined. Presence of an altimeter which caused increased dose rates was detected and the car was prohibited from entering Croatia.

Two interventions concerned finding radioactive sources related to scrap yards:

- A scrap yard company Dinos d.d. Ljubljana informed the SNSA of detection of increased radiation. The SNSA and the Institute of Occupational Safety performed a survey of the storage. An item containing the radioisotope ^{226}Ra was found and immediately stored in the Central Storage for Radioactive Waste. The use of the item was not identified.
- A scrap yard company Primed d.o.o. from Vrtojba informed the SNSA about the identification of containers which were found inside the lead scrap metals. The containers are usually used as storages for radioactive sources in nuclear medicine. The Institute of Occupational Safety preformed an inspection of the containers and found out that the items were labeled with signs of radioisotopes, namely ^{131}I, ^{201}Tl in ^{67}Ga. According to the available data, the items came from Zagreb. A qualified expert identified an increased dose rate in 19 containers. Contamination was found only inside the containers or lids. The estimated activity was around 1–2 MBq. The Institute of Occupational Safety stored the radioactive waste at the site and recommended to store them for additional three months. After that time additional measurement should be performed before the items are released from control. The SNSA informed the Croatian regulatory body about the intervention.

In 2008 one intervention related to personal dosimetry of a user of ionizing sources.

2.4.3 Use of Radiation Sources in Medicine and Veterinary Medicine

2.4.3.1 X-ray Devices in Medicine and Veterinary Medicine

According to data from the register of the Slovenian Radiation Protection Administration (SRPA), 828 X-ray devices and one cobalt therapeutic device were used in medicine and veterinary medicine at the end of 2008. The categorization of the X-ray devices based on their purpose is given in Table 3.

Table 3: Number of X-ray devices in medicine and veterinary medicine by their purpose

Purpose	Status 2007	New	Written off	Status 2008
Dental	397	31	15	413
Diagnostic	247	24	14	257
Therapeutic	8	0	0	8
Simulator	2	0	0	2
Mammography	38	0	3	35
Computer Tomography CT	22	6	3	25
Densitometers	40	4	2	42
Veterinary	40	7	1	46
TOTAL	**794**	**72**	**38**	**828**

With regard to use of x-ray devices in medicine and veterinary medicine in 2008 the SRPA granted 84 permits to carry out a radiation practice, 177 permits to use X-ray devices, 98 confirmations of the programs of radiological procedures, and 91 confirmations of the evaluation of protection of exposed workers against radiation.

In medicine, 388 X-ray devices were used in private dispensaries and 395 in public hospitals and institutions. The average age of X-ray devices in the public sector was 9.6 years (9.6 years also in 2007) and in the private sector 7.9 years (7.6 years in 2007). In veterinary medicine 35 devices were used and 11 devices in public hospitals and institutions. The average age of X-ray devices in the public domain was 11.2 years and 5.4 years in the private sector. A detailed classification of X-ray devices in medicine and veterinary medicine, according to their ownership, is given in Table 4.

Table 4: Number of X-ray devices in medicine and veterinary medicine by ownership

Ownership	Diagnostic		Dental		Therapeutic		Veterinary		Total	
	No. (%)	Age (y)	No. (%)	Age (y)	No. (%)	Age (y)	No. (%)	Age (y)	No. (%)	Age (y)
Public	284 (79%)	9.6	100 (24%)	9.5	11 (100%)	8.9	11 (24%)	11.2	406 (49%)	9.8
Private	75 (21%)	7.3	313 (76%)	8.0	0	0	35 (76%)	5.4	423 (51%)	6.9
Total	**359**	**8.4**	**413**	**8.7**	**11**	**8.9**	**46**	**8.3**	**829**	**8.3**

All X-ray devices are examined by approved experts of radiation protection at least once a year. The devices are classified, with regard to their quality, into the following groups: »perfect«, »service required«, »disuse proposed« and »out of order«. The analysis of data for the recent years is presented in Figure 11. It shows that there were more than 90% of perfect devices in the last four years.

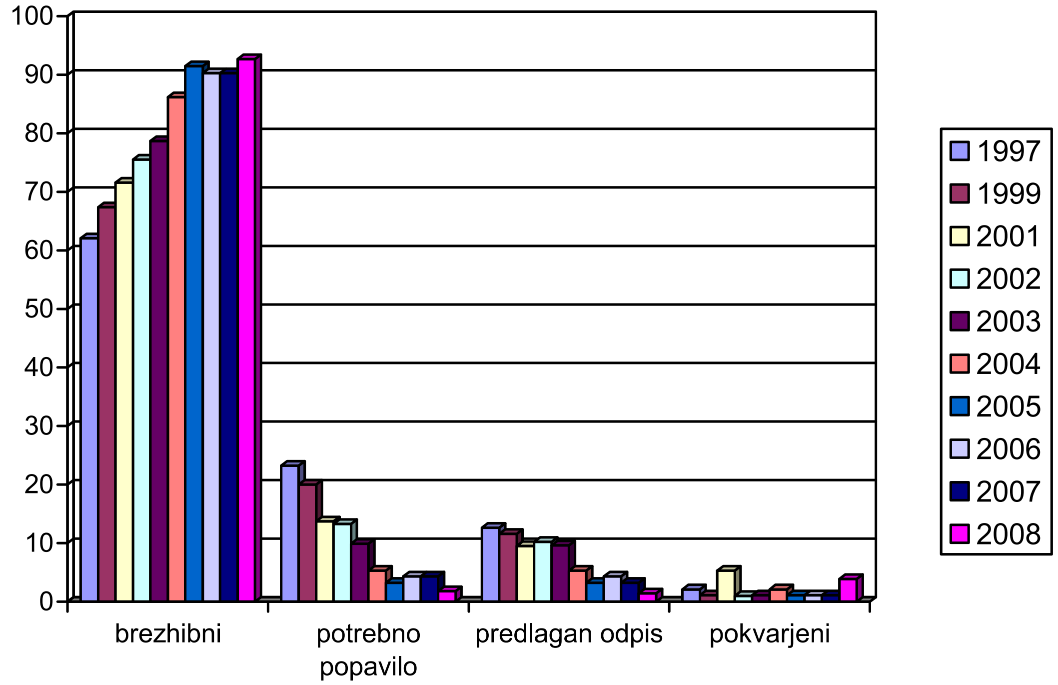


Figure 11: Percentage of diagnostic X-ray devices according to their quality for the period 1997–2008

In 2008 four in-depth inspections of the use of X-ray devices in medicine and veterinary medicine were performed. One case related to control over computed tomography and on the basis of the inspection, provision requiring implementation of legally prescribed conditions was passed. Two inspections related to control over technical adequacy of X-ray devices. In both cases prohibition of further use for X-ray devices was ordered. One inspection related to control of the use of X-ray devices in veterinary medicine. An X-ray device was sealed.

2.4.3.2 Unsealed and Sealed Sources in Medicine

Seven hospitals and clinics in Slovenia use unsealed sources (radiopharmaceuticals) for diagnostics and therapy in nuclear medicine departments: the University Medical Centre Ljubljana - the Department of Nuclear Medicine, the Institute of Oncology, the University Medical Centre Maribor and the general hospitals in Celje, Izola, Slovenj Gradec and Šempeter near Gorica. In nuclear medicine departments, altogether 5034 GBq of isotope ^{99m}Tc, 1336 GBq of isotope ^{131}I, 226 GBq of isotope ^{133}Xe, 1227 GBq of isotope ^{18}F and minor activities of isotopes ^{67}Ga, ^{111}In, ^{90}Y, ^{186}Re, ^{201}TI and ^{123}I were applied for diagnostics and therapy.

Sealed sources for therapy are used at the Institute of Oncology and at the Clinic of Ophthalmology, and for irradiation of blood constituents at the Institute of Transfusion Medicine. At the Institute of Oncology a source with cobalt ^{60}Co with the initial activity of 290 TBq is used at the Department of Radiotherapy, as well as several sources of ^{192}Ir and ^{90}Sr. At the Clinic of Ophthalmology 10 sources of ^{106}Ru with initial activities up to 37 MBq for the therapy of eye tumors were used, and at the Institute of Transfusion Medicine a device with ^{137}Cs with the initial activity of 49.2 TBq was used for irradiation of blood components.

Sealed sources of minor activities are used for operational testing of various devices and measurement equipment at some nuclear medicine departments.

In 2008 14 permits to carry out a radiation practice, 8 permits to use radiation sources in medicine, 6 confirmations of evaluation of radiation protection of exposed workers and two confirmations on fulfillment of conditions for radiation practices for workers were granted with reference to the use of unsealed and sealed sources in medicine. At the Institute of Oncology an in-depth inspection was performed. The inspection concerned the organization of radiation protection, the register of radiation sources, the pending administrative and inspection procedures, increased individual exposures, the procedures for the »HDR« device and inspection of areas with radioactive materials.

On 16 January 2008 the SRPA was informed of an unusual event on 15 January 2008 at the Institute of Oncology. Because of a shutdown of a pump for sewage there was a leakage of radioactive sewage. The maintenance worker was in the room for five minutes. His radiation exposure was negligibly low. The person responsible for radiation practice took all protective measures and proposed actions for the prevention of similar events in the future.

The medical departments with unsealed and sealed radiation sources were surveyed by the authorized experts for radiation protection; no major deficiencies were found.

3 RADIOACTIVITY IN THE ENVIRONMENT

3.1 Monitoring of Environmental Radioactivity

Monitoring of the global radioactive contamination due to the former atmospheric nuclear bomb tests (1951–1980) and the Chernobyl accident (1986) has been carried out in Slovenia for four decades and a half. Above all, two long-lived fission radionuclides ^{137}Cs and ^{90}Sr have been followed in the atmosphere, water, soil and drinking water as well as in foodstuffs and in feeding stuffs. A part of the monitoring program comprises also river water contamination with ^{131}I due to the medical use of this radionuclide. Other natural gamma emitters are also measured in all samples, and additionally tritium ^{3}H in drinking water and in precipitation.

The results for 2008 showed that concentrations of both long-lived fission products in samples of air, precipitation, soil, milk and foodstuffs of vegetal and animal origin, as well as in feeding stuffs continued to decrease slowly and were mostly lower than before the Chernobyl accident. Exceptionally a specific surface activity of ^{137}Cs in the upper layer of uncultivated soil is still enhanced. On average, at the time of the Chernobyl accident approximately five times higher contamination (20–25 kBq/m^2) was measured in Slovenia if compared to the contribution of all nuclear bomb tests in the past. The highest contamination of the ground was measured in the Alpine and forest regions. This feature indirectly contributes to the enhancement of the contents of this radionuclide (in forest fruits, mushrooms and game) as well as on Alpine pastures (milk, cheese). In 2008 no radioactive contamination of the environment was detected by the monitoring performers related to any new nuclear or radiation event.

The biggest contribution to the radiation exposure of the public comes from external radiation and from food ingestion, while the inhalation dose due to aerosols with fission radionuclides is negligible. In 2008 the effective dose for an adult from external radiation of ^{137}Cs (mainly from the Chernobyl accident) was estimated at about 6.7 μSv, which is 0.77% of the dose received by an average Slovenian from natural background radiation. This value is higher than the one measured and calculated for the previous year (4.8 μSv) due to inconsistencies of soil sampling on different pedological basements and due to the use of the methodology of the external doses assessment.

The annual dose from the ingestion pathway (food and drinking water consumption) was 3.1 μSv, which is, compared to the year 2007 (1.6 μSv), slightly more due to higher average values of the radionuclide ^{90}Sr in the selected samples of vegetables. The annual contribution in the annual dose of the ^{90}Sr due to ingestion is 85% and of ^{137}Cs 15%. The annual contribution due to inhalation of both radionuclides is only about 0.001 μSv, which is negligible if compared with radiation exposure from other transfer pathways. In 2008, the total effective dose to an adult individual of Slovenia arising from the global contamination of the environment with fission products was estimated at 9.8 μSv, as shown in Table 5. This is approximately 0.4% of the dose compared to the annual exposure of the adult Slovenian received from natural radiation in the environment (2500–2800 μSv).

The effective dose for drinking water, taking into account natural and artificial radionuclides, was also estimated. It was shown that this dose (average value around 0.05 mSv) did not exceed the limit value of 0.1 mSv per year due to water ingestion from local water supplies in any examined case.

Considering all doses specified in this chapter, it should be taken into account that these values are extremely low and difficult or even impossible to measure indirectly or accurately. In most cases the final results are calculated using mathematical models based on other measurable quantities. The measurement uncertainties are therefore considerable and they differ considerably from year to year in some cases. But what is the most important is that these values are far below the limit values.

Table 5: Radiation exposure of population in Slovenia due to global contamination of the environment in 2008

Transfer pathway	Effective dose [μSv/year]	
	Adults	Children (7 to 12 years)
Inhalation (^{137}Cs, ^{90}Sr)	0.001	0.001
Ingestion:	–	–
– drinking water (^{137}Cs, ^{90}Sr)	0.03	0.06
– food (^{137}Cs, ^{90}Sr)	3.1	4.9
External radiation	6.7	7.7
Total in 2008 (rounded)	**9.8**	**12.6**

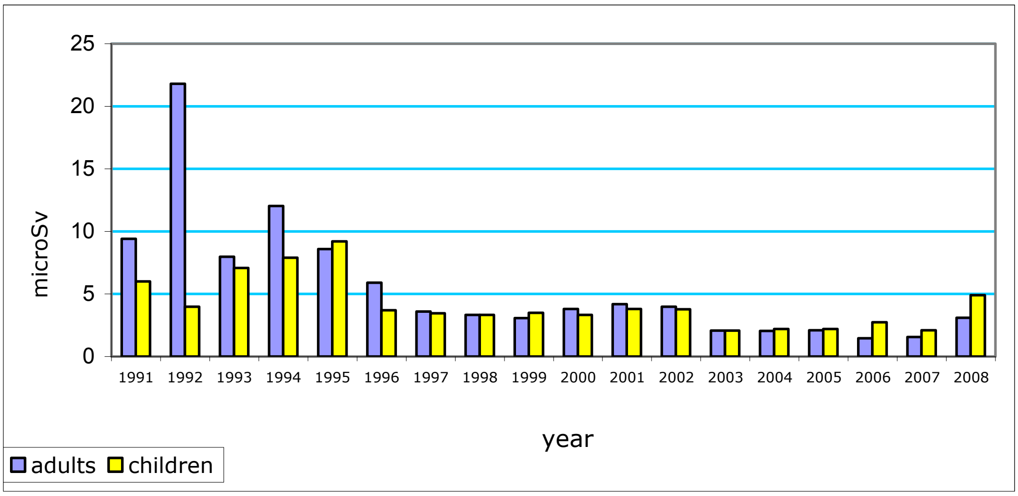


Figure 12: Annual effective doses to members of the public received by ingestion due to global radioactive contamination of the environment with the radionuclides ^{137}Cs and ^{90}Sr in Slovenia

The high value in 1992 is due to the calculated dose estimation, which takes into account also the game used as foodstuff. Not taking into account these samples, the effective dose for this year would have been lower than 10 μSv.

