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

Annual Report 2009 on the Radiation and Nuclear Safety in the Republic of Slovenia

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June 2010

Prepared by the **Slovenian Nuclear Safety Administration** in cooperation with:

- Slovenian Radiation Protection Administration,
- Administration of the Republic of Slovenia for Civil Protection and Disaster Relief,
- Ministry of the Economy,
- Ministry of Agriculture, Forestry and Food,
- Ministry of the Interior,
- Nuclear Pool GIZ,
- Financial Fund for Decommissioning of the Nuclear Power Plant Krško,
- Krško Nuclear Power Plant,
- Jožef Stefan Institute and
- Institute of Occupational Safety.

The report was approved by the Expert Council for Radiation and Nuclear Safety on 31 May 2010.

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Summary

In 2009, there were no events that would present a radiological threat to the population in Slovenia. There were no particularities in relation to the services of radiation practices and operators of radiation facilities.

Krško NPP operated without shutdowns and interrupted the production only for the annual outage. In 2009, the power plant produced 5.74 TWh in total and reached 91.64% availability. The power plant was working on the technical basis for the possible extension of power plant operation after 2023 and prepared for the Second periodic Safety Review which will begin in 2010 and needs to end in 2013.

The environment in Slovenia has not suffered any above normal radiological contamination. There were no major difficulties as far as the operators of nuclear and radiation facilities, the licensees carrying out practices involving radiation and users of radioactive sources are concerned. In the former uranium mine Žirovski Vrh, the remediation of the Boršt depository for hydrometallurgical tailings is still in process, but was prolonged due to adverse climatic effects and further works on the decontamination of the areas around the depository. Unfortunately, there was an unexpected decrease in soil stability which could prolong the final remediation.

The process of the site selection of the repository for low and intermediate level radioactive waste was completed. After the local community of Krško agreed with the proposed plan in July 2009, the Slovenian government, at the end of year 2009, adopted the national spatial plan for such waste repository at Vrbina, in the proximity of the Krško NPP.

In the last two years, the control over the illicit shipments of radioactive material has been reinforced and is carried out most successfully. There were only few such shipments stopped on Slovenian borders. In May, a strong source was detected at the border crossing with Croatia, which was transferred back to its country of origin, in this case Bosnia and Herzegovina.

After long preparations and cooperation with other stakeholders, two extensive rules were adopted, both of which bring best EU practice in the filed of nuclear safety to the Slovenian legislation. Thus the essential requirements for the operators of nuclear and radiation facilities were harmonized with those in other European countries with nuclear programmes.

Slovenian representatives cooperated in the projects for providing assistance to the Western Balkan States. In the ex-Yugoslavian countries and Albania, the existing regulation on the ionizing radiation protection and nuclear safety was examined. Based on the results, the suggestions were made to the European Union on how to focus their help in the future.

In July, the European Council adopted the Nuclear Safety Directive, the first legally binding document in this filed in the European Union. The Directive summarizes fundamental principles of nuclear safety that are already written in the IAEA non-binding standards and Convention on Nuclear Safety. Slovenian representatives were actively involved in creating the mentioned directive. Since its requirements are already incorporated in the Slovenian legislation, no significant changes of our regulation are needed.

CONTENT

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1 INTRODUCTION

The report is prepared annually in accordance with the provisions of Ionizing Radiation Protection and Nuclear Safety Act. It has been issued since 1985 and summarizes all events in connection with the ionizing radiation protection and nuclear safety for the previous year. The report is accepted by the Slovenian Government and is afterwards send to the National Assembly of Republic of Slovenia. Also, the report presents the main way of communicating recent developments in the area of ionizing radiation protection and nuclear safety to the general public. This English version is the essential publication for the presentation of activities in Slovenia to the foreign public.

In creating the report, the Slovenian Nuclear Safety Administration (SNSA) has a role of moderator, while the content is provided also by other state bodies, whose competences include the ionizing radiation protection and nuclear safety, as well as other institutions in this area. The principal are the Slovenian Radiation Protection Administration (SRPA), the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief (ACPRD), the Ministry of the Economy, the Ministry of the Interior, the Nuclear Insurance and Reinsurance Pool, the Krško Nuclear Power Plant (Krško NPP), the Jožef Stefan Institute (JSI), the Institute of Occupational Safety (IOS), and the Fund for Financing Decommissioning of the Krško Nuclear Power Plant and Disposal of Radioactive Waste from the Krško NPP.

Together with this report, which is aimed at a wider group of interested public, its extended version in Slovenian language was prepared. The extended report includes all details and data, which would be of interest to the narrower group of professionals. It is available on the SNSA web page http://www.ursjv.gov.si.

2 OPERATIONAL SAFETY

2.1 Operation of Nuclear Facilities

2.1.1 Nuclear Power Plant Krško

Operation and Performance Indicators

In 2009, the Krško Nuclear Power Plant (Krško NPP) produced 5,738,808.1 MWh (5.7 TWh) gross electrical energy on the output of the generator, which corresponds to 5,459,724.7 MWh net electrical energy delivered to the grid. The reactor was in operation for 8,028.09 hours or 91.64% of the total number of hours in this year. The thermal energy production of the reactor was 15,774,562.20 MWh.

In 2009, the SNSA performed 49 inspections in the Krško NPP, of which one was not announced. There were no events that would require emergency inspection surveys.

In general, the SNSA inspection established that the NPP operated safely without incidents which would pose a threat to the general public or the environment. Also, the inspection assessed that the works carried out during a refueling period were mostly performed professionally and in accordance with the high standards of radiation and nuclear safety. Nevertheless, in certain areas, such high standards were not achieved and during on-site inspections the inspection issued 55 requests related to irregularities found at the Krško NPP. The three most important irregularities are:

- During the refueling period, the operator started the works on the modification of a system for the turbine control, even thought the SNSA has not issued an authorisation by then. Inspectors demanded that the work be stopped and issued a written order.

- The inspection found that the register of radiation sources at the Krško NPP were not in compliance with legal requirements.
- The inspection required from the operator to prepare the strategy related to human resources in a field of training.

In the field of radiation protection of exposed workers, the Krško NPP is also supervised by the Slovenian Radiation Protection Administration (SRPA). In 2009, the SRPA performed 3 inspection surveys related to radiological situation reports from independent experts, the use of sources and monitoring of environmental radioactivity, radiation protection training, the individual exposures of exposed workers in Krško NPP, the organization of radiological protection service and radiation protection provisions.

The most important performance indicators of the Krško NPP are shown in Tables 1 and 2, while their changes through the years are shown in the following parts of this report. The performance indicators confirm stable and safe operation of the power plant.

Table 1: The most important performance indicators in 2009

Safety and performance indicators	Year 2009	Average (1983–2009)
Availability [%]	91.2	85.85
Capacity factor [%]	93.6	83.4
Forced outage factor [%]	0	1.1
Gross realized production [GWh]	5,738.81	4,966.14
Fast shutdowns – automatic [Number of shutdowns]	0	2.67
Fast shutdowns – manual [Number of shutdowns]	0	0.14
Unplanned normal shutdowns [Number of shutdowns]	0	0.89
Planned normal shutdowns [Number of shutdowns]	1	0.82
Event reports [Number of reports]	10	4.56
Refueling outage duration [Days]	32	45.9
Fuel reliability indicator (FRI) [GBq/m^3]	$8.88 \cdot 10^{-4}$	$7.55 \cdot 10^{-2}$

Table 2: Time analysis of the Krško NPP operation in 2009

Time analysis of production	Hours	Percentage [%]
Number of hours in a year	8760	100
Duration of plant operation (on grid)	7992.14	91.23
Duration of shutdowns	767.86	8.77
Duration of the refueling outage	767.86	8.77
Duration of planned shutdowns	767.86	8.77
Duration of unplanned shutdowns	0	0

The operation of the Krško NPP in 2009 is shown in Figure 1. It can be seen that the power plant was shutdown once for the regular refueling outage. The plant operated at reduced power in May, due to the testing failure of a turbine control system, and in December, in accordance with the annual plan. There were no unplanned shutdowns.

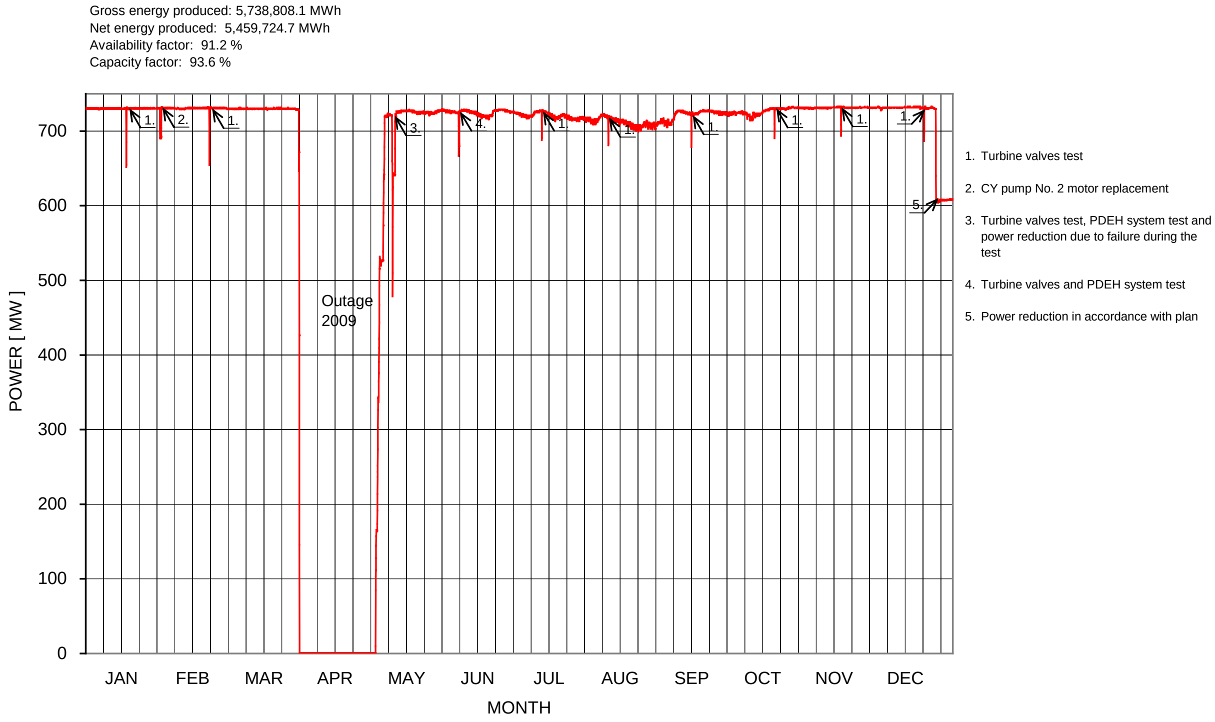


Figure 1: Operating power diagram for the Krško NPP in 2009

In Figure 2 and 3, the number of reactor shutdowns is shown.

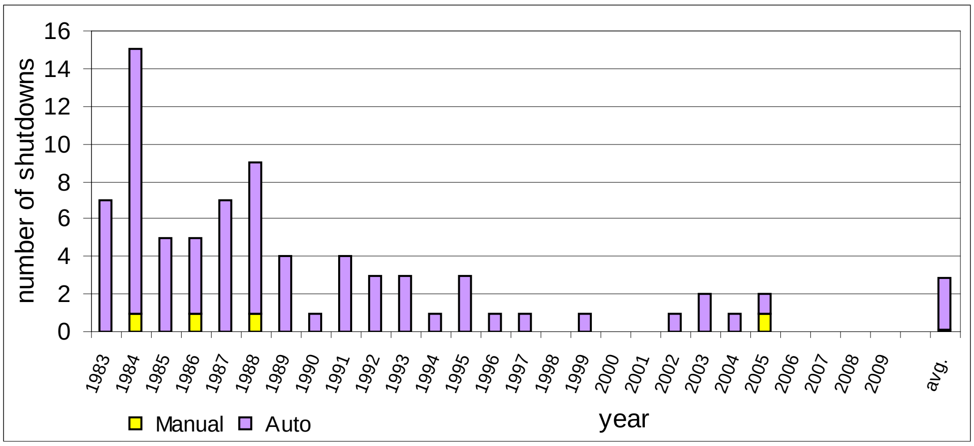


Figure 2: Fast reactor shutdowns – manual and automatic

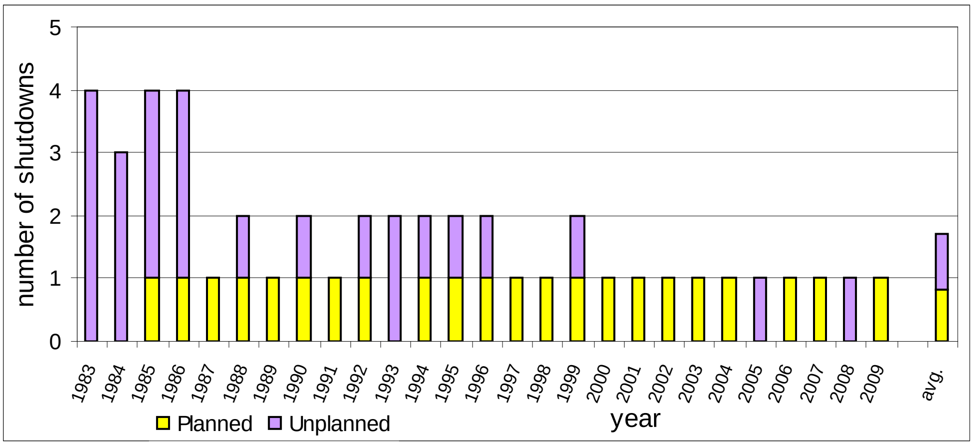


Figure 3: Normal reactor shutdowns – planned and unplanned

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. During 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 gradual shutdown of reactor.