3.2 Operational Monitoring in Nuclear and Radiation Facilities

Each installation or facility that discharges radioactive substances into the environment is required to be the subject of control. Radioactivity measurements in the environment must be performed in the pre-operational period, during operation and a certain period after ceasing the operation. The goal of operational monitoring is to find out if the discharged activities are within the authorized limits, if environmental specific activities are inside the derived limits and also if the population exposures are lower than the prescribed dose constraints or limits.

3.2.1 The Krško Nuclear Power Plant

The radiological situation in the surroundings of the nuclear power plant is monitored by means of continuous measurements of gaseous and liquid radioactive discharges and by carrying out radioactivity measurements of environmental samples. The measured values of analyzed radionuclides in environmental samples (in air, soil, surface and underground water, precipitation, drinking water, agriculture products, and feeding stuffs) during normal operation of the plant are low, mostly even considerably lower than the detection limits of analytic procedures. The impacts of the nuclear power plant are therefore evaluated only on the basis of the data on gaseous and liquid discharges. The data are used as input data for the modeling of dispersion of radionuclides to the environment. Low results of environmental measurements during normal operation are used as a confirmation that radioactive discharges into the atmosphere and in aquifer were low. In case of emergency, the established monitoring network enables immediate sampling and analysis of contaminated samples.

According to the recommendations of the European Verification Commission, the SNSA introduced an independent measurement control of the operational monitoring for the first time in 2008. The measurements were conducted in parallel with the regular measurements. The aim of these measurements is to confirm and check the results of the operational monitoring.

Radioactive discharges

In 2008 the total released activity of noble gases to the atmosphere was 0.27 TBq, which resulted in an exposure of 0.064 µSv, or 0.128% of the limit set to 50 µSv per year. The released activities of iodine isotopes were $2.2 \cdot 10^{-6}$% of the limit and are several orders of magnitude lower than the previous year due to the fact that there was no overhaul in 2008. Activity of the dust particles was $5.3 \cdot 10^{-3}$% of the limit. Discharges of tritium into the atmosphere were within the expected values, as well as ^{14}C discharges, which were approximately the same as in previous years; there is no prescribed limitation for these two radionuclides.

In 2008, in liquid discharges from the plant to the Sava river the activity of tritium (^{3}H) in the form of water prevailed with 7 TBq, which represents 15.6% of the limit or one thirtieth of the release in 2007. The total discharged activity of fission and activation products was lower than in 2007 and was 85 MBq, which represents 0.085% of the operational limit value, while the activity of alpha emitters was under the detection limit.

Environmental radioactivity

The monitoring program of environmental radioactivity due to gaseous and liquid discharges comprises the following measurements of concentrations or contents of radionuclides in environmental samples:

- in air (aerosol and iodine filters),
- in dry and wet deposition (dry and wet precipitation),
- in the Sava river water, sediments and water biota (fish),
- in tap water (Krško and Brežice), water captures and underground water,
- in food of agricultural and animal origin (including milk),
- in soil on cultivated and uncultivated areas, and
- measurements of ambient dose equivalent of external radiation at several locations.

Concerning the assessment of the results of radioactivity monitoring the around Krško NPP it should be noted that the presence of the radionuclides ^{137}Cs and ^{90}Sr is a consequence of a global contamination and not a result of the nuclear power plant operation. The plant's contribution to the dose exposure results in higher concentrations of tritium in the Sava river downstream the plant. The annual average of the concentration of tritium of 0.82 kBq/m^3 was measured at Krško, upstream the plant, while at Brežice, downstream the plant, the value of 2.1 kBq/m^3 was obtained. This value is lower than that in 2007 (8.5 kBq/m^3) due to a much lower release. Elevated values of tritium concentration were also measured in underground water, sampled at the VOP-4 borehole on the Slovenian side (12 kBq/m^3 at the beginning of July) and at Medsave on the Croatian side (3.5 kBq/m^3 in June), yet those values are still much lower then the limit for drinking water (100 kBq/m^3). Measurements of ^{14}C of vegetation samples in the year 2008 confirmed the results of a 2006 study, yielding slightly elevated concentrations in the vicinity of the Krško NPP.

Concentrations of other artificial radionuclides discharged to the river Sava (^{60}Co, and others) were measured below the detection limits in all samples. The concentrations of radioisotope ^{131}I in the Sava river were caused by discharges from the clinics of nuclear medicine in Ljubljana and Celje, not by the operation of the nuclear power plant.

The dose assessment of the public was based on model calculations. The calculated dispersion factors for atmospheric discharges, based on real meteorological data, showed that the most important pathways for public exposure were: ingestion of food with ^{14}C, external radiation from clouds and deposition as well as the inhalation of air particles with tritium and ^{14}C. The highest dose (less than 1 μSv) was received by adult individuals due to ^{14}C intake with vegetable food ingestion, while a ten times lower dose was received also due to inhalation of tritium. The dose assessment due to liquid discharges in 2008 showed their very low additional contribution to the population exposure, 0.02 μSv per year. The levels of external radiation in the vicinity of some structures on-site are higher than in the natural surroundings, but they are hardly measurable at the plant's fence. It was estimated that the plant-related external exposure was less than 0.1 μSv per year. This estimation is similar to the one in recent years and it is now based on more realistic data than before when the estimated values were higher by one order of magnitude.

From Table 6 it is clear that the total effective dose for an individual who lives in the surroundings of the Krško nuclear power plant is less than 1 μSv per year. This value represents about 2% of the authorized dose limit (50 μSv) or less than a thousandth of the dose received by an average Slovenian from natural background radiation (2500–2800 μSv per year).

Table 6: Assessment of partial exposures of the adult member of the public due to atmospheric and liquid radioactive discharges from the Krško NPP in 2008

Type of exposure	Transfer pathway	Most important radionuclides	Effective dose [μSv/year]
External radiation	Cloud immersion Deposition	Noble gases: (^{41}Ar, ^{133}Xe, ^{131m}Xe) Particulates: (^{58}Co, ^{60}Co, ^{137}Cs …)	0.01 < 0.1
Inhalation	Cloud	^{3}H, ^{14}C	0.1
Ingestion (atmospheric discharges)	Vegetable food	^{14}C	< 1
Ingestion (liquid discharges)	Drinking water (the Sava river)	^{3}H, ^{137}Cs, ^{89}Sr, ^{90}Sr, ^{131}I	< 0.1
Total Krško NPP			**< 1***

* Single dose contributions from particular exposures are not additive, because different groups of public were taken into consideration.

3.2.2 The Research Reactor TRIGA and the Central Storage of Radioactive Waste at Brinje

The research reactor TRIGA and the Central storage of radioactive waste are both located at Brinje near Ljubljana. The samples irradiated in the reactor are analyzed in the laboratories of the Department of Environmental Science of the Jožef Stefan Institute, which are located by the reactor. Potential radioactive discharges at this location arise from the reactor, from the waste storage and from the laboratories.

Environmental monitoring of the research reactor TRIGA comprises measurements of atmospheric and liquid discharges and measurements of radioactivity levels in the environment. The latter are performed to find out the environmental impact of the installation and comprise measurements of radioactivity in air, underground water, measurements of external radiation, radioactive contamination of the soil and of radioactivity of the Sava river sediments.

Measurements of radioactive aerosol discharges into the atmosphere again showed results below the detection limit. Discharges of ^{41}Ar to the atmosphere, calculated on the basis of the reactor operation time, were estimated at slightly higher values compared with previous years, around 1 TBq. No radioactive contamination due to the operation of the reactor was detected by the measurements of the specific activities in the environment. The external immersion dose on an individual from the surrounding population due to ^{41}Ar discharges was estimated at 0.02 μSv per year under the assumption that such an individual spends 65 hours per year at a distance of 100 m from the reactor when mowing and plowing and that he stays in the cloud only 10% of his time. An inhabitant of Pšata who constantly lives at a distance of 500 m from the reactor receives 0.5 μSv per year if staying there for the whole time. A conservative assumption was used for dose assessment for individuals of the population for liquid discharges: if the river water is ingested directly from the recipient river (Sava), the annual exposure is around 0.00013 μSv per year. The total annual dose for an individual from the public, irrespective of the pathway, is still one hundred times lower than the authorized dose limit (50 μSv per year). The total annual dose for an individual from the public, irrespective of the model used, is still a thousand times lower than the general dose limit for the public (1000 μSv per year) or the natural background radiation in Slovenia (about 2500–2800 μSv per year).

The monitoring program of environmental radioactivity of the Central Storage of Radioactive Waste at Brinje comprised control measurements of radioactive atmospheric discharges (radon and its short-lived progeny from the storage as the consequence of the stored ^{226}Ra sources), radioactive waste water (from the newly built drainage collector) and direct external radiation on the outside parts of the storage. Environmental concentrations of radionuclides were measured in the same scope as in previous years (in underground water from the two wells, external radiation at several distances from the storage, as well as dry deposition and soil near the storage).

After the reconstruction of the storage in 2004, radon releases to the environment decreased from the annual average value of 75 Bq/s to 52 Bq/s in 2005, 35 Bq/s in 2006, 31 Bq/s in 2007 and 24 Bq/s in 2008, or 0.65 GBq per year on average (Figure 13). Enhancement of radon ^{222}Rn concentrations in the vicinity of the storage was estimated by a model for average weather conditions, and and equaled 2.4 Bq/m^3 at the distance of 30 m and about 0.9 Bq/m^3 at the distance at 50 m, i.e. at the fence of the reactor centre. In the waste water from the new drainage collector artificial radionuclides ^{241}Am, ^{134}Cs, ^{137}Cs and ^{60}Co were measured as a consequence of cleaning the storage after the reconstruction. The decrease of artificial nuclide concentration continued, so ^{241}Am and ^{60}Co were not found in the December sample. Concentrations of nuclides were far lower than the limit for monitoring clearance and also lower than the derived concentrations for drinking water.

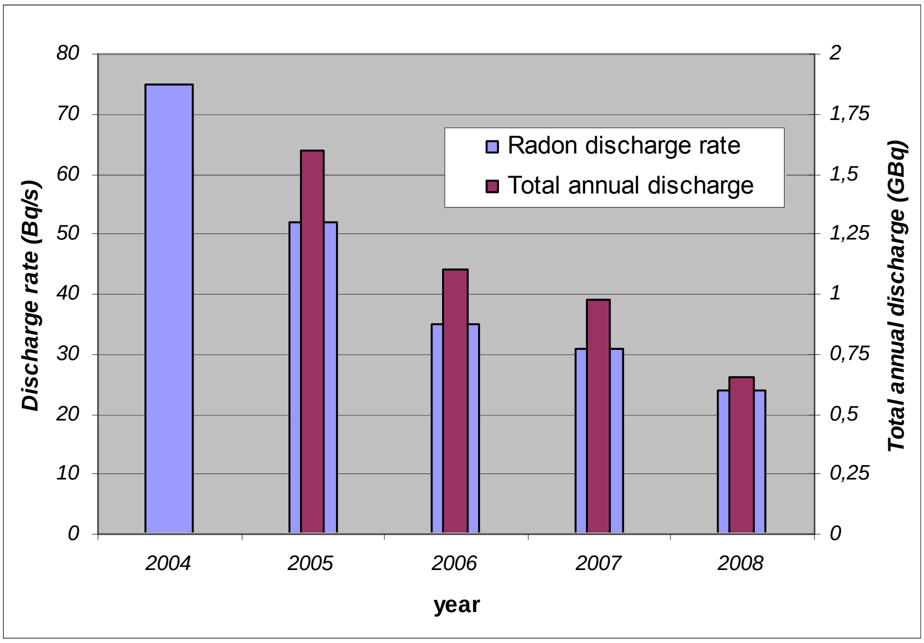


Figure 13: Emission of ^{222}Rn from the Central Storage of Radioactive Waste at Brinje

For the dose assessment of the most exposed members of the public inhalation of radon decay products and direct external radiation were taken into account. The most exposed members of the reference group are the employees of the reactor centre, who are potentially under the impact of radon releases from the storage. According to the calculation they received an estimated effective dose of 2.3 μSv in 2008. The security officer receives about 1.0 μSv per year due to his regular rounds, while the annual dose to the farmer at the fence of the controlled reactor area was estimated to be only about 0.05 μSv. These values are lower than in previous years, mostly due to lower radon releases, and are much lower than the authorized dose limit for individuals from the reference group of the population (100 μSv). The annual dose collected by an individual from natural background is 2500–2800 μSv.

3.2.3 The Former Žirovski vrh Uranium Mine

Monitoring of environmental radioactivity of the former uranium mine at Žirovski vrh – the mine is currently in the post-operational phase – consists of measurements of radon releases, liquid radioactive discharges and concentration in the environment, environmental measurements of radionuclide specific activities of the uranium-radium decay chain, concentration measurements of radon and its decay products in the air, and external radiation. Measurement locations are set mainly at the settled areas in the valley, up to 3 km from the existing mine radiation sources; that is from the village of Gorenja vas to Todraž. Because of measurements of radionuclides of natural origin, the reference measurements for the evaluation of impact of uranium mining (i.e. for the assessment of the enhancement of radioactivity in the environment) have to be carried out at relevant points, outside the influence of mine discharges. The net contribution of radioactive contamination is assessed in a way that the measured values are corrected with regard to the natural background of the measured examined radionuclides.

Concentrations of radionuclides in some environmental media have partially decreased after cessation of mine operation. The differences are the most evident in lower values of concentrations of long-lived radionuclides in particles in the air and surface water radioactivity, and they have been observed also for outdoor radon concentrations. Radioactivity of the surface waters in both streams in the last years has been slowly but steadily decreasing, especially ^{226}Ra concentrations in the Brebovščica, the main recipient stream: they are already close to the natural background level. Only uranium ^{238}U concentrations in the Brebovščica stream (200 Bq/m^3) are still increased, because all liquid discharges from the mine and from disposal sites flow into it – mainly due to arranging works at the disposal sites and higher precipitation in 2008. Also the radioactivity of sediments (^{238}U, ^{226}Ra) in the Brebovščica stream is not more than 50% higher than in the recipient river Sora before the outflow of the Brebovščica stream. The average concentrations of radon ^{222}Rn in the surroundings of the mine (at Gorenja Dobrava) were still higher than a long-term average value concentration at the reference point outside the mine influence (about 20 Bq/m^3). In 2008 the mine's contribution of radon ^{222}Rn from the mines galleries to the natural concentrations in the environment is estimated at around 3 Bq/m^3.

Calculation of the effective dose for the population took into account the following exposure pathways: inhalation of long-lived radionuclides, radon and its short-lived progeny, ingestion (intake of food and water) and external gamma radiation. Radiation exposure of the population living in the vicinity of the mine was estimated to be 0.11 mSv. This is the lowest value so far and is a consequence of finishing the mine tailings dump sanitation at Jazbec site. It represents approximately one third of the effective dose which was estimated in the last decade of 20th century. However, the most important radioactive contaminant in the mine environment still remains radon ^{222}Rn with its short-lived progeny, which contribute two thirds of the additional exposure (Table 7).

Table 7: Effective dose for an average individual from the population in the surroundings of the former uranium mine at Žirovski vrh

Transfer pathway	Important radionuclides	Effective dose [mSv]
Inhalation	– aerosols with long-lived radionuclides (U, ^{226}Ra, ^{210}Pb) – only ^{222}Rn – Rn – short-lived progeny	0.0008 0.0017 0.070
Ingestion	– drinking water (U, ^{226}Ra, ^{210}Pb, ^{230}Th) – fish (^{226}Ra, ^{210}Pb) – agricultural products (^{226}Ra in ^{210}Pb)	(0.0119)* 0.0029 < 0.03
External radiation	– immersion and deposition of radon progeny – deposition of long-lived radionuclides – direct gamma radiation from disposal sites	0.0011 – 0.001
Total effective dose for 2008 (rounded):		**0.11 mSv**

* Dose from water from the Brebovščica stream is not included in the dose assessment because it is not used for drinking, watering of animals and irrigation.

The total effective dose for an adult individual in 2008 due to the contribution of the former uranium mine is one half of the dose from 2007 (0.23 mSv) and was one tenth of the general limit value for the population (1 mSv per year). Estimated doses for 10 year-old children were 0.132 mSv and for 1 year olds 0.089 mSv. These values represent about 4% of the annual dose due to the average natural radiation background in Slovenia (2500–2800 μSv) and only 2% of the natural background dose in the Žirovski Vrh environment (5500 μSv). Annual changes of effective doses due to the mine contribution are shown in Figure 14.

Measurements and dose estimations for the last several years clearly show that cessation of uranium mining and the restoration works carried out till now have decreased the environmental impacts and exposure of population. The estimated dose exposure already in the present restoration phase is not more than one third of the authorized dose limit which is 300 μSv per year after restoration works.

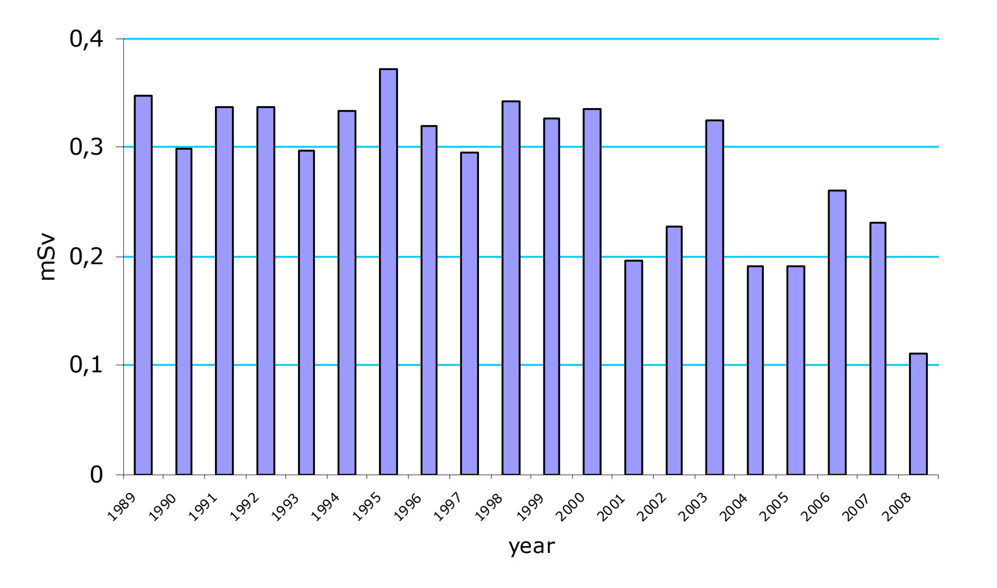


Figure 14: Annual contributions to the effective dose for an average adult individual of the population due to the Žirovski vrh Mine

3.3 Early Warning System for Radiation in the Environment

The Slovenian on-line early warning system for radiation in the environment was established at the beginning of the last decade. The system is designed for immediate detection of raised levels of radiation and is one of the key elements of the alarming and reacting procedures in case of emergency. When radioactive releases into the environment occur, the levels of external radiation and concentrations of radioactive particles in the air are higher, since the air, ground, drinking water and food are contaminated by the fallout. On-line measurements of the external radiation are managed by the Krško NPP, the Slovenian Environmental Agency (EARS), the SNSA and by each of the Slovenian thermal power plants. The data are acquired at the EARS and at the SNSA, where they are analyzed, archived and then presented on-line on the SNSA's web pages. The corresponding alarm would trigger in case of higher detected values

In the year 2008 there were no events which would have triggered the alarms due to elevated values of radioactivity in the environment.

Since 1997 the SNSA has been sending data to the European system EURDEP with its centre at the Joint Research Centre in Ispra, Italy, where the data from most European national early warning networks are collected. Slovenia has thus gained access to the on-line data of external radiation measurements from other participating countries. Additionally, Slovenian data are daily exchanged with the Austrian centre in Vienna, the Croatian in Zagreb and the Hungarian in Budapest.

3.4 Radiation Exposures of the Population in Slovenia

Every inhabitant of the Earth is exposed to natural and artificial radioactivity in the environment. A great part of the population receives radiation doses from radiological examinations in medicine, and only a small part of population is occupationally exposed due to work in the radiation field or with radiation sources. External radiation means that the source is located outside the body. Internal radiation occurs if radiation material enters the body by means of inhalation, ingestion of food, drinking or through the skin. The data on population exposure are presented below, while the occupational exposures (to artificial and natural sources) and medical exposures are presented in Chapter 4.

Exposure to natural radiation

The average annual effective dose from natural sources to a single individual on the Earth is 2.4 mSv, varying according to different locations from only 1 mSv to up to 10 mSv. The average annual dose from natural radiation sources for an average member of the public in Slovenia is somewhat higher than the world average, about 2.5 to 2.8 mSv per year. From the existing data on external radiation and radon concentrations in dwellings and outdoors it can be estimated that about 50% of this value is due to internal exposure as a consequence of inhalation of indoor radon and its progeny (1.2–1.5 mSv per year) in residential buildings. The dose due to intake of food and water is about 0.4 mSv per year. The annual effective dose of external radiation originating from soil radioactivity, building material in dwellings and from cosmic radiation together was estimated at 0.8 to 1.1 mSv. In 2008 the Slovenian Radiation Protection Administration (SRPA) continued the implementation of the governmental program of systematic examination of the working and dwelling environment in the area of radon exposure. This program comprises monitoring as well as public informing about the measures for decrease of exposure due to the presence of natural radioactive sources. In the scope of this program measurements in altogether 49 objects were performed and the accumulated effective doses were assessed for the employees and (in schools and kindergartens) also for children.

Population dose due to global contamination

Particularly people from the Northern Hemisphere are still exposed to ionizing radiation from global contamination of the environment as the consequence of past atmospheric nuclear bomb tests and the nuclear accident in Chernobyl. Average individual dose to the population from long-term radionuclides ^{137}Cs and ^{90}Sr in Slovenia in 2008 was estimated at 9.8 μSv. External radiation contributed with 6.7 μSv, while the effective exposure dose due to intake of food and water was estimated at 3.1 μSv. Due to lower contamination of the ground with ^{137}Cs the population in urban areas is less exposed than the one in rural environment.

Radiation exposure of population due to human activities

Radiation exposures due to the regular operation of nuclear and radiation facilities are usually attributed only to local population. The general dose limit due to the radiation from these facilities is 1 mSv per year. According to the current regulations the authorized dose limit for a particular facility is defined by the regulatory body. This value is normally much lower than the general limit value. Exposures of particular groups of population as a consequence of radioactive discharges from these objects are described in the chapters on operational monitoring. In Table 8 the annual individual doses are given for the maximum exposed adults from all particular objects. For comparison, also an average annual dose for individuals related to global radioactive contamination of the environment (nuclear tests and the Chernobyl accident) is shown. The highest exposures of the population are recorded for the individuals living in the surroundings of the former uranium mine at Žirovski vrh. They were estimated at max. 5% of the exposure due to the natural sources in Slovenia.

The population is exposed to radiation also due to some other human activities. These exposures come from deposited materials with enhanced natural radioactivity and originate from past industrial or mine activities, related mostly to mining and processing of raw materials containing uranium or thorium (in Slovenia: mining and processing of mercury ore, processing of bauxite, phosphates, coal combustion). Only certain data are available on various types of materials, on their amounts, and their higher contents of natural radionuclides. The dose assessment has not been systematically carried out due to the lack of data needed.

Table 8: Dose exposure of the adult individuals from the population due to the operation of nuclear and radiation facilities and due to general contamination in 2008 (the annual dose limit for the population is 1000 μSv, the natural background radiation is 2500–2800 μSv)

Source	Annual dose [mSv]
Žirovski vrh uranium mine	0.11
Chernobyl and nuclear experiments	0.0098
Krško NPP	0.001
TRIGA reactor	0.0005
Central Storage of Radioactive Waste	0.0002

4 RADIATION PROTECTION OF WORKERS AND MEDICAL EXPOSURES

Due to occupational exposure, individuals can receive a substantial dose of radiation. Therefore, the organizations that carry out radiation practice should optimize working activities in a manner to decrease the dose of ionizing radiation to a level as low as reasonably achievable (ALARA). The exposed workers are subject to a regular medical surveillance program and suitable training. The employer has to assure that the dose of ionizing radiation is assessed for every worker performing specific activities.

The Slovenian Radiation Protection Administration (SRPA) manages the Central Records of Personal Doses (CRPD). All approved dosimetry services regularly report to the CRPD for all exposed workers on their external exposure on a monthly basis and for internal exposures due to radon semi-annually and annually.

The approved dosimetry services in 2008 were the Institute of Occupational Safety (IOS) and the Jožef Stefan Institute (JSI). Limited approvals were granted to the Krško Nuclear Power Plant (for thermo-luminescent dosimetry) and to IOS (internal dosimetry for workplaces in mines). Currently 8923 persons have their records in the central register, including those who ceased using sources of ionizing radiation in previous years. In 2008, the dosimetric service at the IOS performed measurements of individual exposures for 3659 workers, JSI monitored 653 radiation workers and the Krško Nuclear Power Plant (Krško NPP) performed individual dosimetry for 346 plant personnel and 236 outside workers, who received an average[1] dose of ionizing radiation of 0.40 mSv. In other working sectors the average annual effective dose due to external radiation was the highest for workers in industrial radiography, namely 0.86 mSv, while the employees in medicine received on average 0.29 mSv. The highest average value of these, 0.73 mSv, was recorded for nuclear medicine workers.

The highest collective dose due to external radiation was received by radiation workers in the medical sector (349 man mSv), followed by workers in the Krško NPP (155 man mSv). Exposures in industry were 73 man mSv.

Among workers who are not involved in work with sources of ionizing radiation, the highest doses are received by the ones exposed to radon and its progeny.

At the Žirovski vrh Mine the highest annual individual dose was 1.5 mSv, and the average for a group of 99 workers was 0.34 mSv. The collective dose was 33.2 man mSv.

In the Idrija Mercury Mine in closure a total of 21 workers were exposed in 2008. On average they received 0.28 mSv and the collective dose was 4.4 man mSv.

41 out of 150 tourist workers in the Karst caves received an effective dose above 5 mSv, while 5 of them received doses exceeding 10 mSv, with the highest individual dose being 12.2 mSv. The collective dose was 500 man mSv, with an average dose of 3.4 mSv.

The findings of a study related to the exposure of individuals in the Karst caves show that the doses received due to radon exposure, assessed according to ICRP[2] 65, are underestimated for tourist workers in the Karst caves. Due to a high unattached fraction of radon progeny, an approximately two times higher dose factor should be taken into account, as described by the ICRP 32 model. Doses calculated in such a manner are thus twice higher than those calculated according to ICRP 65, used in the past.

The distribution of workers by dose intervals in different work sectors is shown in Table 9.

[1] All average doses in this section are calculated per number of workers who received a radiation dose above the minimum detection level.

[2] ICRP stands for International Commission on Radiological Protection which, among other tasks, periodically recommends methods for dose assessments.

Table 9: Number of workers in different work sectors distributed according to dose intervals (mSv)

	0-MDL	MDL≤E<1	1≤E<5	5≤E<10	10≤E<15	15≤E<20	20≤E<30	E≥30	Total
Krško NPP	198	343	41	0	0	0	0	0	582
Industry	367	107	18	3	0	0	0	0	495
Medicine and veterinary	1988	1142	78	2	0	0	0	0	3210
radon	10	148	71	36	5	0	0	0	270
Education, research and other	451	141	4	2	6	3	0	0	607
TOTAL	3014	1881	212	43	11	3	0	0	5164

MDL – minimum detection level
E – effective dose in mSv received by an exposed worker

Education of workers, using sources of radiation, is in accordance with regulations. Minor deficiencies have been found regarding timely refreshment of knowledge and skills. Training, refreshment courses and tests were carried out by the approved technical support organizations, namely the IOS and the JSI. In 2008 a total of 1453 participants attended courses on ionizing radiation protection.

In 2008, medical surveillance of radiation workers was performed by five approved occupational health institutions:

- Clinical Institute of Occupational, Traffic and Sports Medicine, Ljubljana,
- IOS, Ljubljana,
- Aristotelu, Llc., Krško,
- Health Centre Krško and
- Health Centre Škofja Loka.

Altogether 2,688 medical examinations were carried out.

5 RADIOACTIVE WASTE MANAGEMENT AND MANAGEMENT OF NUCLEAR AND RADIOACTIVE MATERIALS

In Slovenia, the high level radioactive waste (HLW) is the spent nuclear fuel (SNF) from the Krško NPP. The greatest amount of low and intermediate level radioactive waste (over 95%) is generated due to the operation of the Krško NPP. The rest is produced in medicine, industry and research activities. A special category of waste are spent sealed radioactive sources, which are in the possession of small holders or are stored in the Central Interim Storage for Radioactive Waste at Brinje.

5.1 Implementation of the National Programme on Radioactive Waste and Spent Nuclear Fuel Management

In 2006, the National Assembly of the Republic of Slovenia adopted the Resolution on the National Programme on Radioactive Waste and Spent Nuclear Fuel Management for the period 2006–2015 (ReNPROJG), which is part of the National Environment Protection Programme (NPVO). ReNPROJG is an extensive and detailed document, setting goals and tasks in the field of radioactive waste and spent nuclear fuel management.