Figure 4 shows the number of unplanned actuations of high pressure injection system, which actuates automatically on the low pressure of the primary or secondary cooling system, on high pressure in the containment, and manually. In 2009, there were no unplanned actuations of this system, so the total number of actuations since the start of commercial operation remains at 10.

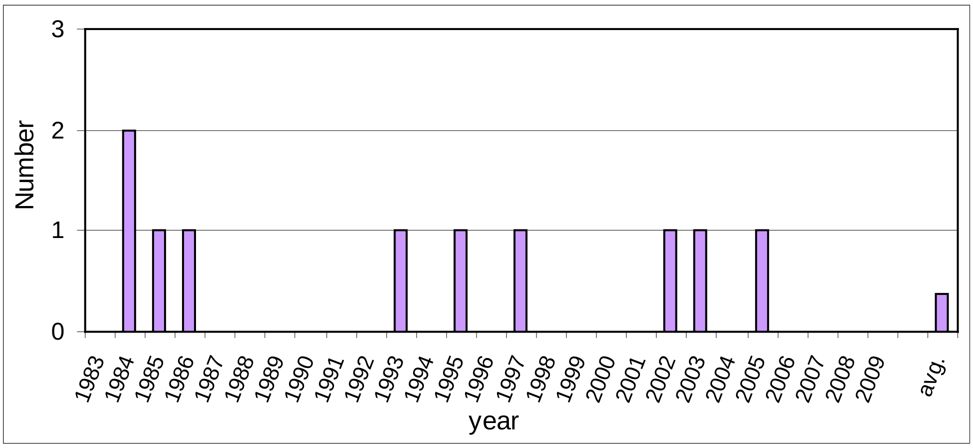


Figure 4: Number of unplanned safety injection system actuations

In Figure 5, the forced outage factor is shown. The factor is a ratio between the hours of duration of unplanned shutdowns and the number of hours in a year. In 2009, there were no unplanned shutdowns, thus the value of this factor is 0%.

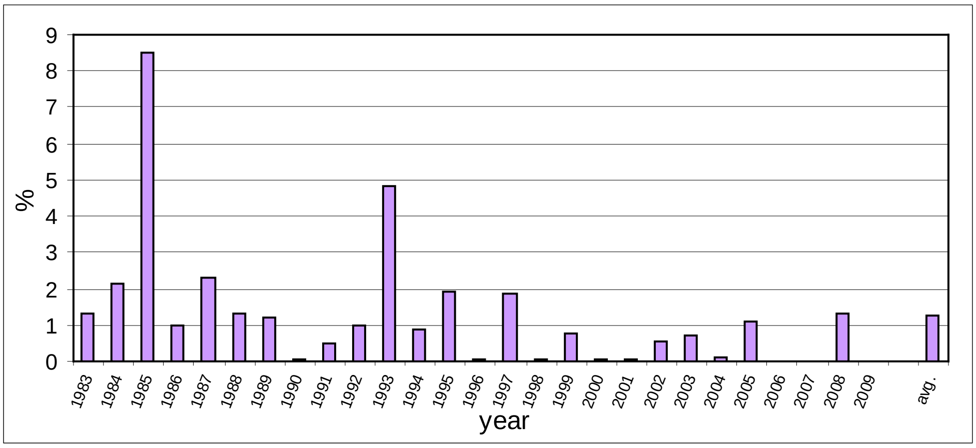


Figure 5: Forced outage factor

The collective exposure to radiation is shown in the Figure 6. Its value in 2009 is 652 man mSv and is one of the lowest in years with refueling outages. The low value of this factor indicates the high efficiency of the radiation exposure control.

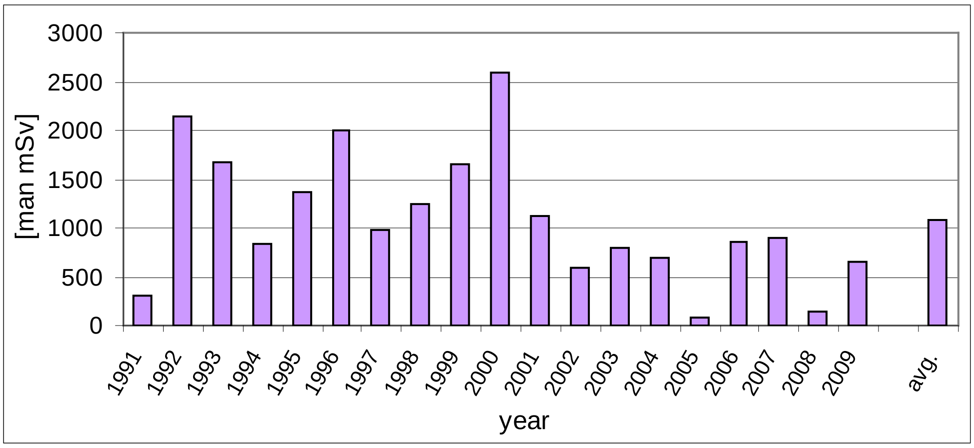


Figure 6: Collective exposure to radiation in the Krško NPP

In Figure 7, the comparison between different means of electrical energy production in Slovenia is shown, in particular in the production in nuclear, hydro and thermal power plants. In 2009, the production of electrical energy exceeded 14 TWh, mostly due to favourable meteorological conditions and increased production of hydro plants, but also on account of the stable operation of the Krško NPP. Compared to 2008, the production of nuclear energy was lower, which was a result of the refueling outage.

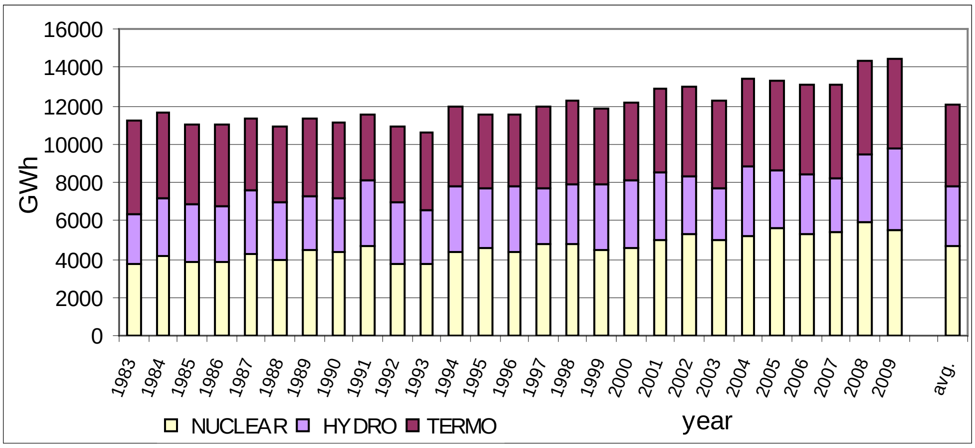


Figure 7: Production of electrical energy in Slovenia

Regulatory Oversight through Safety and Performance Indicators

At the end of 2007, the SNSA introduced its own set of safety and performance indicators to the surveillance of the NPP Krško operation process. Indicators are designed to inform the NPP operator about what the SNSA detected as a potential problem that could become serious risks and should therefore be given attention as soon as possible. The system of indicators provides colour coded warnings much before legal limits for the parameters are reached.

The system was well launched and became the regular practice of communication between SNSA and NPP Krško. After two years of experiences, the survey for feedback information was conducted, after which the number of indicators was cut down from 46 to 38. The new set of indicators also includes the changes of the SNSA thresholds for unacceptable performance which gives the NPP Krško enough time to implement their corrective measures before the increased regulatory inspection is enforced. The SNSA sends monthly reports to the NPP Krško about indicators status and if necessary conducts thematic inspection.

Abnormal Events in the NPP Krško

Event reporting is defined by the regulation, which also defined the types of abnormal events. In 2009, the NPP Krško reported 10 abnormal events, none of which caused an unplanned shutdown or a degradation of nuclear or radiological safety.

All events and the proposed corrective actions to correct the consequences of these events were followed by the SNSA. All events were analyzed by the SNSA, however due to the low safety significance of events, detailed SNSA analyses were not required.

Unwanted activation of the fire protection system on the main transformer

On 6 January and 18 February 2009, two activations of the fire protection system on the main transformer were registered, despite the absence of fire. The cause for the first activation was not found. The second activation was caused by a strong wind that directed hot exhaust air from transformer coolers to the fire annunciators. There were similar events in March and October 2008. As a long-term corrective action, the replacement of existing fire annunciators with a new type is envisaged. The new fire annunciators will activate only at the temperature of 90 degrees Celsius, but not at the temperature rise of 9 degrees Celsius per minute as the existing ones.

Unsuccessful diesel generator tests

Two tests, which were not successful due to problems with rotation speed settings, took place on 29 January and later on 24 April 2009. The first post-maintenance test was performed after the replacement of two relays as a corrective action of the event in February 2008. The diesel generator stopped on the over-speed signal. The comparison of signals revealed abnormal respond of 9 out of 10 signals. It turned out that the wiring on voltage frequency recorder was not correctly linked. Consequently, two fuses for governing contacts were blown. The deficiency was corrected and the generator was tested again. This time, it did not stop at the required rotational speed, since the over-speed signal was incorrect. The over-speed controller was replaced and after the successfully performed test 16 hours and 23 minutes after the first test, the diesel generator was declared operable.

The second test failed because of differences in rotation set points between hydraulic and electronic controller. The operator reduced speed in accordance with the procedure. However, he used hydraulic instead of electronic controller. Since the electronic controller was preliminary engaged for the speed control, the setting of hydraulic controller should automatically reset to the maximum value after the operator's action. That happened only on the motor B, while on the motor A, the hydraulic controller stayed at the lower value. The cause for deviation was a weak contact in electric circuit, so both controllers were replaced. The diesel generator was operable again after 7 hours and 5 minutes.

Leakage of the fire protection pump relief valve

During the monthly test of the fire protection pump on 18 February 2009, the leakage of the pump relief valve was discovered at the pressure lower than the pump operating pressure. The leakage was on the valve seal which was refurbished in 1995. The surface was damaged by the alternate opening and closing of relief valve during the past unwanted actuation of fire protection system (once in 2006 and twice in 2008 and 2009 respectively). The leaking surface was repaired and after 2 days, 2 hours and 35 minutes, the electric driven fire protection pump was again operable. During the event, the operability of fire protection system was assured by stand-by diesel driven fire protection pump.

Oversaturation of the charcoal absorbers for the negative pressure control system of the reactor building

The test performed on 26 March 2009 in the certified laboratory in USA revealed 13.2% to 15.5% saturation of charcoal absorbers specimens taken from the negative pressure control system of the NPP Krško reactor building. The saturation was above technical specification limit of 2.5%. The first information about test results was send to an employee at Krško NPP on Friday, 27 March 2009, at 22:30 hours. Due to such oversaturation, the plant shutdown should be within next 7 hours, as prescribed by technical specification. However, the information was forwarded to the operation staff only at the beginning of next week. Because of lack of communication and waiting the formal confirmation of the first information, the plant shutdown was postponed till Wednesday, 1 April 2009, when the planned annual outage began at 9 o'clock. The SNSA classified the event as the violation of licensing requirement in spite of the licensee disagreement.

The oversaturation of charcoal absorbers occurred when the inside of the containment was painted during the outage in October 2007. For 632 square meters, 92 litres of paint were used. In accordance with technical specification requirements, the test on charcoal absorbers should be performed after the painting was done, but the test was not done until the next outage. The SNSA identified such conduct as a bad practice and an unsuitable interpretation of technical specification's given time »following painting«.

However, a few weeks after the event, re-analyzing of the samples from the same filter showed that their saturation values were below the limit.

The function of the charcoal absorbers is to limit the releases of radioactive gases from the containment in the case of accident. The negative pressure control system of the reactor building is not in operation permanently, but starts automatically, when the annulus pressure increases. The radiological environmental monitoring did not show any increased values during the last fuel cycle, therefore the conclusion can be drawn that the event has no consequences for the environment or population.

The charcoal absorbers were replaced during the outage.

Non-operability of both main steam isolation valves

At the beginning of annual outage, on 1 April 2009, the main steam isolation test was performed. The criterion of 5 seconds for valve closure was not met since it took 6.7 seconds to close one of the two valves, while the other stayed open for about 3 to 4 centimetres and fully closed only in the third attempt. The closing time was longer because of the increased friction in the stem sealing caused by previous maintenance activities, the normal wear out of inner sliding parts and the insufficient opening of air release valve. Since a similar event occurred only during the previous outage, the prolonged fuel cycle, i.e. from 15 to 18 months, was identified as the contributing cause.

As prescribed by technical specification, the plant should be put from hot standby mode to hot shutdown mode within 6 hours after both valves were declared inoperable. The actual cooling time was 9 hours and 41 minutes. The SNSA identified this as the violation of licensing requirement in spite of the licensee disagreement. NPP Krško challenged such interpretation, saying that the first valve was operable, because it was closed and as such in a safe condition and therefore unnecessarily declared as inoperable.

Both valves were maintained during the outage. Their operability was confirmed with a new test.

Loss of the offsite power during the outage generator protection test

On 14 April 2009, during the post-modification test of generator protection, the fast automatic transfer from on-site power to off-site power did not succeed. The plant was in the middle of the outage with one operable diesel generator that automatically turns on as a result of a loss of the power signal. The cause for this unsuccessful test was the incorrect position of fast automatic transfer switches. The description of the test in procedures was not detailed enough and moreover the staff did not know which procedure from the two should be used. To the procedure, test prerequisites were added. Also, such activities will be prepared more attentively and in good time to avoid staff being pressed for time.

Unwanted activation of safety injection during the outage test

On 27 April 2009, when the plant was in cold shutdown mode, the reactor protection system was tested. The required blockade on the low pressure was not performed and that turn on the safety injection signal. The diesel generator, residual heat removal system, component cooling system and essential service water system started in sequences. The safety injection and auxiliary feedwater pumps did not start since they were in pull out position as required due to the plant mode. The cause for absence of blockade was the human error. The staff did not understand test prerequisites and did not ask operators in main control room to perform the blockade. A similar event occurred at the beginning of 2002 outage. Corrective measures for both events refer to better defining procedure instructions and training of the staff.

Activation of seismic instrumentation

On 16 July 2009, the seismic monitoring instrumentation activated. One instrument registered the seismic motion of 0.07 g amplitude, while other instruments did not record any seismic activity. The surveillance test confirmed the accurate functioning of seismic monitoring system. Presumably, the instrument was activated by the stroke or fall of heavy object in the vicinity of seismic accelerometer.

Preparation for Second Periodic Safety Review

Every ten years, Krško NPP must carry out the comprehensive and systematic examination of radiation and nuclear safety of nuclear facility with so-called Periodic safety review. In 2009, Krško NPP submitted the application for the approval of the program of second periodic safety review, which must be completed by the end of 2013. Program is prepared in accordance with the requirements of Rule on safety assurance after the start of radiation or nuclear facilities operation. After intense negotiations between the SNSA and the Krško NPP about the volume and content, the NPP prepared the program revision, in which deficiencies that indirectly affect nuclear and radiation safety are dealt with, such as safety culture, emergency preparedness and management system. The SNSA will approve the program by the beginning of 2010, so that the NPP Krško could start with activities for its implementation. Successfully implemented periodic safety review is one of the conditions for the NPP Krško to continue its operation after 2013.

Ageing Management Program at NPP Krško

In 2009, the NPP Krško requested the approval of the Ageing management program for systems and components. Implementing of such program is one of the prerequisites for the possible extension of power plant operation after initial 40 operating years. The Krško NPP suggested such changes of safety documentation which would fit the assumption of Krško NPP operating for 60 years. Comprehensive documentation was enclosed to the application, as well as the detailed explanation of Krško NPP’s approach to ageing management and analyses.

International group of experts is reviewing the submitted documentation and their expert opinion will be completed in 2010. Afterwards, the SNSA could approve the program. The possible extension of operation will depend on the owners of the plant and on successfully passed periodic safety reviews in the year 2013 and 2023.

Nuclear Fuel Integrity, Reactor Coolant Activities and Fuel Elements Inspections

The year 2009 comprises a part of fuel cycle 23, which started on 6 November 2007 and ended on 1 April 2009 with the refueling outage, and a part of cycle 24, which started after the outage on 2 May 2009. The cycle 24 will last 18 months until the refueling outage in October 2010.

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. At the end of cycle 23, a small tight leakage was detected, like in the cycles 22 and 21. It was estimated that there were no more than four failed fuel rods of more then 28,000 fuel rods in the reactor core. Despite the fuel leakage, the reactor coolant specific activities in cycle 23 reached less than 1% of the authorized limit in operational limits and conditions of the plant.

By the end of 2009, there was no fuel rod leakage in the core of cycle 24.

Fuel integrity is monitored by the Fuel Reliability Indicator (FRI), which shows fuel leakage and is used for comparison with nuclear power plants around the world.

FRI values are determined from the specific activity of ^{131}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 at the end of cycle 23 to 24% of the criterion limit. The FRI values in cycle 24 are very low. The mean FRI values for individual fuel cycles are shown in Figure 8.

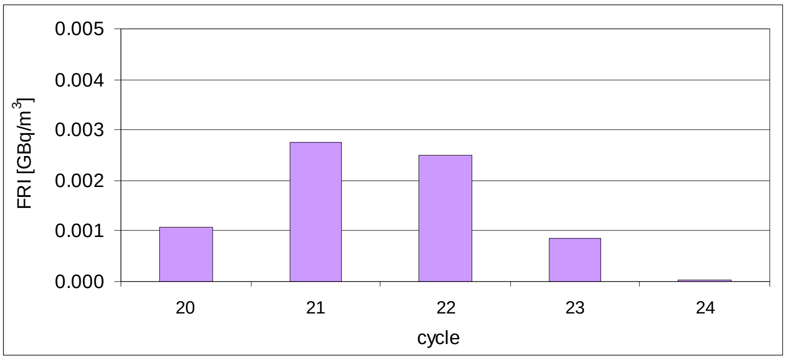


Figure 8: Fuel Reliability Indicator (FRI) values for last five fuel cycles

Refueling Outage

Refueling outage the NPP Krško took place from 1 April till 3 May 2009. During the outage, the actual condition of the equipment was checked and some of equipment was modernized. The Krško NPP also carried out regular preventive maintenance of the equipment; nuclear fuel was replaced and technological upgrade was made. No unexpected degradation of the equipment was found during the operation.

In the reactor core, 56 new fuel elements were inserted. 32 new modifications were introduced. The following are most important: new digital system for turbine control and supervision, relay protection of the generator-transformer block, the modernization of 110 kV long-distance field, the upgrade of polar crane seismic protection, and the replacement and modernization of radiological surveillance system. The most important works done in the field of preventive maintenance are the check-up and renewing of secondary pipelines, switching equipment, pumps, motor drives and valves. As demanded by ageing management program, a wearing check-up on rod guides was performed for the first time in the history of the plant.

During the outage, the preventive checkups of components systems and structures were carried out. At the same time, parts already foreseen for replacement, as well as those on which degradations were found, were preventively replaced. Also, the adequate repairs and adjusting of individual equipment parts were done.

The majority of outage activities, interventions or modifications were executed in compliance with expectations. Before the outage, much attention was put on the qualifying of the staff, the selection of adequate subcontractors, creating and preparing good working procedures, timely purchasing of equipment, tools and spare parts as well as on safety and healthy measures. Nevertheless, delays occurred in certain cases, but works were executed in full and their quality was good. High loadings and the occasionally pressure on the personnel was noticed, which resulted in the above average number of unusual events, which were a result of human errors. The unusual events are described in a separate chapter.

The NPP Krško staff was competently solving all problems that occurred, so that nuclear safety during the outage was not threatened.

The extend of works was unexpectedly enlarged due to the following reasons:

- extensive works at putting up scaffolds in reactor building because of a change on polar crane;
- muddy water in reactor pool before fuel change;
- damages on one of control rods guide tube during the inspection of works;
- extensive and demanding testing of new digital system for turbine control.

The Krško NPP has been paying a lot of attention on the work safety. Contractors were required to organize their works in such manner that the lives and health of people were not in danger and that current regulations and internal procedures demands are consistently followed. The contractors were acquainted with the risks, which could be expected at work, with technical and technological precautions and workers obligations and rights. The first aid was assured at the job site and the contractors were familiar with the steps to be taken in case of an accident.

Beside regular outage activities, the equipment was changed and modernized as a consequence of degradation and demands of modernized standards and operating experiences. Those interventions are usually made once in a power plant lifetime. Most of activities were well planned and carried out professionally.

Modifications in the NPP Krško

According to the Act on Ionizing Radiation Protection and Nuclear Safety (paragraph 83), the SNSA approved 9 modifications and agreed to 38 modifications. During the preliminary safety evaluation, the NPP Krško found out that there was no open safety issue for 27 modifications. Therefore, the NPP only informed the SNSA about the changes. There were 8 implemented modifications to which the SNSA agreed or were approved in previous years, before 2008, and there were 19 temporary modifications. In 2009, the Krško NPP issued the 16th revision of the Updated Safety Analysis Report, considering all modifications confirmed until 7 October 2009.

Flood Protection of the Krško NPP and new Facilities

In January 2009, the SNSA issued consent to an application for the construction permit for the Krško hydro power plant. This SNSA consent confirmed that the Krško hydro power plant will not have a negative effect to the Krško NPP nuclear safety.

In 2009, the national spatial plan for the Brežice hydro power plant was being prepared. The SNSA demanded that the national spatial plan for the Brežice hydro power plant takes into consideration the protection of the Krško NPP against probable maximum flood. The Krško NPP has began the licensing process for upgrading of flood protection dykes upstream from the NPP which is in accordance with the preparation of the spatial plan for the Brežice hydro power plant. In December 2009, the Krško NPP prepared a new concept design for the protection against the probable maximum flood and delivered it to the designers of the national spatial plan for Brežice hydro power plant. At the time, the report for the probable maximum flood was being prepared and an international review of probable maximum flood study, which should be completed in 2010, was in preparation,

In October 2008, the Slovenian government issued consent for the start of the procedure for the preparation of the national spatial plan for the Mokrice hydro power plant. In cooperation with the Krško NPP, the SNSA will prepare guidelines to eliminate any possible effects of this new facility on the Krško NPP nuclear safety.

2.1.2 TRIGA Mark II Research Reactor in Brinje

In 2009, the TRIGA Mark II research reactor of the Jožef Stefan Institute operated for 123 days and released 170.464 MWh of heat. The reactor operated only in stationary mode. The TRIGA reactor was mostly used as a neutron source for the neutron activation analysis and the irradiation of dosimeters, and for educational purposes. A total of 1002 samples were irradiated in the carrousel or the channels (819) and in the pneumatic post (224). Operational data is presented in the Figure 9.

In 2009, the hot cell facility was used for handling the samples irradiated in the reactor.

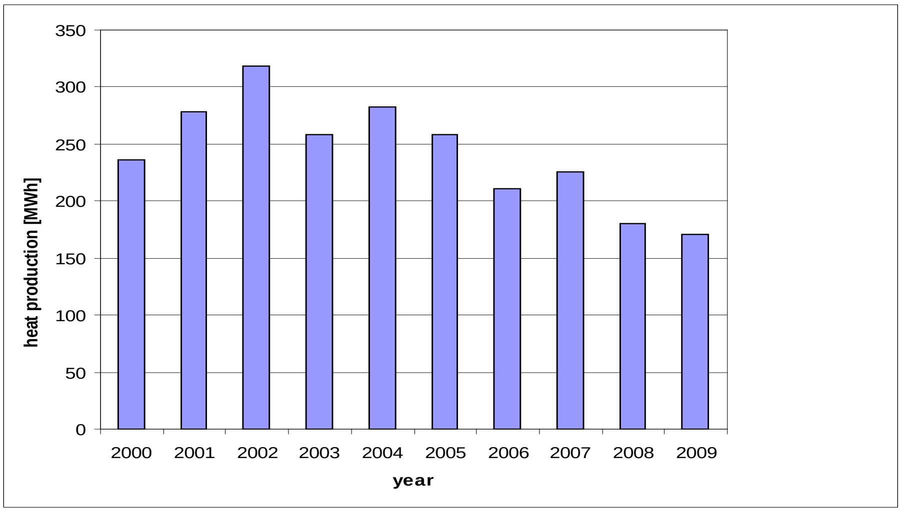


Figure 9: Operational data for TRIGA Mark II research reactor in Brinje

Operational indicators for the collective dose of operators and experimenters reached lower values than in past years and are much below the regulatory limits. The collective dose was 4 man μSv for operators and 161 man μSv for the personnel that performed works at the reactor (operators, radiation protection service, experimenters).

There were no violations of the operational limits and conditions of the safety analysis report, and there were no events that needed to be specially reported about.

There were ten forced shutdowns of the reactor in 2009, seven of which during practical exercises (human error), one caused by loss of external power supply, one due to unintentional pressing of a button for pulse channel testing and one caused by disturbance to the monitor for primary coolant activities measurements. Forced shutdowns during the performance of practical exercises were anticipated since they are a part of educational process, and were not a result of exceeding operational limits and conditions. To prevent the recurrence of the shutdowns, the button for pulse channel testing will be replaced by a more suitable one equipped with a protective cover.