Regarding the implementation of the National Programme, activities on the site selection for the LILW repository were carried out in 2008. The revision of the Krško NPP Decommissioning Programme and Disposal of LILW and SNF started and a draft of the Decommissioning Programme for the TRIGA research reactor was prepared. Furthermore, a modification of the Safety Case for the Jazbec mine waste pile was approved and the license for the CISRW operation was issued in 2008.

The preparation of the Operational Programmes of the National Programme on Radioactive Waste and Spent Nuclear Fuel Management, which assures all the objectives from the Resolution for a period from 2006 to 2009, was prepared in the beginning of 2007. Although the programmes were not adopted yet, ARAO prepared an overview of the implementation and the goals from different points of view (contents, timeframe, public acceptance, etc.) and a new version of the Operational Programmes of the National Programme on Radioactive Waste and Spent Nuclear Fuel Management for the period of 2008–2011. The Operational Programmes are currently being revised by the Ministry of the Environment and Spatial Planning.

5.2 Radioactive Waste and Irradiated Fuel at the Krško NPP

In the past years, volume reduction of LILW radioactive waste was achieved by means of compression, super-compaction, drying, incineration, and melting, so that the total volume of waste accumulated at the end of 2008 amounted to 2189 m^3. The total gamma and alpha activities stored were $1.98 \cdot 10^{13}$ Bq and $2.37 \cdot 10^{10}$ Bq, respectively. In 2008, 190 standard drums containing solid waste were stored with total gamma and alpha activities on 31 December 2008 $1.52 \cdot 10^{12}$ Bq and $1.77 \cdot 10^{9}$ Bq, respectively.

5.2.1 Management of Low and Intermediate Level Waste

Figure 15 shows the accumulation of low and intermediate level radioactive waste in the Krško NPP storage. Periodical volume reductions with compression, super-compaction, incineration, and melting are shown. The lower waste volume accumulation rate after 1995 is a result of a new in-drum drying system (IDDS) for drying of evaporators concentrate and spent ion exchange resins.

In 2006 the Krško NPP started continuous compression of radioactive waste with their own super-compactor installed in the storage facility. In 2008, there were 115 standard drums with compressible and other waste.

250 standard drums with compressible and other waste, the total mass and volume of which amounted to 27.7 tons and 52 m^3, respectively, were sent to incineration in December 2008 to Studsvik in Sweden. This waste will be treated and, in the form of secondary waste, returned to the Krško NPP in 2009 or 2010.

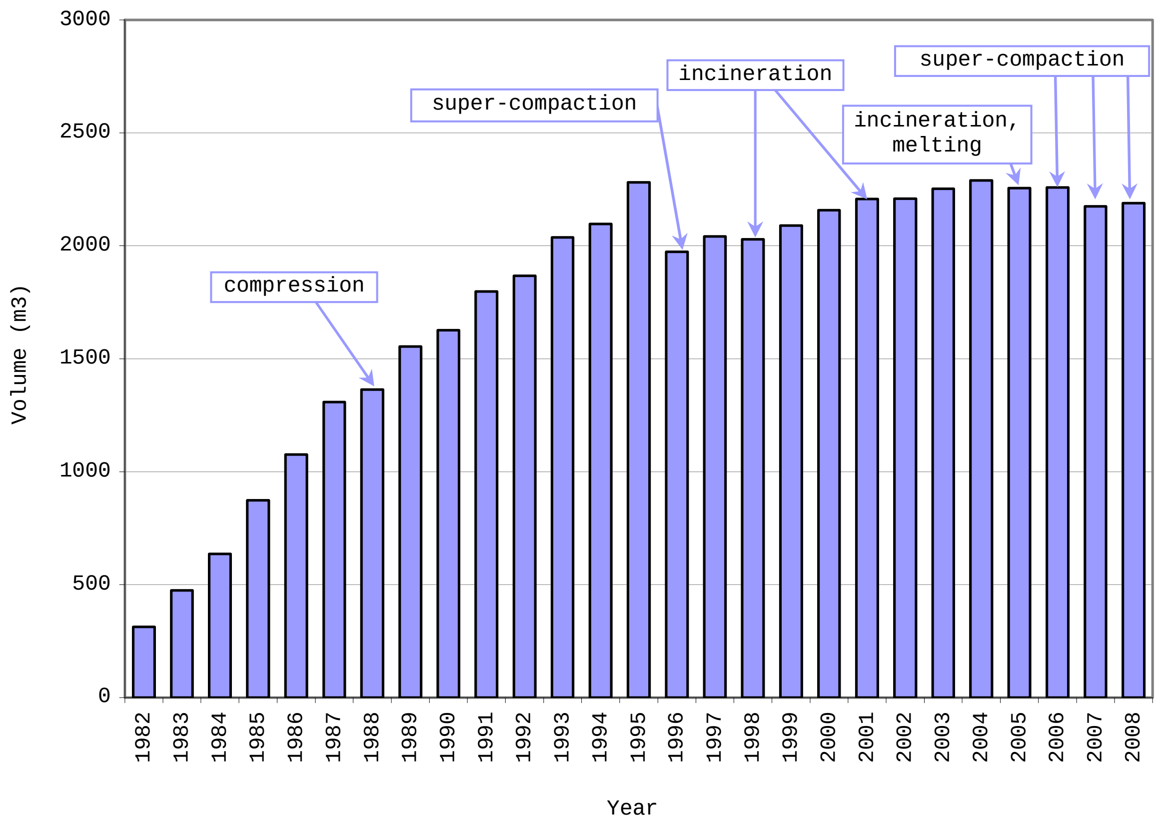


Figure 15: Accumulation of low and intermediate level radioactive waste at the storage in the Krško NPP

5.2.2 Management of Spent Nuclear Fuel

In 2004 the Krško NPP started with a longer fuel cycle, according to which outages take place every 18 months. In 2008, there was no regular outage. At the end of 2008 there were 872 fuel elements stored in the spent fuel pool. Figure 16 shows accumulation of spent fuel at the Krško NPP.

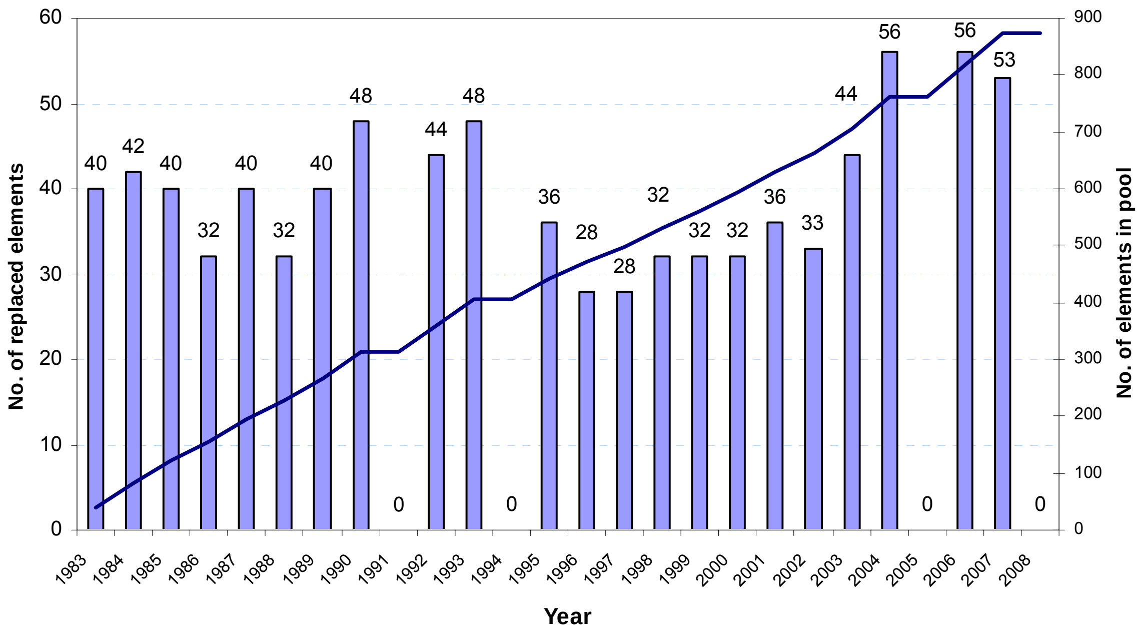


Figure 16: The annual discharges of spent assemblies and accumulation of spent fuel assemblies in the Krško NPP spent fuel pool

5.3 Radioactive Waste at the Jožef Stefan Institute

During the operation of the reactor in 2007, approximately 0.2 m^3 of radioactive material was produced in the hot cells and the controlled area of the Department of Environmental Sciences. After characterization the waste will be handed over to the Central Interim Storage Facility at Brinje by the Institute's Radiation Protection Unit.

The Radioactive Waste and Spent Fuel Management Programme for the reactor TRIGA–Mark II was prepared in 2008 by the Jožef Stefan Institute.

The Institute decided to stop the research in the field of uranium extraction for nuclear technology in 2005. The decontamination and decommissioning of the buildings where the activities were held in the past were finished in 2007.

As a result of these works 2 drums with short–lived waste were filled up and handed over to the CISRW. Furthermore, 31 drums of low-level waste with natural radionuclides (remains of uranium ore) were filled up and since they originate from Žirovski Vrh it would be very reasonable to dispose of the waste at the Jazbec repository. The SNSA extended the time limit for handing over the waste to the CISRW until July 2009 upon application filed by the Institute and because of the possibility of its disposal at the Žirovski Vrh area. Agreement about disposal of the drums at the Jazbec mine waste pile was not reached by the end of 2008 due to resistance of the local community (see Chapter 5.6).

5.4 Radioactive Waste in Medicine

The Institute of Oncology Ljubljana, as the biggest user of radioactive iodine ^{131}I, has appropriate hold-up tanks to facilitate decrease of the activity of waste liquids through decay. The tanks are emptied every four or more months. Also the new Institute of Oncology has appropriately arranged temporarily storage for radioactive waste. Radioactive sources which are no longer in use have been returned to the producer or handed to the CISF. Short-lived solid radioactive waste is temporarily stored in a specially arranged place for ageing. After a period of time authorized experts measure the specific activity of the waste and if the clearance values are not exceeded, the waste is discharged as non-radioactive waste. The Clinic for Nuclear Medicine of the Clinical Centre of Ljubljana has not built the system for holding up liquid waste yet. They intend to build new premises that will have an appropriate system for holding up liquid waste. The construction will be performed in the course of renovation of the Clinical centre.

5.5 Public Service for Radioactive Waste Management

The Agency ARAO is the responsible transactor of the public service of radioactive waste management.

5.5.1 Operation of the Central Interim Storage Facility

The ARAO operates the Central Interim Storage for Radioactive Waste at Brinje and is responsible for the receipt of radioactive waste from small producers. After two and a half years of trial operation, the SNSA issued the license for use and operation of the CISRW. The license is valid for a 10-year period.

In 2008, the first report was sent to the central registry of radioactive waste (»CERAO«), maintained by the SNSA. Besides this, the ARAO started regularly reporting to the European Commission regarding stored nuclear material in CISRW, in accordance with Council Regulation no. 302/2005.

5.5.2 The Process of Site Selection for the Disposal of Low and Intermediate Level Radioactive Waste

The ARAO is also responsible for the site selection and construction of the repository for low and intermediate level radioactive waste (LILW repository). The siting of the nuclear facility shall be carried out through a spatial plan of national importance.

The activities were carried out at two locations: Vrbina (Krško municipality) and Vrbina Šentlenart (Brežice municipality). The latter was proposed only in the beginning of 2007. In the frame of an Initial Field Research Programme, extensive research at the both potential locations, additional research at Vrbina in Krško municipality and initial research at Brežice location were carried out. The tender for additional research in Krško was not successful and it was repeated again in the second half of 2007 and carried out at both potential locations. The repeated tender succeeded and field activities continued in 2008.

Works at the Krško location were finished by the end of the year while works at the Brežice location were temporarily stopped due to a negative opinion of the Ministry of the Environment and Spatial Planning, the Environmental Agency of the Republic of Slovenia (EARS). EARS gave a negative opinion on construction on the proposed location, because it is considered to be a flood area, and the Water Act explicitly prohibits construction on such areas. Consequently the Directorate for Spatial Planning of the Ministry of the Environment and Spatial Planning decided to continue the siting procedure on this location with a modified approach. The ARAO, together with the designer and representatives of the municipality and the local community, tried to find a better location or technical solutions which would not reduce inundation surfaces along the Sava river. Despite an additional study that proposed a new solution, the Environmental Agency again issued a negative opinion in December 2008. All activities, especially in the field research and procurement of background information, were stopped until the final decision about the location in Brežice is reached.

The biggest task in the frame of repository planning was preparation of the Conceptual Design for the repository at the Krško site. The disposal in near-surface silos is proposed as the most suitable option. On the basis of the conceptual design, the contract for the preparation of the documentation was signed in March 2008. In December 2008 the Conceptual Design Project was finished and the document was distributed to experts in particular areas for review.

In the framework of the siting procedure for a LILW repository in Vrbina (Krško municipality) public hearing took place in February 2008. The representatives of the public raised many questions and issued many concerns. The answers were prepared and the concerns were addressed according to spatial legislation in a form of official positions. Based on these official positions the proposal of the Spatial Plan of National Importance will be prepared as a basis for the final confirmation of the location. It is expected that this proposal will be approved in the first half of 2009.

A week-long IAEA Expert mission was carried out in January 2008 to evaluate the proposed solutions for the Krško site. The final report was received in April 2008. The report provides observations about the work and suggestions for the continuation of the project and represents a valuable input for further work. The work on the three-year research project »Development of Technologies for the Existence of Engineer Barriers«, financed by the ARAO, the NPP Krško and the Ministry of Higher Education, Science and Technology was continued. In 2008, the second part of the project was carried out and the second intermediate report on identification of key parameters in implementation of the research on concrete and metal engineer barriers used in the LILW repository was prepared.

In 2008, collaboration with two local partnerships (Brežice and Krško municipalities), continued. The purpose of this local partnership is to facilitate the dialogue between the municipalities and the local public in the process of site selection. Many presentations, exhibitions and round tables about radioactive waste management and the siting procedure for the repository took place. Among others an excursion to a foreign LILW repository was carried out. People from both local partnerships took part in the excursion. Representatives of local partnerships were also involved in some international projects. Local partnership Krško demanded an independent review of the documentation prepared in the context of site selection for the Vrbina location (social aspects) and of the documentation exhibited during the public hearing and included into the preliminary Environmental Report. The report of the review was prepared in 2008 and presented to the local partnership and to representatives of the municipality. The decision of the local partnership Brežice was that three independent studies about the influence of the repository on the local community need to be carried out. Furthermore, a special publication on the fauna and flora at the Vrbina area was prepared.

Unfortunately, the deadline from article No. 141 of the Act on Protection against Ionizing Radiation and Nuclear Safety, according to which the site for the LILW repository should be chosen by the end of 2008, was not met.

5.6 Remediation of the Žirovski vrh Uranium Mine

The remediation of the Žirovski vrh uranium mine has been in progress since 1992. Until now, both the uranium processing plant and the mine, together with the accompanying objects, have been successfully decommissioned.

In 2008, the activities at the Žirovski vrh mine were mainly focused on remediation of the Boršt repository for hydrometallurgical tailings and the Jazbec repository for mine tailings.

On the Jazbec repository the remaining 40% of the surface was covered in 2008. The work was completed at the end of October. The mine water treatment plant was demolished, but two settlers for solid particles in the mine water were additionally installed for mine water treatment at the measuring point. An internal technical review of the Jazbec repository was carried out by Rudnik Žirovski vrh, contractors Cestno podjetje Ljubljana and Rudnik Trbovlje – Hrastnik and the supervising company DDC. Identified deficiencies will be eliminated in spring 2009.

On the Boršt repository the drainage systems were finished and were followed by a partial transformation of the surfaces and construction of the repository cover including the aggravating embankment. The containment pool was removed and ruble was transferred and temporarily deposited on the Boršt repository. With the removal of the pool and final arrangements of the site, outflow of seepage waters and surface rainfall water from the repository area changed.

The Žirovski vrh mine initiated administrative proceedings for excluding the part of the mining area for unlimited use in March 2008. This refers to 15 plots on which remediation works is accomplished. The plots of land were cleaned and decontaminated. Reports on decontamination were prepared, technical reviews were carried out and the provisions of the Ministry of the Economy had no restrictions on the use of the area. The status of the radiation facility on these plots ended by the decision of the SNSA.

The Žirovski vrh mine proposed that all the waste and remains of uranium ore originating from Žirovski vrh (due to technological and research activities), the Jožef Stefan Institute, the Geological institute and the Faculty of Natural Sciences and Technology, as well as the remains of uranium ore stored in the CISRW, should be moved to and deposited at the Jazbec repository. The waste is stored in 43 drums. The Žirovski vrh mine prepared adequate modification of the mining project for the closure of the Jazbec repository and adequate changes to the Safety Report for the Jazbec repository. The project was cancelled due to the resistance of the local community. In March 2008 a local public hearing was organized. In April the municipality Gorenja vas–Poljane requested to get the right to participate in the licensing process. As there is no legal basis for such role, the SNSA rejected such status of the local community and approved the modification of the Safety Report. Finally, all the conditions for the deposition of additional material have been met; however, further activities were stopped due to the opposition of the local community.

After the finalization of mining works for the improvement of the Jazbec repository for mine tailings and the Boršt repository for hydrometallurgical tailings, the license for the closure will have to be obtained from the SNSA. The license is a prerequisite to obtain a final approval on cessation of rights and obligations under the mining regulations. The sites of both repositories with adjacent land plots shall become a property of the government for an unidentified period of time.

The funds for performing the planned activities, for ensuring safe working conditions of the staff and external workers and for limiting the impacts of the mine on the environment, were fully and timely assured.

5.7 Transboundary Movement of Radioactive and Nuclear Materials

The SNSA and the Slovenian Radiation Protection Administration (SRPA) issue permits for import and export of radioactive and nuclear materials as well as consents for the shipments of radioactive material from other EU member states. The SRPA is the responsible regulatory body for radioactive sources used in medicine and veterinary medicine. In 2008, the SNSA approved 10 forms while the SRPA approved 34 forms for shipments of radioactive sources from other EU member states. Such standard document of declaration shall be valid also for multiple shipments, but only for a period up to three years.

Besides the mentioned shipments, the SNSA and SRPA issued altogether 19 licenses for import, 2 for export and 1 for shipment of low and intermediate level waste to Sweden for treatment.

In addition, the SNSA issued three licenses for transit of nuclear material and one license for transit of radioactive sources with significant activity. The SNSA prepared five approvals for package design re-validation of nuclear material and these approvals were issued by the minister responsible for the environment.

At the end of July 2008, a road transport of irradiated fuel from Romania took place from

Dolga vas to the port of Koper. The shipment consisted of two packages with app. 600 highly enriched and irradiated fuel elements. The consignor was the Institute for Nuclear Research (Pitesti), Romania. On the same vessel, bound for the USA, another shipment was loaded, namely non-irradiated enriched uranium. This road shipment derived from Italy.

In the middle of September 2008, a rail transport of irradiated fuel from a Hungarian research reactor was accomplished. There were 798 irradiated fuel elements either highly or low enriched. The total activity amounted to 6657 TBq. This shipment was carried out by a special train. The fuel was loaded into 8 containers containing two transfer casks each. The rail transport between the Slovene–Hungarian border and the port of Koper was followed by loading the containers onto the vessel that traveled across the Mediterranean Sea and the Atlantic Ocean to the port of Murmansk (north of the Russian Federation).

Figure 17: Transport of irradiated fuel from Budapest to port of Koper (location: railway station Hodoš)

The rail transports were accompanied, due to the physical protection measures, by a special police unit. The radiation control was performed by Slovene expert organizations. All transits were accomplished without any problems. In accordance with international agreements, all shipments were carried out in secrecy until their arrival to final destination.

In November 2008, a transit of radioactive sources with important activity took place, namely 51 sources with their total activity of 12,913.77 TBq (Co-60). The consignor was the Institute of Isotopes Co. from Hungary while the consignee was the Atomic Energy Authority from Egypt. This was a road transport from Hungary via Dolga vas (border) to the port of Koper, where the shipment was loaded onto a vessel that delivered the consignment to Alexandria (Egypt). The Co-60 sources will be used for industrial irradiation purposes.

5.8 The Fund for Decommissioning of the Krško NPP and for the Deposition of Radioactive Waste from the Krško NPP

The Fund for decommissioning of the Krško NPP and for the deposition of radioactive waste from the Krško NPP collects financial resources for decommissioning of the Krško NPP and for the safe deposition of LILW and spent nuclear fuel. In 2008, the Krško NPP delivered one half of electric power to Slovenian and one to the Croatian utility. GEN Energija, Llc. was liable for the payment of the regular levy to the Fund in 2008 in the amount of 0.003 EUR for every kWh of electric power received from the NPP. By the end of the year, GEN Energija, Llc. contributed in due time the total amount of 8,957,334 EUR.

In 2008, the Fund invested in accordance with the long term strategy and the investment policy. For the sake of safety of investments, the Fund has at least 25% of financial investments in securities issued or warranted by the EU or OECD member states.

On 31 December 2008, the Fund managed 136,241,305 EUR of financial investments, 14.97% of which was invested in banks in the form of deposits and CDs, 30.52% in state securities, 23.31% in other bonds, 10.83% in mutual funds, 13.04% in investment funds, 4.13% in stock and 3.19% in gold and precious metals.

The yield of the entire portfolio of the Fund for 2008 amounted to 4.46%, while the market yield of the portfolio amounted to −11.83%, as a consequence of prominent unfavorable conditions on the capital market. The income from financing in 2008 amounted to 5.24 million EUR. In 2008, the Fund realized 0.85 million EUR of capital profit. The entire income of 14,195,185 EUR from the funding in 2008 was 1.45% higher than planned. The expenses in 2008 were 38.12% lower than planned and amounted to 5,810,884 EUR. The expenses of portfolio managing in relation to the entire portfolio amounted to 0.33% and were 0.04% lower than in 2007.

The fund is facing a period of bigger investment costs, thus planning of solvency and rational use of finances shall be put forward.

Construction of the LILW repository is expected to take place by 2013. 10.85 million EUR was paid out by the Fund to the ARAO in order to carry out studies and projects in the area of management with radioactive waste and spent fuel. Since 2004, the municipalities have received 11.91 million EUR from the title of allowances due to limited use of space. Despite the above mentioned expenses the Fund has achieved in 11 years, including 2008, an average market profitability that amounts to 6.05% per year, thus exceeding the required minimum profitability by 1.76%. The year 2008 was marked by the financial and economic crisis. The market profitability of the Fund's portfolio was negative due to high drops of share indexes. Despite these facts the Fund managed its assets in an economically sound manner. The good organization and rational spending of assets reflected in the expenses, which were lower than planned.

6 EMERGENCY PREPAREDNESS

Emergency planning and preparedness is an important part of the comprehensive system for ensuring a high level of nuclear and radiation safety. During emergency competent organizations must be prepared to take prompt action according to emergency plans prepared in advance.

During 2008 the **Slovenian Nuclear Safety Administration** (SNSA) carried out a comprehensive revision of its emergency plan for preparedness and response in the case of nuclear emergency. The SNSA emergency organization was simplified. The USRJV Intranet was included in the SNSA emergency preparedness system as a major information hub. The SNSA actively co-operates with the Krško NPP and the Administration of the RS for Civil Protection and Disaster Relief (ACPDR).

The SNSA developed a new tool for internal communication during an emergency called **Communication System during an Emergency** (KSID). The KSID is a simple application for prompt, direct and safe information exchange among all SNSA emergency team members at the same time. Since the KSID was found to be effective, the SNSA developed a related application (**MKSID**) for broader communication between all main Slovenian emergency organizations. During 2008 the MKSID was successfully adopted by the ACPDR, the Slovenian National Warning Point (CORS) and by the Krško NPP (The Technical Support Centre and the Off-site Support Centre). The MKSID was successfully introduced as a parallel communication system during the national exercise »NEK 2008«.

During 2008 the **Administration of the RS for Civil Protection and Disaster Relief** (ACPDR) continuously ensured national emergency preparedness in the area of nuclear and radiation preparedness. Within the scope of nuclear and radiation emergency preparedness the ACPDR continued its permanent activities in amending and updating the national, regional and municipal emergency plans, as well as harmonizing other plans with the National Nuclear Emergency Response Plan. The number of written and harmonized plans in municipalities increased by about 20% compared to the previous year.

In 2008 the activities of the **NPP Krško** in the area of emergency preparedness focused on the maintenance of the existing preparedness and accomplishing professional training, drills and exercises. Besides that, there were also permanent activities in revision of its own emergency plan, as well as harmonizing it with the National Nuclear Emergency Response Plan. Activities also went on coordination of emergency tasks with all other relevant organizations.

Besides training, there were also all-year maintenance and inspections activities of the operability of centers and equipment used for emergency response, updating of the documentation in the centers, monthly tests of communication systems and tests of the emergency personnel response.

During 2008 it was found that the **Mobile Unit** coordination during emergency should be improved. It was arranged that in the case of emergency the mobile units would be directed by the SNSA and coordinated by the Unit for a rapid rescue intervention, which was included in the new procedure. There is still a need to better define data transfer from the field and to carry out testing of the solution.

The **National Exercise »NEK2008«** (NEK – the Krško NPP), which was a staff exercise only, was conducted on 20-21 October. It started with an unusual event and competent authorities were informed in accordance with the procedures. Adequate operating, corrective and protective measures were taken on the site; the intervention personnel and the centers for the control of the event participated; assessment of radiological consequences was made and external institutions were activated for notification. The meteorological conditions were very important for the decision on implementation of protective measures for residents.

Because of the long duration of the exercise, it was carried out in shifts. All the planned goals were achieved. The exercise demonstrated good preparedness of the plant and the participating external institutions in all components of the control of emergency that were tested. Some minor deficiencies were established in the national report and will be eliminated in accordance with the action plan; the solutions will be incorporated in the National Nuclear Emergency Response Plan, which will be revised in 2009.

The International Atomic Energy Agency (IAEA) organized an **international exercise ConvEx-3 2008** to verify the response to a simulated nuclear accident at the Mexican nuclear power plant Laguna Verde. The exercise was conducted from 9 to 10 July 2008 and lasted continuously for 48 hours. In the exercise 74 IAEA member states and 10 international organizations participated. The SNSA and the CORS took part in this international exercise.

6.1 The Media Alarm in Europe because of the Unusual Event at the NPP Krško on 4 June 2008

A leak from the primary system to the containment was detected by the Krško NPP operating personnel at 15:07 on Wednesday, 4 June 2008. Since the leak was larger than allowed, the plant was under controlled shutdown from 98.6% power by 5 MW/min. The generator was disconnected from the grid at 19:30 and the reactor was subcritical at 19:50.

The Krško NPP announced the unusual event on 4 June 2008 at 15:56. The Slovenian national and regional warning points (CORS, ReCO) and the SNSA were notified.

The SNSA inspector on duty was first called and he informed the SNSA director about the event at 16:09. The SNSA director promptly decided to partially activate the SNSA expert team for managing emergency situations.

The SNSA sent the first message about the event to the European Commission (EC) by the ECURIE system at 17:38. The ECURIE office head forwarded the SNSA message to all national centers in Europe at 18:00.

The SNSA prepared and exchanged a draft summary of its press release for the public with the Krško NPP at 18:08 and then issued it at 18:16. A few minutes later the Krško NPP issued the same press release as well.

Between 18:35 and 19:00 the SNSA sent the report to the IAEA and competent authorities of Austria, Hungary, Croatia and Italy.

At around 19:30 the EC issued a press release on the event, which set off extraordinary interest all across Europe. Immediately after that, the media pressure started on all competent authorities and continued until the next day. Because of high media pressure the SNSA published an additional press releases on the SNSA website and sent additional information to the ECURIE system.

There was a meeting of the ECURIE member states and EC in November 2008 in Brussels to discuss the event. It was found out that Slovenia in this case did not need to send an alert message, but on the other hand Slovenia was following the procedures to communicate transparently and to report minor events as well. The members of the meeting agreed that EC published a press release which was too alarming and which started a large media alarm throughout Europe. The EC prepared improved criteria for reporting to the ECURIE system. The provision when to report was explained in greater detail.

In the future, similar cases will be announced as information messages with a new keyword - »incident«. The EC representatives agreed that the press release was too alarming, however they kept the right to inform the public in similar cases also in the future. They agreed that before issuing press releases they would consult with the country of the event.

The Slovenian government formed a commission to investigate the event. The commission found out that the actions were in accordance with expectations but with some deficiencies. The government commission suggested the procedures for emergency information should be improved, that emergency exercises should be regularly continued, that the Slovenian competent authorities and the EC should improve the procedures for similar cases and that the system for implementing emergency measures should be more rigorous.

7 CONTROL OVER RADIATION AND NUCLEAR SAFETY

7.1 Legislation

The most important legal instrument in the area of nuclear and radiation safety in the Republic of Slovenia is the Act on Protection against Ionizing Radiation and Nuclear Safety (ZVISJV, Off. Gaz.RS,102/04 – official consolidated text).

Based on the ZVISJV, twenty-three implementing regulations were adopted at the beginning of 2008, namely five governmental decrees, seven regulations issued by the minister of the environment, nine issued by the minister of health and two issued by the minister of the interior.

In 2008 the adoption of implementing regulations continued and the following regulations were issued:

- Decree on safeguarding of nuclear materials (Off. Gat. RS, 34/08) and
- Regulation on transboundary shipment of nuclear and radioactive substances (Off. Gaz. RS, 20/07).