In 2009, a total of 84 fuel elements were located on the reactor site. 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. A visual examination of 4 fuel elements of the operational core was performed and no visible changes were found.

A modification of the chapter 13.2 of the safety analysis report for the TRIGA reactor was approved, which included the hot cell facility to the nuclear facility of the reactor. By this approval, the hot cell can be used to process the radioactive materials and radioactive waste.

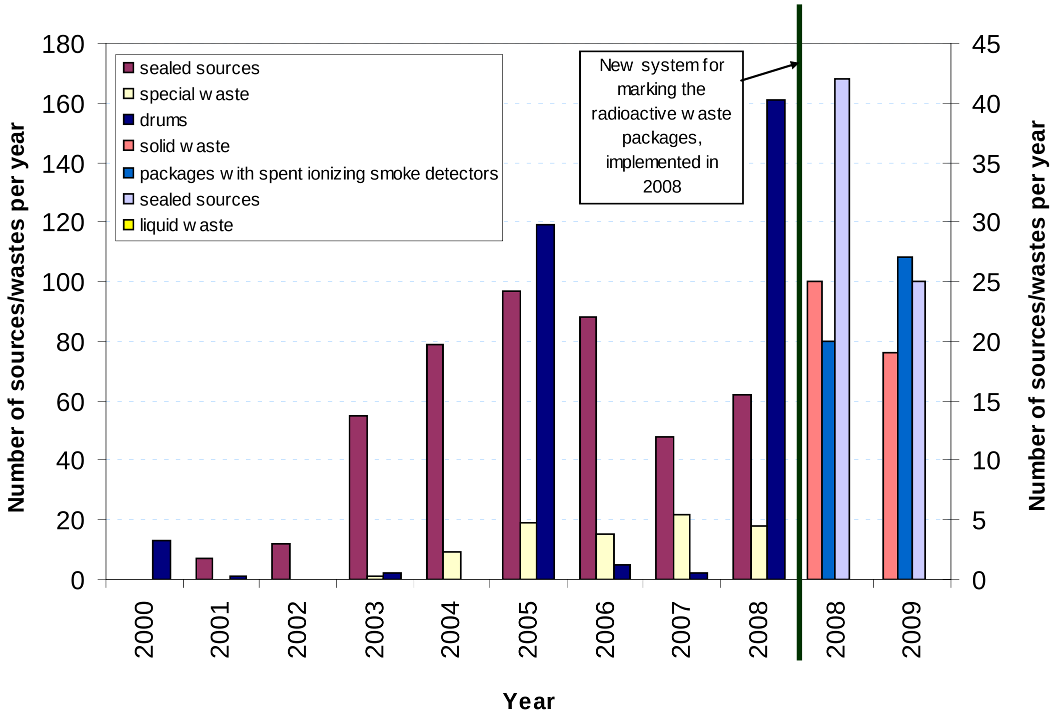
Regular periodic examinations and control of systems, structures and components required for safe operation did not show any deficiencies. The improvement of fire protection equipment and reconstruction of ventilation system was proposed. Also, the fire protection equipment was replaced and a design project for the reconstruction of ventilation system was prepared. The physical protection system was upgraded with a video control system for the supervision of reactor building and vicinity of the reactor.

The reactor management began the preparation of a program for a periodic safety review of the TRIGA research reactor.

2.1.3 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 reconstruction in 2005, the ARAO obtained a license for the operation of storage in 2008 which is valid until 18 April 2018.

The design basis for the upgrade of the current storage process includes, among others, the replacement of the wooden separation racks and the separation of packages containing nuclear material from other non-nuclear wastes was prepared in 2009. The design will facilitate better use of storage space and uniformity of the storage system and was co-financed by the Belgium government within a frame of bilateral cooperation with Slovenia.



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.
- In 2008, the new system for marking the radioactive waste packages was implemented. For easier comparison of the distribution of the accepted waste packages, the figure presents the distribution of the waste packages accepted in 2008 as shown by the old and new marking system.

Figure 10: Types and quantities of radioactive waste annually accepted in the Central Interim Storage at Brinje

The ARAO performed some maintenance works on the adjacent auxiliary building with a small room for staff and the storage room for equipments and instruments. Meteorological station Brinje was refurbished and is registered under the No. 6 in a national registry of meteorological stations since September 2009.

In 2009, the ARAO upgraded the current security system with the IAEA Security Remote Monitoring System, which is a video controlled system.

During the project »Management of Institutional Radioactive Waste in Slovenia«, which is executed by the ARAO and has received financial support from the European Commission, liquid radioactive waste was discovered in some waste packages already stored in the CISRW. The storage of liquid radioactive waste does not comply with the safety analysis report for the CISRW, which states that the storage is allowed only for radioactive waste in solid form. For this reason, the SNSA inspection issued a waiver requesting the operator to solidify liquid radioactive waste by the end of 2009, but because of lack of financial recourses this was not made on time and the deadline was extended.

In 2009, the ARAO accepted into the CISRW the radioactive waste from 34 generators. There were 19 packaging units of solid wastes, 25 packages containing sealed sources, and 27 packages containing spent ionization smoke detectors. The total volume of the waste was 2 m^3. At the end of 2009, there were 529 packaging units, out of which there were 365 packages of solid wastes, 99 packages with sealed sources, 56 packages with ionization smoke detectors and 9 packages with liquid wastes. In 2008, the new system for marking the radioactive waste packages was implemented. At the end of 2009, the total activity of the 82 m^3 waste stored is estimated at 3.7 TBq.

2.2 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 2009, 221 approvals were issued.

In 2009, the SNSA Inspection carried out 47 inspections of 23 legal persons or organizations and interventions related to radiation sources. The inspections were carried out at the radiation practitioners in the industry and research, education, state authorities and organizations authorized for measurement of radioactivity in scrap metal shipments. At few scrap metal companies inspection discovered that X-ray spectroscopy devices were not properly registered. The inspectors of SRPA carried out 23 inspections in nuclear facilities and in the area of medicine, veterinary, safety of exposed workers, and exposure of population to natural radiation and by the transportation of radioactive material.

No major violations were found during the SNSA inspections. Only some minor deficiencies were found which were related to record keeping and registration of the sources of radiation. In few cases, the licensees did not have proper written procedures for the use of sources or for the emergency situations.

In 2009, the SRPA performed 10 inspections of radiation practices regarding the use of X-ray devices in medicine and veterinary. In one case, the license for the use of an obsolete and technical inadequate X-ray device was withdrawn. The use of two devices was assured through sealing, because the devices were stored as redundant and did not have licenses for use. Five inspections were carried out at the users of open and sealed sources in a medical institution. Two decisions requesting corrective measures were issued because of the late notification on surface contamination, irregular exchange of the personal dosimeters and incorrect operation of the hold-up tanks for waste liquids. Three inspections were carried out in the Krško NPP and at one of the company performing works at the Krško NPP. In the area of radon exposure, the exposure of population to natural radiation and the exposure during the transportation of radioactive material, 3 inspections were performed and no violations were found.

In 2009, the Institute of Occupational Safety examined 1,202 radiation sources, while the Jožef Stefan Institute examined 38 radiation sources at holders in the area of industry, medicine and research.

2.2.1 Use of Ionizing Sources in Industry and Research

In 2009, 54 licenses to carry out radiation practices, 72 licenses for the use of a radiation source, 12 certificates of registration of radiation sources and 13 approvals to the external operators of practices involving ionizing radiation were issued.

At the end of 2009, 92 organizations in the industry, research and state administration were using 193 X-ray devices, most of them for cargo and luggage inspection. 969 sealed sources were used in 89 organizations, mostly for the calibration and testing of instruments. 53 sources stored at 21 organizations will be handed over to the ARAO. The users will retain 13 empty shielding containers with depleted uranium.

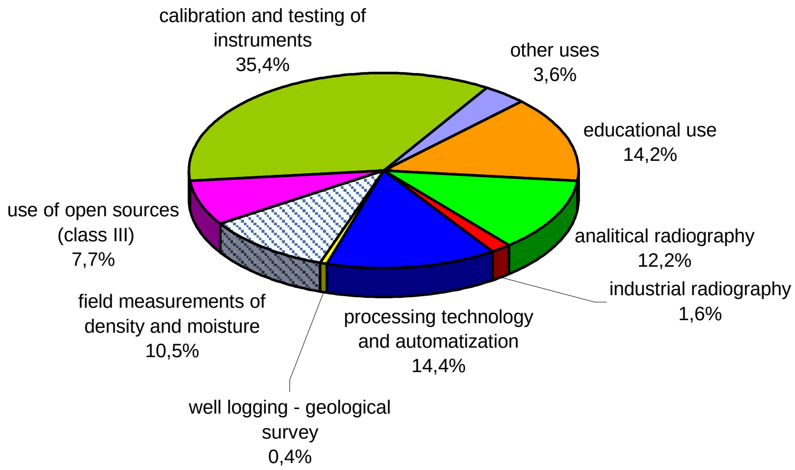


Figure 11: Distribution of application of radioactive sources according to their purpose and mode of use, excluding X-ray devices and ionizing smoke detectors

According to the registry of radiation sources, there were 26,900 ionizing smoke detectors used at 297 organizations by the end of 2009. In addition, 12,837 ionizing smoke detectors were stored at users' premises, most of them at the company which is commercially dealing with systems for early fire detection and alarm.

In 2009, altogether 33 regular, one at hoc inspection, and 13 interventions were performed by the SNSA Inspectorate.

Two inspections were performed at two organizations using radioactive lightning rods. One organization is still using two such sources. The decision was made that they will be transferred to the Central Interim Storage Facility by the August 2010. During the inspection, it was discovered that two radioactive lightning rods, manufactured by the Elind Valjevo, containing radionuclide ^{60}Co, each with initial activity of 3.8 GBq, are missing. The radioactive sources were fixed on the poles intended for other use without appropriate labelling. Because of this, the tops of the metal poles (the rods) were cut off together with radioactive sources and mixed with other scrap metal without the awareness of the presence of radioactive sources. The sources were lost. No radiological consequences were detected. The SNSA inspection issued a warning for the offence.

In 2009, SNSA Inspection notified the Police about the illegal disposal of dangerous goods, which happened at the waste collector company Dinos d.d. in Ljubljana. The unknown offender left 27 ionization smoke detectors at the company premises. The SNSA inspection immediately carried out an ad hoc examination and the sources were stored at the Central Interim Storage Facility for Radioactive Waste.

2.2.2 Interventions and Search for Sources

In 2009, the SNSA inspection unit performed 28 inspections or interventions at which inspectors searched for sources of ionizing radiation. The inspections can be separated in three groups:

- inspections related to searching for sources,
- interventions related to the transport of radioactive materials or detection of sources during transport,
- interventions related to possible uncontrolled sources.

In 2009, the inspection unit of the SNSA completed a project related to identification of sources at the Ministry of Defence. 21 inspections were conducted in a period from 2008 to 2009. Some hundreds of sources that were used unsafely were identified. The SNSA ordered to the ministry to establish a system that will enable the safe use of sources and radioactive waste.

Figure 12: Binoculars with ^{3}H of 37 GBq i.e. well above exemption level of 1 GBq

In 2009, the inspection of the Škofja Loka museum took place due to a fact that radioactive minerals and the petrified wood from the Žirovski Vrh uranium mine were stored at the museum facilities. The minerals mentioned were collected by Mr. Braniselj, a private collector, so the collection is called »Braniselj collection or radioactive minerals«. Mr. Braniselj donated the collection to the museum, but no documents regarding this donation were available at the time of inspection. Furthermore, the museum management was not aware of the donation and was also not familiar with safety measures which should be implemented when storing or exhibitexhibiting such items. Minerals and the petrified wood were stored in an unsuitable room at the collapsing tower of the castle. The inspection ordered the museum management to follow the requirements given by the legislation when handling the mentioned radioactive items.

Figure 13: Airplane with altimeter containing a radioactive source above exemption level

The SNSA issued similar orders to the National Museum of Slovenia.

Figure 14: Collection of the radioactive minerals at Škofja Loka Museum

In 2009, there were six interventions related to the transport of radioactive sources. Two of them took place at the customs office at Obrežje border crossing and one at the custom office at Gruškovje border crossing. The most demanding was the intervention on 25 May 2009 at Obrežje border crossing when the customs detected an elevated dose rate at the truck transporting scrap metals from Bosnia. Namely, the dose rate of 227 μSv/h was measured. The SNSA inspection ordered to reload the truck at the border crossing, which was done by qualified experts, who identified the lightening rod with europium. The SNSA informed the regulatory authority of Croatia about the radioactive source, as well as the regulatory authority of the origin county Bosnia and Herzegovina. The source was put in a special container and sent back to Bosnia on 15 June. A full control was established by a regulatory authority in Sarajevo. The SNSA reported the event to the IAEA database related to a transport.

Figure 15: Packaging the radioactive source for a transport

Eight interventions were related to suspicions that items at the undertakings or institutions were radioactive. At four such interventions the inspection identified radioactive waste which was put in the Central Storage for Radioactive Waste in Brinje.