A detailed list of the already adopted implementing regulations and those under preparation can be found at the SNSA web page http://www.ursjv.gov.si/, but is not yet fully available in the English translation.

7.2 The Expert Council for Radiation and Nuclear Safety

The Expert Council for Radiation and Nuclear Safety provides expert advice to the Ministry of the Environment and Spatial Planning and to the Slovenian Nuclear Safety Administration in the fields of radiation and nuclear safety, physical protection of nuclear materials and facilities, safeguards, radioactivity in the environment, radiation protection of the environment, intervention measures and mitigation of the consequences of emergencies and use of radiation sources other than those used in health and veterinary care.

The Expert Council convened three regular sessions and two correspondence sessions in 2008. In addition to the regular reporting of the SNSA Director to the Council on the news and developments in the field of radiation and nuclear safety between the meetings, the Council considered the following subject areas: monitoring of operation of nuclear facilities, drafts of new nuclear regulations and their status, preparedness and communication in case of emergency and general questions on nuclear and radiation safety. In 2008, the Expert Council also reviewed and adopted the Annual Report on Radiation and Nuclear Safety in Slovenia for 2007, the Third Report of the Republic of Slovenia under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, Regulation on Transboundary Shipment of Radioactive and Nuclear Materials and Regulation on Transboundary Shipment of Radioactive Waste and Spent Fuel.

It is worth mentioning that the Expert Council also took into consideration general open issues on nuclear and radiation safety. However, the members expressed their concern about the observance of their opinions and proposals that should be complied with. Another problem is the unduly long time span between the approval of the regulation drafts by the Expert Council and the adoption of these drafts.

7.3 Slovenian Nuclear Safety Administration

The Slovenian Nuclear Safety Administration (SNSA) performs specialized technical and developmental administrative tasks and tasks of inspection in the areas of: radiation and nuclear safety; carrying out of practices involving radiation and use of radiation sources, except in medicine and veterinary medicine; protection of environment against ionizing radiation; physical protection of nuclear materials and facilities; non-proliferation of nuclear materials and safeguards; radiation monitoring; and liability for nuclear damage.

The web pages of the Slovenian Nuclear Safety Administration (http://www.ursjv.gov.si/) offer general information about the SNSA, information to the public, legislation, agreements and standards in this field, annual and other reports, information on meetings, workshops, projects and invitations for tenders co-financed by the International Atomic Energy Agency, data on radiation monitoring, INES events and links to the web pages of other regulatory authorities, organizations and research centers. On these web pages all relevant information required by the Act on Access to Information of Public Nature is also available. Unfortunately the English version is less comprehensive.

At the end of 2008the SNSA had 46 employees.

In December 2007 the SNSA successfully passed the external audit and acquired the certificate according to the requirements of the standard ISO 9001:2000, Quality management systems – Requirements. On 17 December 2008 the Bureau Veritas performed the regular yearly control audit of the SNSA management system and found that the system was coherent, well maintained and that a significant progress had been achieved in the last year.

The Expert Commission for the *Verification of Professional Competence and Fulfillment of Other Requirements in respect of Workers Performing Duties and Tasks in Nuclear and Radiation Facilities* (the Commission) carried out examinations for the extension of licenses for the Senior Reactor Operator, the Reactor Operator and the Shift Engineer of the Krško NPP. Five candidates successfully acquired the extension of the Senior Reactor Operator license, three candidates acquired the extension of the Reactor Operator license and eight candidates acquired the extension of the Shift Engineer license. One candidate passed the examination for the Senior Reactor Operator for the first time. The SNSA granted the prolongation of licenses for performing work and duties in the Krško NPP to the operators.

In addition, in October 2008, the Commission organized the initial licenses examination of qualification for new Reactor Operators. All seven candidates successfully passed the initial examination and acquired the first Reactor Operator license. The SNSA granted them the initial licenses of Reactor Operator.

In 2008 no examinations for the license prolongation of operators and the shift supervisor were preformed at the research reactor TRIGA at the Jožef Stefan Institute.

7.4 The Slovenian Radiation Protection Administration

The Slovenian Radiation Protection Administration (SRPA), an agency within the Ministry of Health, performs specialized technical, administrative and developmental tasks and tasks of inspection related to carrying out practices involving radiation and use of radiation sources in medicine and veterinary medicine, protection of public health against harmful effects of ionizing radiation, systematic survey of exposure at workplaces and in the living environment due to the exposure of humans to natural ionizing radiation sources, monitoring of radioactive contamination of foodstuffs and drinking water, restriction, reduction and prevention of health detriment resulting from non-ionizing radiation, and auditing and authorization of radiation protection experts.

The Expert Council for radiation protection of people was nominated by the Minister of Health on 19 September 2005. The Expert Council advises the Ministry of Health and the

SRPA on topics related to radiation protection of people, radiological procedures and use of radiation sources in medicine and veterinary medicine.

As a special operational unit within the SRPA, the Inspectorate for radiation protection is competent for the control of sources of ionizing radiation used in medicine and veterinary medicine and for the implementation of legislation in the field of protection of people against ionizing radiation. In 2008, the SRPA had five employees.

The activities of the administration were focused on performing duties in the field of radiation protection and on strengthening of the system for health safety of people against harmful impacts of radiation in the Republic of Slovenia.

Within this framework, the activities of the SRPA comprised issuing of permits and certificates as prescribed by the Act, issuing of approval to radiation protection experts, performing inspections, informing and increasing awareness of the public about procedures of health protection against harmful effects of radiation, and co-operation with international institutions involved in radiation protection.

The SRPA carried out the project »Analysis of patient exposures at interventional cardiac procedures«. In 2008 the SRPA financed monitoring of foodstuff and drinking water in the Republic of Slovenia, the project »Ensuring quality assurance system for radiotherapy devices« and the project »Assessment of radiation exposure of the population due to intake of the ^{210}Po«. The SRPA controlled radiation practices in medicine and veterinary medicine and use of radiation sources in these activities. Altogether 98 permits to carry out a radiation practice, 185 permits to use radiation sources, 7 permits to import radioactive sources, 98 confirmations of programmes of radiological procedures, 91 evaluations of protection of exposed workers and 34 statements of consignees of radioactive materials were granted. 4 in-depth inspections were performed in medicine and veterinary medicine, 1 provision requiring correction of established deficiencies was issued and 1 provision requiring prohibition of further use of obsolete devices.

With regard to radon, the SRPA supervised the Žirovski vrh uranium mine, the Idrija Mercury Mine in closure, the Postojna Cave, the Škocjan Caves, as well as primary schools, kindergartens, hospitals and other public buildings with increased radon concentrations.

7.5 Authorized Experts

Authorized experts for radiation and nuclear safety

The Act on Protection Against Ionizing Radiation and Nuclear Safety lays down the requirement that the operators of radiation or nuclear facilities consult authorized experts or acquire their expert opinion on specific interventions in the facilities.

In 2008 the SNSA, based on applications and records on the fulfillment of the conditions, authorized for carrying out the work of authorized expert for radiation and nuclear safety in individual fields or in a number of fields of radiation and nuclear safety two legal entities. Based on yearly reports of authorized experts, the main conclusion was that in comparison with the previous years there were no major changes in their performance. In the field of staffing they maintained their competence and the equipment used in their professional work was well maintained and updated. The organizations established the Quality Management Programmes certificated in compliance with ISO 9001:2000. The authorized experts kept providing professional support to the Krško NPP by preparation of an independent expertise. An important part of their work focused on an independent review and assessment of plant modifications. They also offered professional support to the remediation of the mining waste sites of the Žirovski vrh mine and to the activities of the Agency for Radwaste Management.

An important part of their activities consisted of research and development activities. Some organizations successfully participated in international research projects.

Authorized radiation protection experts

Authorized radiation protection experts cooperate with the employers in drawing up assessment of the radiation protection of exposed workers, give advice on the working conditions of exposed workers, on the extent of implementation of radiation protection measures in supervised and controlled areas, on the examination of the effectiveness thereof, on the regular calibration of measuring equipment, and on the control of usefulness of protective equipment, and perform training of exposed workers in radiation protection.

Authorized radiation protection experts regularly monitor the levels of ionizing radiation, contamination of the working environment and working conditions in supervised and controlled areas. The authorization can be granted to individuals (for giving expert opinions and for presentation of topics relating to training on radiation protection) and to legal entities (for giving expert opinions, performance of control measurements, inspection of radiation sources and protective equipment and for performance of training on radiation protection). Individuals can acquire authorization if they have appropriate formal education, working experience and expert skills, and legal entities if they employ appropriate experts and have at their disposal appropriate measuring methods accredited against the standard SIST EN ISO/IEC 17025. Authorizations are limited to specific expert areas.

Based on the opinions of the Commission for verification of fulfillment of the conditions for carrying out the work of authorized radiation protection experts, the SRPA issued in 2008 authorizations to two individuals.

Authorized dosimetric service

Authorized dosimetric service performs tasks related to monitoring of the exposure of people to ionizing radiation. An authorization can be granted only to legal persons if they employ appropriate experts and have at their disposal appropriate measuring methods accredited against the standard SIST EN ISO/IEC 17025. In 2008 the SRPA did not issue any authorization for the dosimetric service.

Authorized medical physics experts

Authorized medical physics experts give advice relating to the optimization, measurement and evaluation of irradiation of patients, to the development, planning and use of radiological procedures and equipment, and to ensuring and verifying the quality of radiological procedures in medicine. Authorized medical physics experts can only be physical persons. In 2008 the SRPA issued an authorization to five physical persons.

Authorized medical practitioners carrying out medical surveillance of exposed workers

In 2008 one specialist in work medicine, employed by the authorized institution Aristotel Medical Centre Plc. from Krško, acquired the authorization for carrying out medical surveillance of exposed workers.

7.6 The Nuclear Pool GIZ

The pool for the insurance and reinsurance of nuclear risks GIZ (Nuclear Pool GIZ) is a special type of insurance company dealing with insurance and reinsurance of nuclear risks. The Nuclear Pool GIZ has been operating since 1994 and at the moment includes seven members. The Insurance Company Triglav, Ltd., the Reinsurance Company Sava, Ltd. and the Adriatic Slovenica, Ltd. have the biggest shares in the Pool. The Nuclear Pool GIZ has its headquarters at the premises of the Insurance Company Triglav, Ltd., Miklošičeva Street 19, Ljubljana.

The Krško NPP third party liability cover is insured by the Nuclear Pool GIZ in the amount of SDR 150 million, in Euro equivalent (app. 167 million €).

The Nuclear Pool GIZ participated in third party liability insurance risk up to its capacity level, while the rest of the risk is reinsured by 18 foreign pools, the most important being the British, the Japanese, the French, the Swiss and the German pool.

In 2008 the NPP Krško did not report any damage to the Nuclear Pool GIZ.

Also the Jožef Stefan Institute's TRIGA type Research Reactor third party liability cover is insured by the Nuclear Pool GIZ in amount of SDR 5 millions.

8 NUCLEAR NON-PROLIFERATION AND SECURITY OF RADIOACTIVE MATERIALS

The international community has increased its attention to nuclear non-proliferation in the last few years. A violation of the nuclear non-proliferation treaty has been discovered due to the Gulf crisis, as well as of clandestine activities in North Korea. A few countries which are not contracting parties continue with their nuclear weapons programmes (India, Pakistan and Israel). The situation in Iran shows that their peaceful nuclear program is not always transparently presented. The United Nations Security Council adopted two additional resolutions, namely 1803 (2008) and 1835 (2008), about Iranian nuclear activities of international concern.

Slovenia completely fulfils its obligations which derive from the adopted international agreements and treaties. Together with other countries it tries to prevent further expansion of nuclear weapons. Due to potential misuse of radioactive sources, the international community, including Slovenia, has increased the control of these sources with significant activity. Slovenia amended its legislation in compliance with the EU and IAEA guidelines.

Nuclear Safeguards

Nuclear safeguards are regulated on the international level with the Nuclear non-proliferation treaty and the EURATOM treaty. In the process of accession to the EU, the legal frameworks had to be rearranged. Slovenia now completely fulfils its obligations regarding nuclear safeguards.

In Slovenia, all nuclear material (fresh and spent fuel) at the Krško NPP, at the Jožef Stefan Institute, at the Central interim storage for radioactive waste in Brinje and at the other eleven holders of small quantities of nuclear material is under the supervision of international inspection.

All holders of nuclear material report directly to the European Commission about their quantities and status of nuclear material, in accordance with the Commission Regulation (EURATOM) No. 302/2005 on the application of EURATOM safeguards. The reports are sent in parallel to the SNSA, which maintains its registry on nuclear material, in accordance with Slovene legislation.

There were five joint IAEA/EURATOM inspections in 2008, and EURATOM carried out one without the presence of IAEA. No anomalies were found. The Slovenian holders of nuclear material reported to EURATOM in accordance with legislation.

Due to the »non-side letter« application of the Additional Protocol, the SNSA reports in accordance with the Protocol, to the IAEA and to EURATOM (to the latter in the defined scope).

The Comprehensive Nuclear Test-Ban Treaty

One of the international legally binding instruments for combating proliferation of weapons of mass destruction is the Comprehensive nuclear-test-ban treaty (CTBT). Slovenia signed the treaty on September 24, 1996 and ratified it on August 31, 1999.

Several meetings of working groups in the framework of the CTBT Organization took place in 2008. The SNSA together with the Ministry of Foreign Affairs considered the events in this area. In the meetings taking place in the first half of the year, Slovenia also acted as the chair country of the EU.

Export Controls of Dual-Use Goods

In the scope of international activities in this area, the SNSA and the Ministry of Foreign Affairs participate in the work of the Nuclear Suppliers Group (NSG) and the Zangger

Committee. Slovene representatives regularly participate in the sessions of both organizations.

The 18th Plenary week was held in Berlin (Germany) in May 2008. Slovenia was in charge of EU Presidency and harmonized the joint statement, which was supported also by some non-EU European countries. One of the crucial meetings was the extraordinary Plenary in September, when the NSG Member States, after long negotiations, endorsed an exemption for India (non-NPT signatory), regarding nuclear transfers.

On the basis of the Act on Export Controls of Dual-Use Goods, a special Commission for Export Controls of Dual-Use Goods, such as goods that can be used not only for civil but also for military purposes (including nuclear weapons, weapons of mass destruction), was formed at the Ministry of Economy. Representatives of the Ministry of Economy, the Ministry of Foreign Affairs, the Ministry of Defense, the Ministry of the Interior, the Customs Administration, the SNSA, the Slovenian Intelligence and Security Agency and the National Chemicals Bureau constitute the membership of the Commission. An exporter of dual-use goods must obtain a permit from the Ministry of Economy, issued upon opinion of the Commission. In 2008, the Commission had 9 regular and 14 correspondence sessions.

Physical Protection of Nuclear Material and Facilities

In July 2006 the application of provisions for two regulations in the area of physical protection of nuclear material and facilities, issued on the basis of the 2002 Act, started. State administrative bodies and nuclear facility operators coordinated their activities with the provisions of both regulations. The operators prepared the plan for physical protection of nuclear facilities and handed it over to the Ministry of the Interior for approval. Following new regulations, training of workers performing physical protection of nuclear facilities as well as transports of nuclear material was carried out. The Inspectorate of the Republic of Slovenia for Internal Affairs, together with inspectors of the SNSA, performed an inspection of physical protection at the Reactor Infrastructure Centre of the Jožef Stefan Institute. The commission for performing expert tasks in the field of physical protection of nuclear facilities and materials worked in compliance with its mission. The commission works intensively on the coordination of work of various competent authorities.

In 2008, the new Penal Code of the Republic of Slovenia entered into force. It defines as criminal acts not only sabotage in a nuclear facility but also other criminal acts from the Convention on physical protection of nuclear material. The process of ratification of the amendments is in process.

The physical protection of shipments of irradiated fuel and nuclear material from Romania, Italy and Hungary was successfully accomplished. Road as well as rail transport was used to the port of Koper.

In 2008, Slovenia became a member of the European Nuclear Security Regulators Association (ENSRA). The meeting of ENSRA was held in Prague (Czech R.); Slovenian was represented by the SNSA and the Police.

Illicit Trafficking of Nuclear and Radioactive Materials

The **Decree on checking the radioactivity for shipments of metal scrap** has been in force since January 1, 2008. This decree determines the requirements and rules on radiation safety provisions which have to be considered by the consignee and the organizer of transport in the case of import of scrap metal into the Republic of Slovenia. The purpose of the decree is to prevent overexposure of workers and the general public due to insufficient control over radiation sources of unknown origin, and to prevent high costs of potential decontamination. Eighteen organizations were authorized for measurement of radioactivity in scrap metal shipments by the end of 2008. Seventeen of these sent their annual reports to the SNSA. According to them, 82,661 measurements of shipments were carried out. In eight cases, the dose rate was more than 50% above the natural radiation of background. One of these cases was detected by an Austrian organization.

To enable assistance and consultation, the SNSA gave some other state offices and private organizations (scrap recyclers, melting facilities) the phone number of a 24-hour on-duty officer. Four calls were registered in 2008. One case was related to elevated radiation due to orphan source (Ra-226) at the premises of a scrap collector and recycler. At the end of July, the source was safely transferred to the Central interim storage for radioactive waste in Brinje. The reasons for the small number of events are probably: positive effects of implementation of the above-mentioned decree, growing interest of the industrial sector as well as training of customs officers, organized in 2008. A step forward has also been achieved by the installation of additional detection devices, at scrap dealers and recyclers, as well as others.

There were more than 100 cases of illegal trafficking reported to the IAEA Illicit Trafficking Database in 2008. It should be noted that some Member States delay their reports, therefore the actual number of events will be substantially higher. The IAEA estimates that at about 40% of all incorporate criminal activity. About 70% of all were characterized as found or seized radioactive sources, for which no data on loss, theft or missing was recorded. Concerning nuclear material, the cases mostly involve unauthorized transfer or sale, while with regard to radioactive sources they mostly involve theft or unauthorized disposal.

9 RESEARCH ACTIVITIES

With specifically targeted research projects we try to maintain and improve the technical and scientific knowledge needed for providing radiation and nuclear safety. In this chapter the research projects financed or organized by the SNSA for this purpose are presented.

Radioactivity of building materials in dwelling constructions in Slovenia

According to the data of the Slovenian Statistical Office (2004) there are half a million of building constructions in Slovenia, 58% of which were built of clay bricks, 32% of concrete and combined clay and concrete building elements, 8% were made of stone, and only 2 percent are wooden buildings. Slightly over a half of all buildings were built in the rural environment, and the rest in urban areas. Approximately two thirds of buildings are older than 30 years. Slovenian legislation on radiation protection prescribed the limits for radioactive substances in building materials used in dwelling construction.

In the research study, performed by the Jožef Stefan Institute in collaboration with the Institute of Occupational Safety, 85 specimens of different building elements and raw material were analyzed, among them wall bricks, wall and floor linings, roof tiles, and basic raw materials. The most frequently used clay building elements contain natural radionuclides about the levels of 60 Bq/kg ^{226}Ra, 50 Bq/kg ^{232}Th and 600 Bq/kg ^{40}K mainly. Concrete building elements contain the lowest radioactivity (at least three times less than the clay ones), while the highest levels of ^{226} Ra were analyzed in fly ash bricks from Velenje (up to 460 Bq/kg). They were being produced for two decades (till the middle of the eighties); 170 million pieces were produced for approximately 25,000–30,000 individual houses, mostly in Styria. A half of the above fly ash bricks quantity was produced from coal ash from the thermal power plant of Trbovlje, containing only a half of ^{226}Ra content compared to Velenje. Enhanced levels of ^{40}K were measured in some marble tiles (window tiles, floor and wall tiles), among others also in tonalite material from Pohorje. The extent of the research study was limited and did not cover all clay factories (both clay factories from Styria are missing, one at Pragersko and another at Ormož). The producers of ceramic tiles are not considered either, such as the Martex company from Volčja Draga). Only a limited number of samples from older houses were analyzed, mostly due to problematic sampling of already built-in materials in the dwelling constructions.

Radionuclides in underground water in the environment of the Krško NPP and tracing of tritium in the Sava river

The goals of the research project, performed by the Jožef Stefan Institute, were above all to ascertain a potential impact of the nuclear power plant on underground water and the possibility of application of radionuclides such as tritium (^{3}H) and gamma emitters in searching for the origin and dynamics of underground water. Within the frame of the research, samples of underground water, taken at 13 locations and in both surface waters, the rivers Sava and Krka, were analyzed. The performed research work showed that discharges from the nuclear power plant have an impact on the underground water in the nearby vicinity of the Sava river, that is only within a narrow zone along the river.

A special part of the project comprised dynamic measurements of tritium concentrations in the river in the time frame of the planned discharge of tritium from the NPP with known activity. Sampling was performed during the discharge, lasting for three hours at five locations along the Sava river, starting from the dam of the NPP, and downstream to the sampling station at the Brežice bridge. Measurements showed that during the discharging, concentrations of tritium steeply increase at the spots closer to the NPP dam, while a delay of their growth and longer duration of higher concentrations were observed at more distant spots. Concentrations of ^{3}H in the Sava river in the vicinity of the power plant reached over 200 kBqm^{-3}, and at the most distant location at Brežice 85

$kBqm^{-3}$. The impact was periodically observed also with essentially enhanced concentrations of ^{3}H in underground water in the nearby vicinity of the Sava river bed downstream the plant in cases of major discharges.

Targeted research program Competitive position of Slovenia in 2006–2013 – providing radiation and nuclear safety

Already in 2005 the Government of the Republic of Slovenia approved the starting points for sustainable assurance of supporting activities in the field of nuclear and radiation safety and appointed a working group that prepared the program of long term assurance of supporting activities in the field of nuclear and radiation safety. Based on this program, within the targeted research program Competitive position of Slovenia in 2006–2013 also the thematic cluster was tendered, including chapter 5.6 Assurance of radiation and nuclear safety. It comprised three thematic items: Safety questions on technologies of nuclear and radiation facilities, Safety disposal of radioactive waste and spent fuel, and Radioactivity monitoring in the living environment.

The project was closed in 2008. The contractual obligations were entirely fulfilled. Work of the research project contractors was assessed as good, and consequently the same thematic cluster was tendered in 2008 for implementation and its financing.

Three long-term joint projects were selected:

- Development of knowledge indispensable for evaluation, assessment and surveillance of ageing management in nuclear facilities,
- Construction properties of concrete and water penetration through concrete structures and
- Establishment of the ratio between 129I and 127I in marine and terrestrial environment in Slovenia.

The research projects are financed by the SNSA and the Slovenian Research Agency.

10 INTERNATIONAL CO-OPERATION

10.1 The International Atomic Energy Agency

Traditionally the Slovenian delegation attended the regular annual session of the General Conference. The cooperation between Slovenia and the International Atomic Energy Agency was the closest in the following fields:

- Slovenia received 14 applications for training of foreign experts in our country in 2008. 12 of these were implemented in the same year, as well as 8 applications from the previous year. 1 IAEA application was cancelled by the Agency while another one already approved by our country will be implemented in 2009.
- Slovenia submitted 3 new proposals for research contracts. 8 research contracts were in progress from the previous years, while 1 research contracted was completed in 2008.
- Already in 2007, Slovenia submitted 4 new proposals of national technical assistance projects for the cycle 2009–2011. The Board of Governors approved 2 new technical assistance projects for this three-year period. In 2008, all 3 national projects from cycle 2007–2008 were completed.
- Slovenia continues with its active policy of hosting activities organized by the IAEA. In 2008, Slovenia hosted 2 regional workshops and 1 training course.
- In 2008, three Slovenian experts, appointed to the Nuclear Standards Committee, the Waste Standards Committee and the Radiation Standards Committee, actively participated in activities of the three committees.

In the first half of 2008 Slovenia, during its Presidency of the EU, drafted and coordinated several statements and reports concerning Iran, the Democratic People's Republic of Korea and Syria, the Programme and Budget Committee, the Cooperation agreements with intergovernmental organizations, the report of the commission of eminent persons and the Annual Report for 2007.

In 2008, the Board of Governors convened at four regular sessions, in one extraordinary session, once as the Board of Governors’ Programme and Budget Committee and once as the Board of Governors’ Technical Assistance and Cooperation Committee.

10.2 Organization for Economic Co-operation and Development – Nuclear Energy Agency

In 2008, the Republic of Slovenia continued its well-developed cooperation with the Nuclear Energy Agency (NEA) – Organization for Economic Co-operation and Development (OECD). The mission of the NEA is to assist its member countries in maintaining and further developing the scientific, technological, and legal bases required for the safe, environmentally friendly and economical use of nuclear energy for peaceful purposes. The Agency has a network of cooperation with the Atomic Energy Agency in Vienna and European Commission in Brussels and Luxembourg. The NEA implements specific scientific projects including verification and benchmarking of some scientific results which will pave the way to further progress.

Organization-wise the Agency has seven standing technical committees working under the auspices of the Steering Committee for Nuclear Energy – the governing body of the NEA –, which reports directly to the OECD Council. The standing technical committees consist of member- and observer-states experts. The Committees represent a specific international forum for the exchange of experiences and knowledge regarding specific technical issues. Since 2007, when Slovenia received the invitation for regular OECD membership, the Slovenian representatives have been aware that their successful work will influence the membership decision when the OECD Council considers the Slovenian request for NEA membership.

10.3 Cooperation with the European Union

Working Party on Atomic Questions (ATO)

In the first half of 2008, Slovenia chaired and actively participated in the Council of the European Union Atomic Questions Working Group (ATO).

The Slovenian Presidency Programme for the Atomic Questions Working Group was fully implemented. It comprised preparations for the review meeting under the Convention on Nuclear Safety, reporting on the work of the high-level group (HLG, later renamed into ENSREG) as well as monitoring developments in the field of safeguards, where the high-level liaison committee (HLLC) convened and reviewed the open issues, and signing the political statement between EURATOM and IAEA.

In the second part of 2008, France took over the presidency. The main focus remained on the proposal of the nuclear safety directive, initially prepared by the High Level Group. The Working Party also dealt with the renewal of Agreement between EURATOM and Canada, and reporting on KEDO dissolution. Successful coordination of the draft Council Resolution on Spent Fuel and Radioactive Waste Management marked the end of French presidency.

High-level Group on Nuclear Safety and Waste Management (ENSREG)

The High-level Group on Nuclear Safety and Waste Management (HLG, later renamed into ENSREG) was established by the European Commission on 17 July 2007. On its first meeting in January 2008 Dr. Andrej Stritar, the SNSA Director, was nominated as the representative of a country with a small nuclear program and later he was also elected the chair of the High-Level Group. The High-Level Group established three subgroups for the implementation of planned work: for nuclear safety, radioactive waste, and transparency.

The High-level Group convened four times in 2008. In October the 2008 members of the group received the European Commission’s first draft of the nuclear safety directive to prepare it in a manner suitable for the ATO discussion. During the last 2008 meeting the official name of the High-level Group was changed into ENSREG (European Nuclear Safety REGulators).

Consultative Committees under the EURATOM

Within the framework of the European Atomic Energy Community Treaty (EURATOM) there are several technical and consultative committees dealing with different areas of the nuclear energy field. Representatives of the SNSA are active in the committees under Articles 31, 35/36 and 37.

Under Article 31 the Committee prepares recommendations for the European Commission regarding legal acts in the field of radiation protection and public health. At the same time EURATOM requires the Member States to establish a system of radiation monitoring in the environment and consequently to report to the European Commission within the Committee under Articles 35 and 36. The European Commission can verify the existence and compliance of such a system with the Community requirements (Art. 36). Such verification took place in Slovenia in 2006.

Under Article 37, the Committee held two meetings in 2008. Both were chaired by the Slovenian national representative. The main task of the Committee is to prepare opinions for the European Commission regarding the impact of a certain nuclear object to the adjacent Member States. Some Member States have already announced their new applications in 2009.

Consultative Committees of the European Commission

The Consultative Committee Instrument for Nuclear Safety Co-operation (INSC) advises the European Commission on issues with regard to assistance to the third countries in the area of nuclear and radiation safety. In 2008, the consultative committee INSC discussed a multi-national assistance program in the field of emergency preparedness, projects concerning assistance to nuclear regulatory bodies, and projects of assistance for the NPP operators.

The Consultative Committee Euratom-Fission (a comitology body in the seventh Framework Program) represents a group of experts advising the European Commission regarding nuclear research projects financed by the EU. In 2008, the Committee held two meetings. The Slovenian representative attended both these meetings.

10.4 Cooperation with Other Associations

Western European Nuclear Regulator's Association (WENRA)

WENRA is an informal association consisting of representatives of Nuclear Regulatory Authorities of European countries with nuclear power plants. The main objectives of WENRA are to develop a common approach to nuclear safety and to exchange experiences between the chief nuclear safety regulators in Europe.

In 2008 Member State representatives in the main body and the two sub-committees dealt mainly with the draft proposal of the new nuclear safety directive and reference standards for radioactive waste disposal safety.

Network of Regulators of Countries with Small Nuclear Programs (NERS)

NERS is an international network of nuclear regulators providing means of communication between regulators of countries with small nuclear programs. These countries have a small number of nuclear power plants and their nuclear regulators have much smaller resources to develop administrative systems and practices to the level of detail which bigger countries can afford.

At the regular annual meeting in April 2008 in Prague, the state representatives presented news in the regulatory area, which mainly comprise changes in the legislation or in administration matters. One of the topics was also power uprate in the existing NPP's, which was followed by the review of important events in the member countries.