2.2.3 Use of Radiation Sources in Medicine and Veterinary Medicine

X-ray Devices in Medicine and Veterinary Medicine

According to data from the register of the Slovenian Radiation Protection Administration (SRPA), 874 X-ray devices were used in medicine and veterinary medicine at the end of 2009. The categorization of the X-ray devices based on their purpose is given in Table 3.

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

Purpose	Status 2008	New	Written off	Status 2009
Dental	413	47	20	440
Diagnostic	257	20	12	265
Therapeutic	8	1	0	9
Simulator	2	0	0	2
Mammography	35	3	3	35
Computer Tomography CT	25	8	4	29
Densitometers	42	2	0	44
Veterinary	46	5	1	50
Total	**828**	**86**	**40**	**874**

With regard to use of x-ray devices in medicine and veterinary medicine in 2009, the SRPA granted 117 licenses to carry out a radiation practice, 227 licenses to use X-ray devices, 136 confirmations of the programs of radiological procedures, and 134 confirmations of the evaluation of protection of exposed workers against radiation.

In medicine, 410 X-ray devices were used in private dispensaries and 414 in public hospitals and institutions. The average age of X-ray devices was 9.4 years in public sector (9.6 years in 2008) and 8.1 years in private sector (7.9 years in 2008). In veterinary medicine, 39 devices were used in private dispensaries and 11 in public hospitals and institutions. The average age of X-ray devices was 12.2 years in the public domain and 5.6 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	298 (80%)	9.4	105 (24%)	8.8	11 (100%)	8.2	11 (22%)	12.2	425 (49%)	9.7
Private	75 (20%)	8.0	335 (76%)	8.1	0	0	39 (78%)	5.6	449 (51%)	5.4
Total	**373**	**9.1**	**440**	**8.9**	**11**	**8.2**	**50**	**7.1**	**874**	**7.5**

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 16. It shows that there were more than 90% of perfect devices in the last five years.

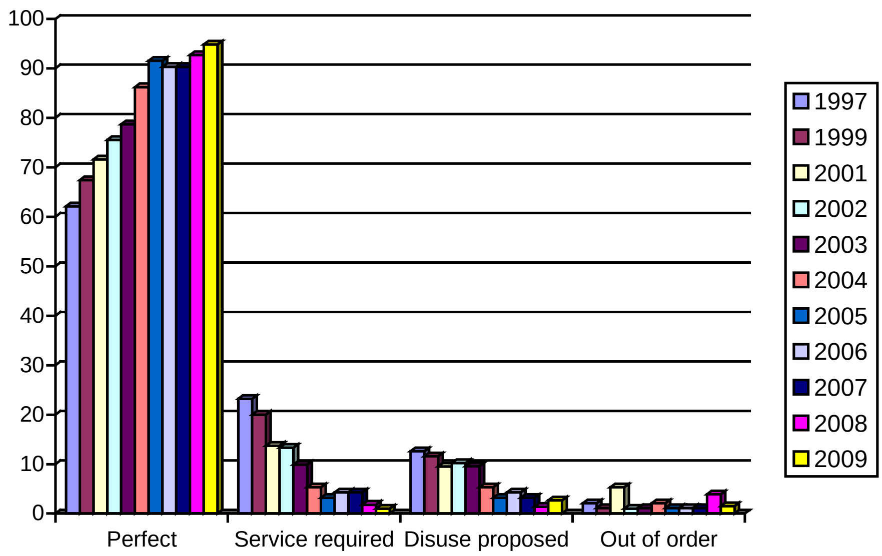


Figure 16: Percentage of diagnostic X-ray devices according to their quality for the period 1997–2009

In 2009, ten in-depth inspections of the use of X-ray devices in medicine and veterinary medicine were carried out. On the basis of the inspection finding, the decision was issued, demanding the compliance with the existing regulation, in six cases. One inspection was related to the control of technical adequacy of X-ray devices. The inspection issued the prohibition of further use due to the obsolete technology and technical inadequacy of the device. In one case, the inspected device was sealed to prevent to be used as a back-up. Two inspections were related to the control of the use of X-ray devices in the veterinary medicine. Both devices were sealed until the necessary clearance for it use is obtained.

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 Clinic for 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 5598 GBq of isotope ^{99}Mo, 1644 GBq of isotope ^{18}F, 1197 GBq of isotope ^{131}I and minor activities of isotopes ^{133}Xe, ^{177}Lu, ^{123}I, ^{201}Tl, ^{90}Y and ^{111}In 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 6 sources of ^{106}Ru with initial activities up to 37 MBq for the therapy of eye tumours 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 (mostly ^{57}Co with typical activity around ten MBq) are used for the operational testing of various devices and measurement equipment at some nuclear medicine departments. Most of them are used for calibration.

The SRPA register shows that there are still 2.163 ^{241}Am ionization smoke detectors in 21 medical facilities. For most of them, the activity is about 30 kBq, while some have higher activity (up to 2.67 MBq).

In 2009, 11 licenses to carry out radiation practice, 17 licenses to use radiation sources in medicine, 8 conformations on fulfilment of the conditions for radiation practices for workers, 9 consents for the programs of radiological procedures, 10 permissions for the import of radioactive materials, and 22 statements about the intakes of radioactive materials from EU member states were granted with reference to the use of unsealed and sealed source in medicine.

The medical departments with unsealed and sealed radiation sources were surveyed by the authorized experts for radiation protection. No major deficiencies were found. Also, the SPRA inspection made five other inspections, beside regular ones, three at the Institute of Oncology, one in General Hospital in Celje and one at the Clinic for Nuclear medicine.

The inspections at the Institute of Oncology focused on the organization of ionization radiation safety, radioactive waste management, the doses of exposed workers, the ceasing of carrying out radiation practices in building A and the register of supplied isotopes.

Due to the surface contamination on the 9 January 2009 and untimely informing about the event, irregular replacements of personal dosimeters, and the deficiencies in the system for detaining radioactive sewage, two decisions were issued to the Institute to correct the deficiencies. Also, a warning was issued because one of the suppliers delivered the goods without the validated form that is in compliance with the requirement 1493/93/Euratom.

At the Clinic for Nuclear Medicine and in General Hospital in Celje, a general inspection was carried out. The emphasis was put on the accordance of radiation protection measurements with the existing regulation. No major deficiencies were found. Some of the employees did not have valid medical certificates, and one of the employees was forbidden to work on the exposed workplace, until the valid medical certificate is presented by his employer.

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 almost entire five decades. Primarily, 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. The radionuclide ^{14}C which is a consequence of nuclear tests is not monitored, just like in most other European countries. A part of the monitoring program, related to radioactivity of surface waters, also comprises 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 2009 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. Only the specific surface activity of ^{137}Cs in the upper layer of uncultivated soil is still much enhanced. At the time of the Chernobyl accident approximately five times higher contamination (20–25 kBq/m^2) was measured on average in Slovenia if compared to the total 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). The concentrations of tritium in liquid samples (surface waters, precipitation and drinking water) decrease very slowly, only a couple percents per year. In 2009, the monitoring performers detected no radioactive contamination of the environment that would be 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 2009, the effective dose for an adult from external radiation of ^{137}Cs (mainly from the Chernobyl accident) was estimated at about 7.6 μSv, which is 0.78% of the dose received by an average Slovenian from natural background radiation. This value is quite similar as to the one that was measured and calculated for the previous year (2008: 6.7 μSv).

The annual dose from the ingestion pathway (food and drinking water consumption) was 2.1 μSv, which is the intermediate value in comparison with 2007 and 2008 (1.6 μSv and 3.1 μSv respectively). The dose in the previous year is higher due to the higher average values of the radionuclide ^{90}Sr in the selected samples of vegetables, sampled in the regions with higher Chernobyl contamination. The annual contribution in the annual dose of the ^{90}Sr due to ingestion is 68% and of ^{137}Cs 31%. The annual contribution due to inhalation of both radionuclides is only about 0.001 μSv, which is negligible if compared with the radiation exposure from other transfer pathways. The effective dose for drinking water, taking into account artificial radionuclides, was also estimated. It turned out that this dose was on average around 0.04 μSv per year. The annual limit value of 0.1 mSv per year due to natural and artificial radionuclides in drinking water from local water supplies was not exceeding in any examined case.

In 2009, the total effective dose to an adult individual of Slovenia arising from the global contamination of the environment with fission products was estimated at 9.7 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). In the regions with lower radioactive contamination of the ground (Prekmurje, Coastal-Karst region), the corresponding dose is lower, while it is much higher in the Slovenian Alpine region.

Considering all doses specified in this chapter, it should be taken into account that these values are extremely low and cannot be measured directly. The final results are calculated using mathematical models and are based on 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 2009

Transfer pathway	Effective dose [μSv per year]
Inhalation	0.001
Ingestion:	
drinking water	0.04
food	2.1
External radiation	7.6
Total (rounded)	**9.7**

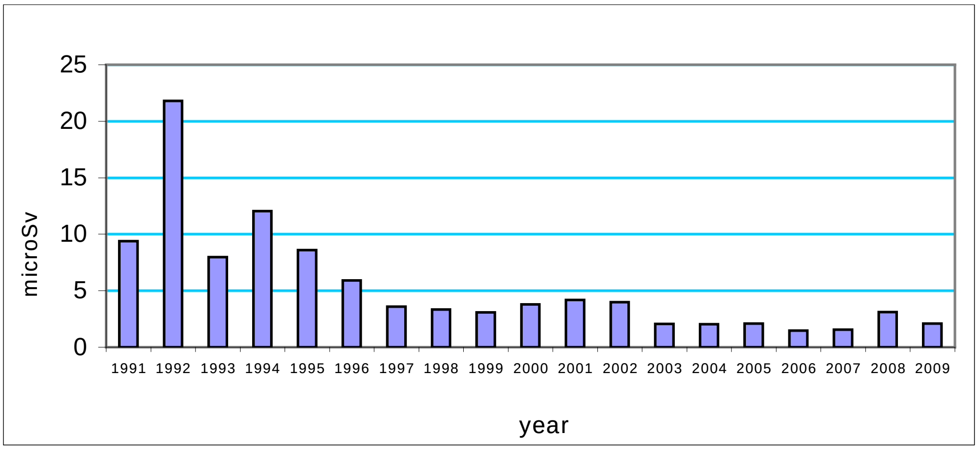


Figure 17: Annual effective doses to members of the public received by ingestion due to global radioactive contamination of the environment with the radionuclides ^{137}Cs and ^{90}Sr in Slovenia

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 those samples, the effective dose for that 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 surroundings of the installations 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 whether the discharged activities are within the authorized limits, if environmental specific activities are inside the prescribed 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 the 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 modelling 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 eventual 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. Independent monitoring in 2009 confirmed that the measurements of discharges, performed by the Krško NPP, were in full accordance with the results of measurements, carried out by the authorised performers of radioactivity monitoring, the Jožef Stefan Institute and the Institute of Occupational Health.

Radioactive discharges

In 2009, the total released activity of noble gases to the atmosphere was 0.171 TBq, which resulted in the public exposure of 0.045 µSv, or 0.09% of the limit, set to 50 µSv per year. The released activities of iodine isotopes were higher than in 2008 due to plant outage and amounted to 0.085% of the limit. Activity of the dust particles was 0.0035% of the limit. The activity of alpha emitters was below the detection limit. Discharges of tritium into the atmosphere were within the expected values from the last years, as well as ^{14}C discharges, which were approximately the same as in previous years; there are no prescribed limits for these two radionuclides.

In liquid discharges from the plant to the Sava river, the activity of tritium (^{3}H) in the form of water prevailed with 7.3 TBq, which represents 16.2% of the annual limit. This value represents only one third of the release in 2007. The total discharged activity of fission and activation products was lower than in 2008 and amounted to 63 MBq, which represents 0.06% of the operational limit value.

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), wells 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 impact of the 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 plant operation. The measurable contribution of the plant operation results in the higher concentrations of tritium in the Sava river downstream the plant. The annual average of the concentration of tritium of 0.87 kBq/m^3 was measured at Krško, upstream the plant, while at Brežice, downstream the plant, the value of 2.3 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 left bank of the Sava river (2.7 kBq/m^3 at the beginning of May and 1.7 kBq/m^3 as an annual average), yet those values are still much lower then the limit for drinking water (100 kBq/m^3). The concentrations of other artificial radionuclides discharged to the river Sava (^{60}Co, and others) were 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. Measurements of ^{14}C in vegetation samples (apples) repeatedly showed slightly elevated concentrations in the nearby vicinity of the Krško NPP.

Exposure of the public

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 the 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 annual dose (less than 1 μSv) was received by adult individuals due to ^{14}C intake with vegetable food ingestion (0.3 μSv of this figure belongs to ingestion of local apples), while a ten times lower dose was received also due to inhalation of tritium. The dose assessment due to liquid discharges in 2009 showed their very low additional contribution to the population exposure, 0.02 μSv per year. The levels of external radiation in the very vicinity of some structures on-site are higher than in the natural surroundings, but the plant contribution is 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 those in recent years and it is now based on more realistic data than at the first period of plant operation when the estimated values of external dose were higher at least 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 NPP is less than 1 μSv per year. This value represents about 2% of the authorized limit value (dose constraint of 50 μSv per year) or less than a thousandth of the effective 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 2009

Type of exposure	Transfer pathway	Most important radionuclides	Effective dose [μSv per 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	0.3*
Ingestion (liquid discharges)	Drinking water (the Sava river)	^{3}H, ^{137}Cs, ^{89}Sr, ^{90}Sr, ^{131}I	< 0.1
Total Krško NPP			**< 1****

* The value is underestimated since only seasonal consumption of local apples was taken into account. Based on the comparison with annual discharges of ^{14}C and dose assessment results in the past period, the more realistic value shall be < 1 μSv per year.

** 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 laboratories.

Environmental monitoring of the research reactor TRIGA comprises the measurements of atmospheric and liquid discharges and the measurements of radioactivity levels in the environment. The latter are performed to determine 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, close to 1 TBq. The measurements of the specific activities in the environment showed no radioactive contamination due to the operation of the reactor. The external dose due to radiation from the cloud on an individual from the surrounding population because of the ^{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 grass and ploughing snow and that he stays in the cloud only 10% of his time. An inhabitant of the Pšata village who constantly lives at a distance of 500 m from the reactor receives 0.5 μSv per year. 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, 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 effective dose from the natural background 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 the 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 gradually 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, and only 4 Bq/s in 2009 (Figure 18). Enhancement of radon ^{222}Rn concentrations in the vicinity of the storage is not measurable and was estimated by a model for average weather conditions to 0.16 Bq/m^3 at the fence of the reactor site. In the waste water from the new drainage collector, artificial radionuclides ^{60}Co and ^{137}Cs were measured, the latter as a consequence of global contamination and not due to storage operation. There were no more other artificial radionuclides (^{241}Am, ^{134}Cs) detected in 2009. Concentrations of radionuclides were far lower than clearance levels and also lower than the derived concentrations for drinking water.

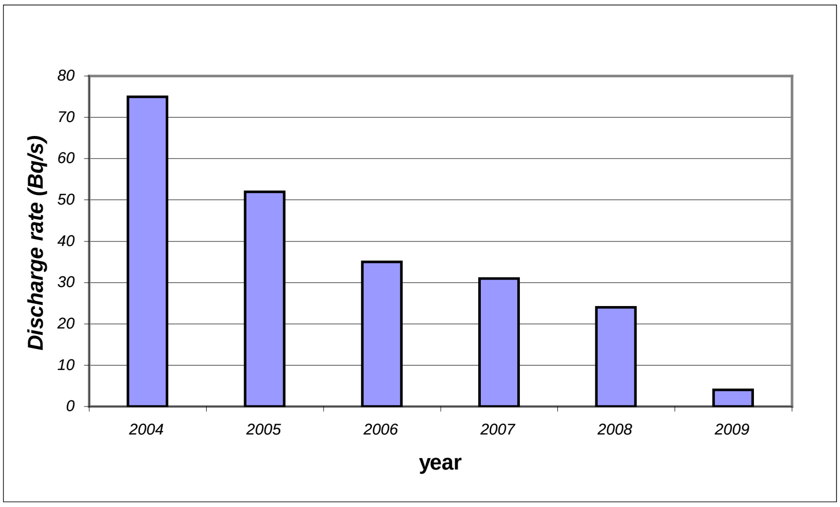


Figure 18: Emission rate of ^{222}Rn from the Central Storage of Radioactive Waste at Brinje

For the dose assessment of the most exposed members of the public, the 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 model calculation they received an estimated effective dose of 0.6 μSv in 2009. The security officer received about 0.3 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 0.01 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 per year). The annual dose collected by an individual from natural background is 2500–2800 μSv.

3.2.3 The Former Žirovski Vrh Uranium Mine

The monitoring of environmental radioactivity of the former uranium mine at Žirovski Vrh, which is currently in the post-operational phase, consists of the measurements of radon releases, liquid radioactive discharges and concentrations in the environment. An integrated programme of measurements is performed, including the radionuclide specific activities of the uranium-radium decay chain in the environmental samples, the concentrations 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 relevant measurements for the evaluation of impact of uranium mining and milling have to be carried out at reference points, outside the influence of mine and repository discharges (as an approximation for natural radiation background). 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 observably 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 waters, and in the outdoor radon concentrations. In last years, the radioactivity of surface waters in both streams has been slowly but steadily decreasing, especially ^{226}Ra concentrations in the Brebovščica, the main recipient stream, where they are already close to the natural background level (4.4 Bq/m^3 in 2009). Only the concentrations of uranium ^{238}U in the Brebovščica stream (average monthly concentration 176 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. 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 2009, the mine's contribution of radon ^{222}Rn from the repository sites and the mine to the natural concentrations in the environment is estimated at around 4 Bq/m^3.

The calculation of the effective dose for the population took into account the following exposure pathways: the 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 adult member of the public living in the vicinity of the mine was estimated at 0.12 mSv. The low exposure is a consequence of finishing the restoration at the mine repositories at the Jazbec site and at the Boršt site. It represents approximately one third of the effective dose which was estimated in the last decade of the 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 in 2009

Transfer pathway	Important radionuclides	Effective dose [mSv]
Inhalation	– aerosols with long-lived radionuclides (U, ^{226}Ra, ^{210}Pb)	0.0023
	– only ^{222}Rn	0.0022
	– Rn – short-lived progeny	0.087
Ingestion	– drinking water (U, ^{226}Ra, ^{210}Pb, ^{230}Th)	(0.012)*
	– fish (^{226}Ra, ^{210}Pb)	0.0006
	– agricultural products (^{226}Ra in ^{210}Pb)	< 0.03
External radiation	– immersion and deposition of radon progeny	0.0013
	– deposition of long-lived radionuclides	–
	– direct gamma radiation from disposal sites	0.001
Total effective dose (rounded):		**0.12 mSv**

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

The total effective dose for an adult individual in 2009 due to the contribution of the former uranium mine is for one half of the dose lower as 2007 (0.23 mSv) and amounted to one tenth of the general limit value for the population (1 mSv per year). Estimated doses for 10 year-old children were 0.148 mSv and for 1 year olds 0.110 mSv. These values represent about 2% of the natural background dose in the Žirovski Vrh environment (5.5 mSv). Annual changes of effective doses due to the mine contribution are shown in Figure 19.

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

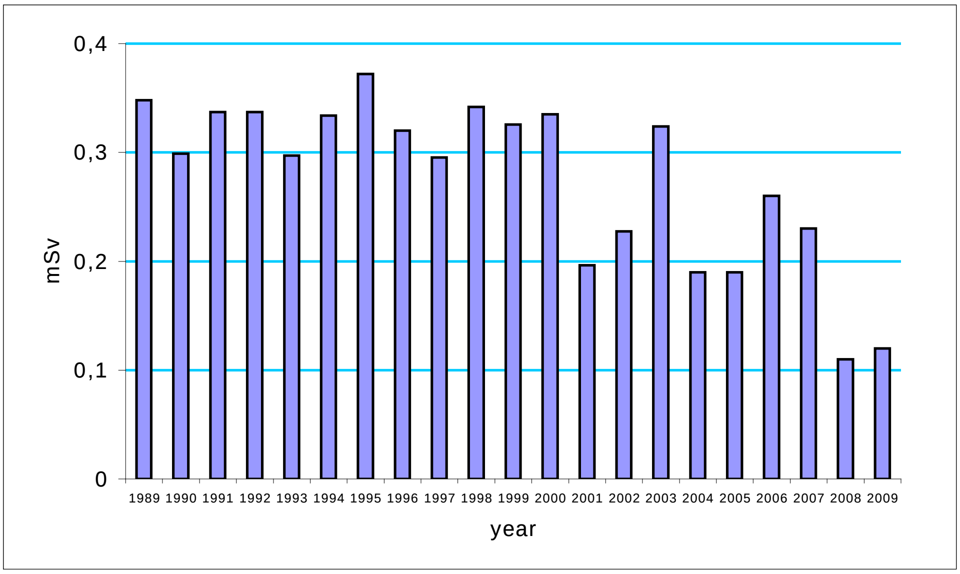


Figure 19: Annual contributions to the effective dose for an average adult member of the public due to the former Žirovski Vrh uranium mine in the period 1989-2009

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 previous decade. The system is designed for the immediate detection of increased levels of radiation in the environment and is one of the key elements of the alarming and reacting procedures in case of emergency. In such a case, the levels of external radiation and concentrations of radioactive particles in the air increase and with their deposition and wash-out by precipitation, the ground, drinking water and food subsequently become contaminated. On-line measurements of the external radiation are managed by the Slovenian Environmental Agency (EARS), the SNSA, the Krško NPP, 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 when higher values are detected.

In the year 2009, 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 centre in Zagreb and the Hungarian centre 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 exposed occupationally due to their work in 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 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 annual dose due to the intake of radioactivity with food and water is about 0.4 mSv. 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.

Radon measurements in dwellings

In 2009, the Slovenian Radiation Protection Administration (SRPA) continued with the implementation of the governmental program of systematic examination of workplaces and dwellings. This program comprised monitoring as well as informing the public about the measures for decrease of exposure due to the presence of natural radioactive sources and was approved in 2006. The highest priority was repeatedly given to the radon exposure since this radioactive noble gas is the main source of natural radiation in dwellings and at workplaces. On average, radon contributes to more than a half of an effective dose received from all natural sources of ionising radiation. It penetrates into rooms from the earth ground, above all through different openings, like for instance shafts, outlets, gaps, and cracks.

In the scope of the programme the measurements of radon and its decay products concentrations were performed altogether in 29 objects and the estimated effective doses were assessed for the employees, and also for the children in schools and kindergartens. Based on the results of measurements and the occupancy time in these buildings, the effective doses for employees and children were assessed. In thirteen establishments, the doses were lower than 1 mSv per year, in three buildings the doses were between 2 and 6 mSv per year and in seven buildings they were higher than 6 mSv per year. The SRPA performed three inspections in kindergartens and public schools and issued one written order on mitigation.

Population dose due to global contamination

People from the Northern Hemisphere in particular are still exposed to ionizing radiation from the global contamination of the environment that is 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 2009 was estimated at 9.7 μSv. External radiation contributed with 7.6 μSv, while the effective exposure dose due to the intake of food and water was estimated at 2.1 μSv. Because of the 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

Additional radiation exposures due to the regular operation of nuclear and radiation facilities are usually attributed only to local population. The exposures of particular groups of population as a consequence of radioactive discharges from these facilities are described in the subchapter on operational monitoring. In Table 8, the annual individual doses are given for the maximum exposed adults from the reference groups for all objects in consideration. For comparison, an average annual dose for individuals related to global radioactive contamination of the environment (nuclear tests and the Chernobyl accident) is also 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 maximum 5% of the exposure due to natural sources in Slovenia. In any case, the exposure of members of the public does not exceed the dose levels defined with the regulatory limits.

The population is also exposed to radiation because of 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.

Table 8: Exposures of the adult individuals from the population due to the operation of nuclear and radiation facilities and to the general contamination in 2009

Source	Annual dose [mSv]	Regulatory limit [mSv]
Žirovski Vrh uranium mine	0.12	0.300*
Chernobyl and nuclear weapon tests	0.0097	-
Krško NPP	<0.001	0.050**
TRIGA reactor	0.0005	0.050
Central Storage of Radioactive Waste	0.0006	0.100

* Limitation after the final restoration of disposal sites
** Due to radioactive discharges

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 programme 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 2009 were the Institute of Occupational Safety (IOS), the Jožef Stefan Institute (JSI) and the Krško Nuclear Power Plant (Krško NPP). Additionally, the approval was granted to the IOS to perform internal dosimetry for radon exposure in mines and Karst caves. Currently 9882 persons have their records in the central register, including those who ceased using sources of ionizing radiation in previous years. In 2009, the dosimetric service at the IOS performed measurements of individual exposures for 3610 workers and the JSI monitored 859 radiation workers. Krško NPP performed individual dosimetry for 440 plant personnel and 717 outside workers, who received an average[1] dose of ionizing radiation of 0.68 mSv. In other working sectors, the average annual effective dose due to external radiation was the highest for workers in industrial radiography, namely 0.51 mSv, while the employees in medicine received on average 0.28 mSv. The highest average value among 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 Krško NPP (652 man mSv), followed by the workers in the medical sector (336 man mSv). Exposures in industry were 33 man mSv.

Among workers not working with sources of ionizing radiation, the highest doses are received by those exposed to radon and its progeny.

In 2009, 25 out of 150 tourist workers in the Karst caves received an effective dose above 5 mSv, while 1 received a dose exceeding 10 mSv, namely 10.1 mSv. The collective dose was 377 man mSv, with an average dose of 2.6 mSv. Therefore, the tourist workers in Karst caves are the category of workers most exposed to ionising radiation.

The findings of a study related to the exposure of individuals in the Karst caves show that the doses that are assessed according to ICRP[2] 65 and received due to radon exposure are underestimated for tourist workers in 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 in the ICRP 32 model. Doses calculated in such a manner are thus twice as high as those calculated according to ICRP 65, used in the past.