The International Nuclear Law Association (INLA)

The International Nuclear Law Association – INLA is an international association of legal and other experts in the field of peaceful use of nuclear energy: INLA's objectives are to arrange and promote studies in and knowledge of legal problems related to the peaceful use of nuclear energy, focusing on the protection of people and their environment, on promoting exchange of information among its members and on cooperation, on a scientific basis, with similar associations and institutions. INLA has more than 500 members from more than 50 countries and international organizations.

European Nuclear Security Regulators Association (ENSRA)

Slovenia became a member of the European Nuclear Security Regulators Association in 2008. The participating Slovenian organizations are the SNSA and Slovenian Police. Through the ENSRA meetings, information relating to physical protection of nuclear facilities and materials is exchanged, and coordination of activities in this area is discussed.

10.5 Cooperation in the Framework of International Agreements

Slovenia is a party to numerous bilateral and multilateral agreements in the field of nuclear and radiation safety, safeguards of nuclear materials, notification, and response during a nuclear accident, physical protection of nuclear objects, nuclear non-proliferation, and nuclear liability.

Convention on Nuclear Safety

From 14 to 25 April 2008 the Fourth Review Meeting of Contracting Parties of the Convention on Nuclear Safety took place in Vienna in the IAEA headquarters. The Slovenian EU Presidency gave a statement pointing out the importance of the review process, its transparency, and the growing number of contracting parties. The first week was dedicated to presentations by the contracting parties. On 4 April 2008 Dr. Andrej Stritar, the SNSA Director, had a presentation on behalf of Slovenia comprising highlights of the national report which was prepared in 2007 and published on the SNSA website. The presentation also addressed news since the national report was issued, recommendations of the rapporteur of the last review meeting, established good practices, as well as a summary of questions received. Concerning its national report Slovenia received 90 questions and posted 72 to other national reports. During the plenary meeting the rapporteurs of all six groups presented for each of the participating countries the highlights of their national presentations, compliance with the recommendations of the previous review meeting, good practices and measures for short- and long-term improvements of nuclear safety. One day was devoted to drafting and finalization of the Summary Report of the Review Meeting, the initial draft of which was prepared by the review meeting President and his advisers and the Main Committee.

As this was the fourth review meeting, there is an obvious need to change certain aspects of the process in order to achieve a higher degree of efficiency. In that light it was agreed that an extraordinary meeting shall be held in September 2009, where the recommendations prepared by the Working Party on the National Report (WPNR) are to be considered.

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

The third Slovenian national report on fulfillment of the obligations under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management was prepared in cooperation with the relevant competent authorities and organizations. After the confirmation by the Government of the Republic of Slovenia the report was sent to the IAEA Secretariat and it will be presented at the third review meeting of the Contracting Parties, which will be held in May 2009 in Vienna.

Bilateral Co-operation

In the beginning of May 2008, a quadrilateral meeting with the Czech Republic, the Slovak Republic, and Hungary was organized in Prague. The main issues of the meeting related to a regulatory overview of organizational changes in NPP’s. The main topics were questions of ownership, reorganization of NPP’s, adaptation to the market situation, changes in management in general and organizational changes in NPP’s. In the framework of the meeting, Slovenia presented its experiences concerning managing the Presidency of the EU.

The 10^{th} bilateral meeting between Austria and Slovenia took place in November 2008 in Vienna. Both sides described the main developments in the field of legal framework and administration, radiation monitoring, emergency preparedness, waste management and research reactors.

Intergovernmental Agreement on the Co-ownership of the Krško NPP

In 2008 the Krško NPP operation, management and decision-making in its bodies were in line with the Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on Regulating the Status and Other Legal Relations with Regard to the Investment in the Krško Nuclear Power Plant, Its Exploitation and Decommissioning (hereinafter referred as the »Intergovernmental Agreement«). Both companies which have the rights over the energy produced in the Krško NPP cooperated in an amicable spirit and ensured all necessary financial means for the operation of the Krško NPP.

In 2008 the Assembly convened their 17th and 18th sessions. At the 17th session the company »GEN Energija, Ltd« nominated for the President of the Krško NPP Managing Board Stanislav Rožman, for the period until 8 April 2013. The company »Hrvatska elektroprivreda Plc« proposed the following members of the Krško NPP Supervisory Board, Kažimir Vrankić MSc, Velimir Lovrić MSc and Ante Despot, to cease their membership in the Supervisory Board. During the same session of the Assembly the company »Hrvatska elektroprivreda, Plc« nominated new members of the Krško NPP Supervisory Board, Ivan Mravak MSc, Darko Dvornik PhD and Kažimir Vrankić MSc, for the period until April 6, 2011. At the 18th regular session of the Assembly the Annual Report 2007 was approved. The Annual Report 2007 was prepared by the Managing Board and the Supervisory Board issued a positive statement. This session of the Assembly decided that the members of the Managing Board and the members of the Supervisory Board of 2007 ceased their terms of office. The financial Auditor was also nominated and approved for 2008.

In 2008 the Krško NPP Supervisory Board had six regular sessions and it:

- adopted the business information of 2007 and the »Biannual Report on Modification Status II-2007« (July–December),
- elected as the President of the Control Board Ivan Mravak MSc, issued a positive opinion on the draft Annual report for 2007, adopted the investment program including replacement of the main generator stator, and adopted the ISEG reports for January and February 2008,
- adopted the business information for the period from 1 January to 31 March 2008 and the ISEG report for March 2008, proposed the ISEG report for April 2008 to be expanded, adopted the Krško NPP Operational Report and took note of the information about the bid evaluation for the replacement of the main generator stator,
- adopted the business information for the period from 1 January to 30 June 2008 and the »Biannual Report on Modification Status I-2008« (January–June), as well as the ISEG reports for May, June and July,
- adopted the Economy Plan for 2009 and the Long-Term Investment Plan of Technological Infrastructure of the Krško NPP for the Next Five Year Period (2009–2013), agreed that the Krško NPP Management plans and implements the programmes related to the plant lifetime extension, and issued a consent that the Krško NPP, as the responsible subject, provides its own financial means for the project PDP –Preliminary Decommissioning Plan,
- adopted the business information for the period from 1 January to 30 September 2008 including the assessment of conducting of business for 2008, as well as the ISEG reports for August, September and October.

On 3 September 2008, the Intergovernmental Commission for Monitoring of the Implementation of the Intergovernmental Agreement convened in accordance with the rules stipulated in the Intergovernmental Agreement and it approved the Terms of Reference for the implementation of the second revision of the Krško NPP Decommissioning Programme. For the writing of the Decommissioning Programme two expert services from Slovenia and Croatia were established, namely ARAO and APO.

10.6 Use of Nuclear Energy in the World

At the end of 2008 there were 31 countries operating 436 nuclear reactors for electricity production. In 2008, only one new nuclear power plant was put in operation, i.e. in India, with the total installed electric power of 220 MW. The construction of six new nuclear power plants also started, five in China and one in Russia.

Detailed data on the number and installed power of reactors by countries is given in Table 10.

Table 10: Number and installed power of reactors by countries

Country	Operational		Under construction	
	No.	Power [MW]	No.	Power [MW]
Belgium	7	5.824		
Bulgaria	2	1.906	2	1.906
Czech Republic	6	3.634		
Finland	4	2.696	1	1.600
France	59	63.260	1	1.600
Germany	17	20.470		
Great Britain	19	10.097		
Hungary	4	1.859		
Lithuania	1	1.185		
Netherlands	1	482		
Romania	2	1.300		
Russia	31	21.743	8	5.809
Slovakia	4	1.711		
Slovenia	1	700		
Spain	8	7.450		
Sweden	10	8.958		
Switzerland	5	3.238		
Ukraine	15	13.107	2	1.900
Europe total	**196**	**169.620**	**14**	**12.815**
Argentina	2	935	1	692
Brazil	2	1.766		
Canada	18	12.577		
Mexico	2	1.300		
USA	104	100.683	1	1.165
America total	**128**	**117.261**	**2**	**1.857**
Armenia	1	376		
China	11	8.438	12	11.220
India	17	3.782	6	2.910
Iran			1	915
Japan	53	45.957	1	866
Korea, Republic of	20	17.647	5	5.180
Pakistan	2	425	1	300
Taiwan	6	4.949	2	2.600
Asia total	**110**	**81.574**	**28**	**23.991**
South Africa	**2**	**1.800**		
World total	**436**	**370.255**	**44**	**38.663**

Reference: International Atomic Energy Agency

In developed countries, interest in renaissance of nuclear energy is again noticeable. In the USA the number of construction permit applications has been increasing, and the UK has made considerable progress with its ambitious building program for new NPP's. Sweden's rejection policy has been also changing. France has announced the construction of a second new nuclear power plant, while Italy has also announced the revival of its nuclear program. New builds are planned in Poland, Lithuania (jointly with the neighboring countries), Hungary, Slovakia and the Czech Republic. Romania is planning to continue the construction of two long-dormant projects. Switzerland is planning to start with construction works, too.

10.7 Radiation Protection and Nuclear Safety World-wide

The International Atomic Energy Agency (IAEA) maintains a system for reporting on abnormal radiation and nuclear events in nuclear facilities and in the use of nuclear energy in the IAEA member states. The system is known as the International Nuclear Event Scale (INES).

The Nuclear Events Web Based System (NEWS) has been providing a fast flow of information between regulatory bodies, operators, technical support organizations, media and the public for eight years. It enables transfer of information on the INES events that could attract interest of the media. The system has different levels of access, for experts from regulatory bodies and nuclear facilities, for other users of nuclear energy, and also for journalists and members of the public. It is available on the Internet site http://www-news.iaea.org/news/default.asp.

All INES reports are simultaneously translated into the Slovenian language and can be browsed on the Internet address: http://www.ursjv.gov.si/si/info/ines_dogodki/.

Twenty six INES reports on nuclear events were received by the IAEA NEWS in 2008. Eight reports were on events in nuclear power plants, the remaining eighteen related to: exceeded dose levels due to use of radioactive sources (9 reports), uncontrolled discharge of a liquid containing uranium (2), and iodine-131 (1) into the environment, consumer goods contaminated with cobalt-60 (3) and with another radioactive source (1), lost equipment for industrial radiography (1) and an analytical laboratory contaminated with plutonium.

One event in a nuclear power plant was rated as level 2 – incident, two as level 1 – anomaly, two other as level 0 – deviation/no safety significance, one event was not included on the INES scale and two events were not rated. The reports related to an earthquake close to a nuclear power plant, contamination of an NPP's surrounding with radioactive particles and to irregular operation of an NPP.

The other events connected with radiation were rated: four as level 3 – serious incident, 8 as level 2 – incident, four as level 1 – anomaly, one as level 0 – deviation/no safety significance and one was not rated.

Slovenia reported to NEWS on an event that occurred on 4 June 2008 at the Krško Nuclear Power Plant, when the plant was safely shut down after a primary circuit leak was detected. The event was classified as an unusual event. There was no demand on the safety systems. The loss of coolant was controlled by the charging flow. There was no need for off-site protective measures since there were no releases to the environment. The event was classified on the INES as Level 0 – deviation/no safety significance.

It can be concluded from the reports that the management of radioactive sources which are widely used in industry and the control thereof are deficient in the world, that workers using the sources are often exposed over the regulatory limits, and that a source is often lost during transport or stolen. It is evident that control over scrap metal has improved, since there was only one such report in 2008 compared to several in the previous years.

The events reported to NEWS in 2008 did not have any strong impacts on the environment. In nine cases radiation workers received doses higher than the legally prescribed limit, but that did not result in any permanent consequences with the exception of local injuries on fingers.

In the last few years several accidental overexposures of industrial radiographers have been noted. In 2008, five events were reported to NEWS of some radiographers receiving doses assessed as in excess of the regulatory limits. The highest assessed whole body dose of 160 mSv was received by a worker in the USA; two other workers received a dose to fingers of 2800 mSv.

Last year was marked by three events which saw uncontrolled releases to the environment. In July France was the scene of an incident at two facilities, when a leak of a uranium solution occurred (the incident occurred at the uranium conversion facility and at a uranium enrichment plant). The leak was stopped and precautionary restriction measures were taken concerning the use of river and lake waters. The third incident occurred at the Institute for Radioelements in Belgium, where 45 GBq of radioactive iodine was released into the air. The release occurred following the transfer of liquid waste from one tank to another. This amount corresponds to an effective dose of 0.16 mSv to a hypothetical person living permanently at the facility's border. During the incident the facility staff was not contaminated, and the exposure levels did not exceed the prescribed dose limits.

During the periodic radiological surveillance outside the controlled area of the Spanish nuclear power plant also several solid radioactive particles were detected in different places outside the plant buildings. The origin was the release of radioactive particles through the chimney of the fuel building ventilation system. This system was contaminated during cleaning operations on the fuel transfer channel, at the end of the refueling outage on 26 November 2007. The final decontaminating fluid was thrown into the fuel pool, and unexpectedly suctioned by the surface ventilation screens. Three days later, the emergency ventilation system was stopped bypassing HEPA filters and normal ventilation started, consequently spreading the contamination outside. CSN, the Spanish nuclear regulatory body, sent an inspection team to search for evidence and possible causes, and to make independent radiological verifications. Preliminary radioactive scanning in the neighborhood of the site found no radioactive contamination.

The event on 26 November was not notified to CSN, in spite of the reporting criterion. Preliminary information was not even distributed within the licensee to the operation staff. Neither was the radiological surveillance program modified after the incident and the first finding of particles. New radiological data were retained unnecessarily by the licensee until 14 April 2008.

11 NAME OF ORGANIZATIONS WITH WEB LINKS

Organization	Web link
Administration for Civil Protection and Disaster Relief	http://www.sos112.si/
Agency for Radioactive Waste Management	http://www.arao.si/
Institute of Occupational Safety	http://www.zvd.si/
International Atomic Energy Agency	http://www.iaea.org
Jožef Stefan Institute	http://www.ijs.si
Krško Nuclear Power Plant	http://www.nek.si
Ministry of Agriculture, Forestry and Food	http://www.mkgp.gov.si/
Ministry of Defence	http://www.mors.si/
Ministry of the Environment and Spatial Planning	http://www.mop.gov.si/
Ministry of the Health	http://www.mz.gov.si/
Ministry of the Interior	http://www.mnz.gov.si/
Ministry of the Interior, Inspectorate	http://www.inz.gov.si/
OECD Nuclear Energy Agency	http://www.nea.fr
Slovenian National Building and Civil Engineering Institute	http://www.zag.si/
Slovenian Nuclear Safety Administration	http://www.ursjv.gov.si/
Slovenian Radiation Protection Administration	http://www.uvps.gov.si/
State Office for Radiation Protection, Croatia	http://www.dzzz.hr/
University of Ljubljana, Biotechnical Faculty	http://www.bf.uni-lj.si/
University of Ljubljana, Faculty of Pharmacy	http://www.ffa.uni-lj.si/
Žirovski Vrh Uranium Mine	http://www.rudnik-zv.si/

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