At the Žirovski Vrh Uranium Mine, the highest annual individual dose was 0.88 mSv, and the average for a group of 38 workers was 0.22 mSv. The collective dose was 8.2 man mSv.

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	201	750	199	7	0	0	0	0	1157
Industry	358	90	9	0	0	0	0	0	457
Medicine and veterinary	2127	1128	75	1	0	0	0	0	3331
radon	5	84	74	24	1	0	0	0	188
Education, research and other	541	137	3	0	0	0	0	0	681
Total	**3232**	**2189**	**360**	**32**	**1**	**0**	**0**	**0**	**5814**

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 were 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 2009, a total of 1465 participants attended courses on ionizing radiation protection.

In 2009, the medical surveillance of radiation workers was performed by five approved occupational health institutions:

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

Altogether, 3467 medical examinations were carried out. Among examined candidates, 2696 fulfilled requirements for work with sources of ionising radiation. 411 fulfilled requirements with limitations, 22 did not fulfil requirements temporarily and 4 did not fulfil requirements at all. For 4 workers, a different job was recommended, and in 29 cases, the evaluation was not possible. There were 302 cases of control upon termination of work.

5 RADIOACTIVE WASTE MANAGEMENT AND MANAGEMENT OF NUCLEAR AND RADIOACTIVE MATERIALS

In Slovenia, the only 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 from 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 Parliament 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. ReNPROJG is an extensive and detailed document, setting goals and tasks in the field of radioactive waste and spent nuclear fuel management.

As for the implementation of the National Programme, activities on the site selection for the LILW repository continued in 2009. By the Governmental decree, the site in Vrbina in the Krško municipality was approved for the construction of the low and intermediate level radioactive waste repository, Also, the revision of the Krško NPP Decommissioning Programme and Disposal of LILW and SNF continued. Central Interim Storage for Radioactive Waste operated normally. Furthermore, activities for the solidification of liquid waste in a hot cell facility were carried out in 2009. Furthermore, the closing works at the Jazbec mine waste pile were finished while at the Boršt repository they are still in progress.

The Operational Programmes for the Radioactive Waste and Spent Nuclear Fuel Management for a period from 2006 to 2009, which assures that all objectives from the Resolution are met, were prepared in the beginning of 2007. The document was revised in 2008. In 2009, the Agency for Radwaste Management (ARAO) prepared a new version of Operational Programmes for the period from 2010 to 2013, based on the review of planned and already implemented activities. The last Operational Programmes are structured differently than in the previous versions and are in line with the provisions from the 2002 Act in the field of the state public company for radioactive waste management, the disposal of radioactive waste from power production nuclear facilities, and the long-term surveillance of the mine and hydrometallurgical tailings repositories, as well as commitments defined in the Agency's founding documents (Decree on the transformation of the public company ARAO into public institution, January 2010). The Operational Programmes were sent into approval procedure.

5.2 Radioactive Waste and Irradiated Fuel at the Krško NPP

In the past years, the volume of LILW radioactive waste was reduced by compression, super-compaction, drying, incineration, and melting. The total volume of waste accumulated by the end of 2009 amounted to 2,209 m^3. The total gamma and alpha activity of stored waste were $2.00{\cdot}10^{13}$ Bq and $2.48{\cdot}10^{10}$ Bq, respectively. In 2009, 158 standard drums containing solid waste were stored with total gamma and alpha activity on 31. 12. 2009 $1.21{\cdot}10^{12}$ Bq and $1.37{\cdot}10^{9}$ Bq, respectively.

5.2.1 Management of Low and Intermediate Level Waste

Figure 20 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 marked. After 1995, the accumulation of waste volume was reduced as a result of a new in-drum drying system (IDDS) for evaporator concentrate and spent ion exchange resins.

In 2006, the super-compactor was installed in the storage facility at the Krško NPP, so the power plant started with the continuous super-compaction of radioactive waste. In 2009, there were 61 standard drums with compressible and other waste.

In December 2008, 250 standard drums with compressible and other waste, total mass and volume of which amounted to 27.7 tons and 52 m^3, respectively, were sent to Studsvik in Sweden to be incinerated. These wastes were treated in 2009 and returned in the form of secondary waste to the Krško NPP. The total net mass of the waste, packed in 19 drums, was 1.527 kg.

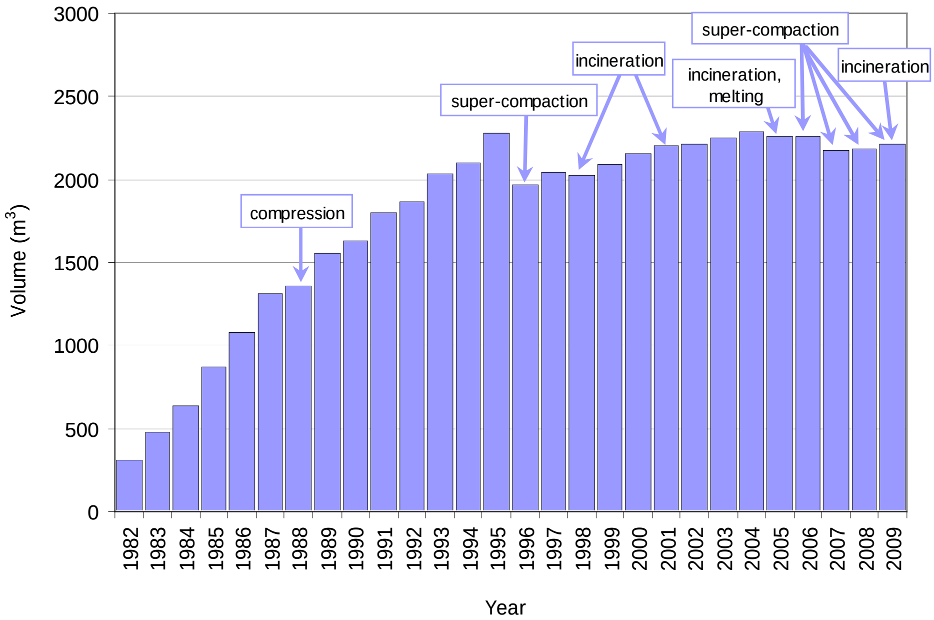


Figure 20: Accumulation of low and intermediate level radioactive waste at the storage in the Krško NPP

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 2009, 56 fuel elements were replaced during the regular outage. At the end of 2009, there were 928 fuel elements stored in the spent fuel pool. Figure 21 shows accumulation of spent fuel at the Krško NPP.

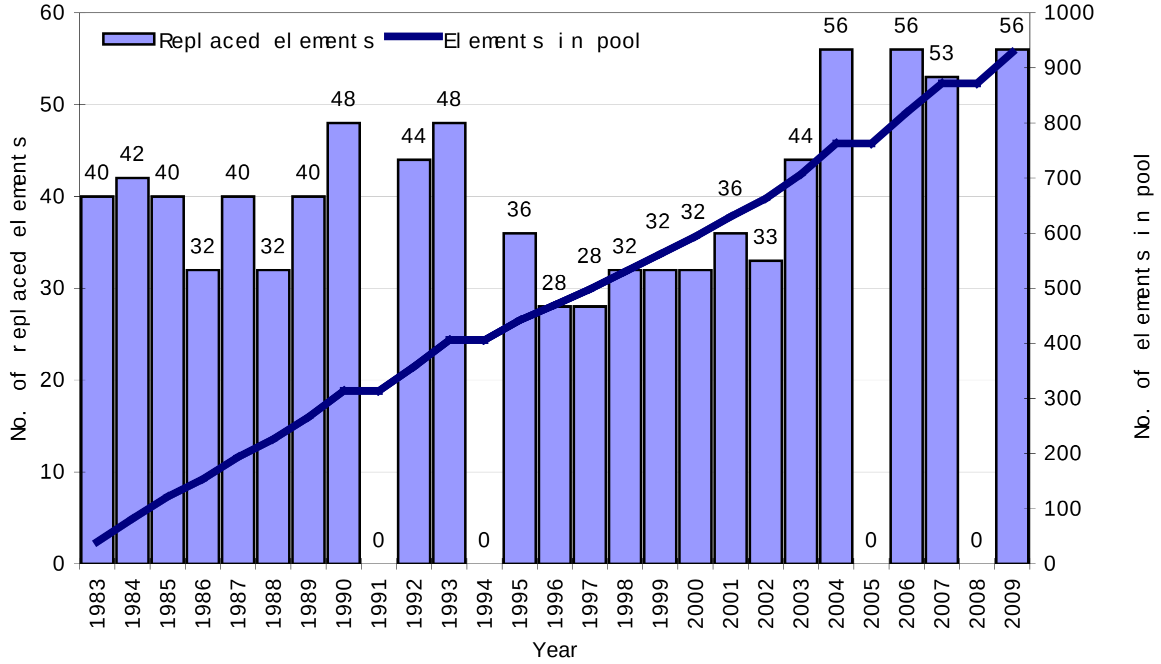


Figure 21: The annual production of spent assemblies and accumulation of spent fuel assemblies in the Krško NPP spent fuel pool

5.3 Radioactive Waste at the Jožef Stefan Institute

In 2009, approximately 0.2 m^3 of radioactive material was produced during the operation of the reactor as well as works in hot cells and controlled area of the Department of Environmental Sciences. After characterization, the Institute's Radiation Protection Unit will hand the waste over to the Central Interim Storage for Radioactive Waste at Brinje.

The radioactive waste, generated at the decontamination and decommissioning of buildings, used for the processing of uranium in the past, was still temporarily stored on the location of the Reactor center in Brinje. An authorized expert performed a radiological survey of the storage, after which the SNSA extended the time limit for handing the waste over until July 2011. Since the waste contains low concentrations of natural radionuclides, the disposal at the Jazbec uranium mine tailing would be preferred choice for their disposal. However, the agreement for the disposal of few tenths of drums of the waste at the Jazbec depository was not reached because of the opposition of the local authorities. As a consequence, the Institute has begun the procedure for the transfer of 12 drums to the Central Interim Storage. As for the remaining 19 drums, the concentration of the radionuclides in them is very low; therefore the clearance procedure can be applied. The Institute prepared a dose estimation report and on 19 October, and filed application for the approval of the conditional clearance for this waste. In November 2009, the SNSA requested additional independent activity assessment. At the end of 2009, the decision was still not made.

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 after authorized radiation protection experts carry out preliminary measurements of specific activities. Also, the new Oncological Institute has arranged the appropriate temporary storage for radioactive waste. Radioactive sources which are no longer in use were returned to the producer or handed over to the Central Interim Storage. Short-lived solid radioactive waste is temporarily stored in a special place for decay until they are released as non-radioactive waste. As for the Clinic for Nuclear Medicine at the University Medical Centre in Ljubljana, they have not yet built the system for holding up liquid waste. In the course of renovation of the University Medical Center, the Clinic intends to build new premises with an appropriate system for holding up liquid waste. Since in other Slovenian hospitals only ambulant treatment is carried out and patients leave the hospital immediately after the application of a therapeutic dose, the holds up tanks are not necessary.

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. In 2009, the Agency made a significant effort in assuring the financial resources needed for the use of hot cell facility, for the conditioning and preparation of the waste received from small producers and for the conditioning of liquid waste. Since the financial resources were not assured, the realization of the projects was shifted to 2010.

The ARAO reported on the waste stored in 2009 to the Central registry of radioactive waste (CERAO), which is maintained by the SNSA. The ARAO maintains the system for accountancy and the control of nuclear material and regularly reports to the European Commission EURATOM in Luxembourg. At the end of March 2009, the European Commission and the IAEA carried out the safeguard inspection of the Central Interim Storage in last year.

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 sitting of the nuclear facility shall be carried out through a spatial plan of national importance.

In 2009, the supplement to the site investigation programme of the Vrbina site in Krško municipality was accomplished. The results were reviewed and the final report is being translated into English. With these investigations, the site characterization for the approval of spatial plan was concluded. The purpose was to investigate whether the site is suitable for the approval of the spatial plan and to select the most favourable option for design.

For the Vrbina-Krško site, the Conceptual design for the low and intermediate level waste repository was prepared for the proposed option of disposal into near surface silos. The document was sent for review to the experts and was supplemented in June 2009. This document is the basis for the further work in the areas of safety analysis, environmental impact assessment and investment documentation. Also, it is taken into consideration in the new decommissioning programme.

In 2009, the consultation process of sitting of the low and intermediate level waste repository at the location Vrbina in Krško municipality continued. On the request of the Krško municipal council, the documentation prepared and revealed during the spatial plan preparation was independently reviewed. The objective of the review was to evaluate the technical feasibility of the selected option. In the basis of the review, the positive official position of the local municipality on the proposal of Spatial Plan of National Importance was adopted in July 2009. Between May and December 2009, the opinions of the authorities responsible for the spatial plan were collected and the final proposal for the national spatial plan was produced in December 2009.

On the 30 December 2009, the Government adopted a decree approving the site for a low and intermediate level waste repository. It was published in the Official Gazette of the Republic of Slovenia No. 114/09 on December 31st 2009. Thus, the procedure for sitting of the repository was finished.

In 2009, the sitting process of the repository at the location Vrbina, Gornji Lenart in Brežice municipality was terminated due to the negative opinion of the Environmental Agency of the Ministry of the Environment and Spatial Planning. The location was assessed as unacceptable because of the flood risk and reduction of the flooding area of the Sava River.

The work continued 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. In 2009, a second part of the project was carried out and the second intermediate report on the identification of key parameters in the implementation of the research on concrete and metal engineer barriers used in LILW repository was prepared. In the measurements, the data obtained from field investigations at the potential location Vrbina were used.

Also, the cooperation with two local partnerships (Brežice and Krško municipalities), continued in 2009. The purpose of the local partnership is to facilitate the cooperation between the representatives of municipalities and the local public in the process of site approval. There were many presentations, exhibitions and round tables about radioactive waste management and sitting procedure for the repository. Regular and ongoing flow of information on the sitting process in each local area was assured. Excursions to some of existing foreign LILW repositories for the local representatives were organized. The representatives of local partnerships were also involved in certain international projects, which facilitate the exchange of relevant information with other countries. For various target groups, the visits to the Central Interim Storage for Radioactive Waste and the exhibition on nuclear energy were organized which informed people about the line of work in the storage and the work itself.

The ARAO provides to the members of the partnerships the opportunity to take part in other projects, such as consultations on environmental issues and the implementation of Aarhus convention in the area of radioactive waste management.

In July 2009, the Krško local partnership ordered an independent study on the analysis of possible legal solutions for the introduction of individual financial compensation and an opinion on the criteria for the identification of beneficiaries for such compensation. Local partnership Brežice ordered a public opinion survey on the work of the local partnership and on the sitting of low and intermediate level waste repository in their municipality.

5.6 Remediation of the Žirovski Vrh Uranium Mine

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

In 2009, the works for the completion of the final remediation of the Boršt mill tailing continued in 2009. The remaining 50% of the tailing was covered. Only a small surface of tailing was not covered with the final humus layer due to the increased works on the decontamination of waste water channels and bad weather at the end of the 2009. Also, the surface drainage of the tailing into the west Boršt stream was under construction, as well as the sampling station for monitoring the seepage water from the depository won the west Boršt stream. Inclinometers and piezometers for the technical monitoring of the depository were installed. In the seepage waste water channel, the decontamination was carried out downstream to the Todražica creek. The GPS system was set for the continuous geodetic monitoring of the stability of the landfill area.

The landslide on which the hydrometallurgical tailings depository Boršt is situated moved for a few centimetres in the period 2008-2009. The SNSA requested a report on the dynamic of the movements in the last couple of years and the analysis of the effect the sliding had on the long-term assurance of the nuclear and radiation safety. The Faculty of Civil Engineering and Geodesy from University of Ljubljana prepared a report in which the intensive remediation work and the extreme quantities of rain in 2008 are stated as possible reasons for the increased rate of movement. They estimated that due to unfavourable condition, such as high precipitation in coincidence with an earthquake, could accelerate to the rate of movement as observed in 1990. The sudden collapse of the landslide is not likely, except in the case of the catastrophic combination of events. It is recommended in the report that the second phase of the remediation works commence.

On the mine tailings Jazbec, the activities within the scope of five years transitional period were carried out, such as mowing, the strengthening of grassy vegetation, the removal of bushes on the both sides of the fence and the maintenance and cleaning of lateral channels and drainage trenches. Other monitoring of the repository was also carried out. On the surface of the repository, some small deficiencies, identified during the internal technical review in October 2008, were corrected. The repository was covered with the final overlay in October 2008 and since then no contaminated or inert materials were disposed there.

After finishing the remediation, the SNSA will need to issue the license for the closure. This license is a prerequisite to obtain permit for the cessation of rights and obligations according to mining regulations and for the transfer of the sites into national infrastructure.

The financial resource needed for planned activities and safe working conditions of the staff and external workers as well as for limiting the effects of the mine to the environment, were fully assured in time.

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 approvals 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 2009, the SNSA approved 10 forms while the SRPA approved 22 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 21 licenses for import, 3 for export of radioactive or nuclear material.

In addition, the SNSA issued two licenses for multiple shipments in or out of EU countries and the import/export of contaminated equipments and tools, one license for the return of secondary radioactive waste which were sent to Sweden for treatment and one transit license for the air shipment of high activity sources from Germany to Bosnia and Herzegovina via Slovenia.

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

The Slovenian Fund for decommissioning of the Krško NPP and for management of radioactive waste from the Krško NPP collects financial resources for decommissioning of the Krško NPP and for the safe disposal of LILW and spent nuclear fuel. In 2009, the Krško NPP delivered one half of electric power to Slovenian and the other half to the Croatian utility. GEN Energija, Llc., was liable for the payment of the regular levy to the

Fund in the amount of 0.003 EUR for every kWh of electric power received by Slovenia from the NPP. By the end of the 2009, the total amount of 8,218,676 EUR was paid into Slovenian fund.

The safety of investments is assured by the structure of investments, as 82.45% of the total portfolio is invested in debit securities, deposits and CDs which have low credit risk and assure long time stable incomes.

On 31 December 2009, the Fund managed 145,072,568.38 EUR of financial investments, 17.77% of which was invested in banks in the form of deposits and CDs, 32.58% in state securities, 32.10% in other bonds, 3.59% in mutual funds, 8.13% in investment funds from OECD countries and evolving markets and 5.82% in state and EU investment funds.

The yield of the entire portfolio of the Fund for 2009 amounted to 5.95%, while the market yield of the portfolio amounted to 6.3%. The income from financing in 2009 amounted to 7.3 million EUR. In 2009, the Fund realized 0.63 million EUR of capital profit. The entire income of 13,019,266 EUR from the funding in 2009 was 1.81% higher than planned. The expenses in 2009 were 35.89% lower than planned and amounted to 7,201,907 EUR. The expenses of portfolio managing in relation to the entire portfolio amounted to 0.36%.

At the end of 2009, a Decree on low and intermediate level waste repository at the location Vrbina in Krško municipality was issued. With the adoption of the Decree, more precise planning of the expenses due to construction of the repository could be assessed and consequently, more precise planning of liquidity of the Fund would be possible. The beginning of construction of the LILW repository is expected to take place by 2014, so Fund is facing the four year period of planning and the liquidity is put on the top of investment principles.

In all years of the existence of the Slovenian Fund a total of 119.79 million EUR was paid by the Krško NPP and GEN Energija, Llc. From 1998 until end of 2009 total of 13.26 million EUR was paid out by the Fund to the ARAO for the purchase of studies and projects in the area of management of radioactive waste and spent fuel. Since 2004, the municipalities have received 12.85 million EUR as a compensation for the limited use of land. Despite the above mentioned expenses the Fund has operated successfully in all years of its existence. This is demonstrated through the average market profitability that amounts to 6.07% per year, thus exceeding the planned minimum profitability by 1.78%.

6 EMERGENCY PREPAREDNESS

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

In 2009, the **SNSA** continued and completed a comprehensive revision of its emergency plan for emergency preparedness and response in the case of nuclear or radiological emergency. All procedures were anew set up and their number decreased for one fourth because of optimization. In this way the clearness and applicability of procedures were improved.

The Communication System during an Emergency (M/KSID) was a major improvement. M/KSID is an online tool for communication among all SNSA emergency team members during an emergency. The SNSA also developed a related application for the interdepartmental communication between all main Slovenian emergency organizations (Krško NPP, Emergency Notification Centre of the Republic of Slovenia, and Headquarters of the Civil Protection). The first version of M/KSID system was tested during the exercise in December 2008. In 2009, an updated version was created which can completely replace conventional communication during an emergency.

In 2009, the SNSA regularly co-operated with the Krško NPP in the filed of emergency preparedness. The SNSA was also very actively involved in updating the National Nuclear and Radiological Emergency Response Plan (National Plan), which was led by the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief. The SNSA also worked with the Ministry of Health to update the regulations governing the use of potassium iodide tablets.

On the international level, the SNSA assumed the Presidency of the group EENCA (Eastern European National Competent Authorities), which is composed of 31 East Europeans countries. Group under the auspices of the International Atomic Energy Agency coordinates the preparedness for emergency situations.

The SNSA emergency response is assured by regular training for the members of emergency expert groups and response verification, as well as through exercises, regular checks of computers and other equipment, participation in international activities, and regular checks on all organizational regulations and associated guidance. Thus, in 2009, the SNSA conducted 37 training sessions. Also, the SNSA actively participated in the annual NPP Krško 2009 exercise and conducted several internal exercises.

In 2009, the **Administration of the RS for Civil Protection and Disaster Relief** (**ACPDR**) maintained, developed and ensured the preparedness for the effective response of the system for the protection against natural and other disasters in cases of nuclear or radiological disasters. The existing equipment and resources for action were regularly renovated.

A working group appointed by the Minister of Defence, to which representatives from all levels of planning (working, municipal, regional and national) were appointed, continued updating and upgrading the version 2.0 of the National Plan. The new Proposal for National Nuclear and Radiological Emergency Response Plan, version 3.0, includes radiological accidents and the conclusions of the state exercise NEK 2008. Besides the possibility of the disaster in NPP Krško, the plan also treats accidents in other nuclear and radiation facilities in the Republic of Slovenia and nuclear or radiological disasters abroad with potential impact on Slovenia as well as other radiological accidents with sources of ionizing radiation.

In the Training Centre for Civil Protection and Disaster Relief at Ig, the radiological and nuclear emergency units were involved in different training programs.

The **Emergency Notification Centre of the Republic of Slovenia** at the ACPDR is the national contact point for the notification of the competent national authorities as well as neighbouring and other countries, and international institutions in case of a nuclear or radiological accident at the Krško NPP or other nuclear or radiation facilities in Slovenia, and nuclear or radiological emergencies abroad with a potential impact on Slovenia. The Centre also participated in annual NEK 2009 exercise.

In the area of emergency preparedness, the **Krško NPP** focused on the activities for maintaining the existing preparedness, which include training and exercises, the maintenance of centres, equipment and communications, a documentation audit, hiring new staff, addressing the deficiencies identified during the National Exercise NEK 2008 and other exercises and drills, and coordination with administrative authorities as well as supporting institutions, planners and operators of protection and rescue tasks at the local and national level. In 2009, there were 14 training exercises and 11 drills. In December 2009, a regular annual review of the NEK emergency plan was made.

In June 2009, the Krško NPP revised its risk assessment study.

The Krško NPP was also involved in updating the Protection and rescue plan in case of nuclear accident.

The **National Exercise NEK 2009** was a staff only exercise without any field activities. It was held on 28 October 2009 from 3:00 a.m. to 10:00 a.m. The dynamics of work was based on a pre-established scenario of events and equipment failures in the technological process, simulated by a simulator or let the assumption they were on site in the technological part of the plant.

The exercise showed that the plant was well prepared to handle the simulated emergency. The identified deficiencies will be remedied in the near future.

In 2009, the **Mobile Units** for field radiological measurements practised on the rounds to Krško NPP and its vicinity. The field radiological measurements include the atmosphere sampling, the dose rate and contamination measurements, in-situ measurements and gamma spectrometry sample measurements. In 2009, the mobile unit of the Krško NPP has done two rounds with the mobile unit of Institute of Occupational Safety and tour of inspection with the ELME, the JSI mobile radiological laboratory. Both laboratories also cooperate with the ACPDR, the unit of the Institute of Occupational Safety as a specialized unit for terrorist events with radiological impact and the ELME for other radiological events.

7 CONTROL OVER RADIATION AND NUCLEAR SAFETY

7.1 Legislation

The most important piece of legislation in the field 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-five implementing regulations were adopted by the end of 2008, namely six governmental decrees, eight rules issued by the minister of the environment, nine issued by the minister of health and two issued by the minister of interior.

In 2009, the adoption of implementing rules continued and the following rules were issued:

- Rules on transboundary shipments of radioactive waste and spent fuel (Official Gazette RS, No. 22/09),
- Rules amending the Rules on the monitoring of radioactivity (Official Gazette RS, No. 97/09),
- Rules on operational safety of radiation and nuclear facilities (Official Gazette RS, No. 85/09, 9/10) and
- Rules on radiation and nuclear safety factors (Official Gazette RS, No. 92/09, 9/10).

Especially, the last two mentioned extensive rules represent a very important step towards the harmonisation of Slovenian legislation related to the nuclear safety with the best EU practice. The Slovenian Nuclear Safety Administration was preparing the two rules for four years in close cooperation with all stakeholders. The so-called Reference Levels, i.e. few hundreds of concrete requirements which need to be fulfilled by nuclear power plants, have been transposed in those rules. These Reference Levels have been in preparation for several years by informal association of European nuclear regulators WENRA, who defined the best practices and bound all participating countries to transpose them as legal requirements into their national legal frames by 2010. By these two rules, Slovenia almost completely fulfilled this commitment. For the year 2010, only some minor changes of the existing rules on qualification of workers in the NPP's are to be adopted.

In 2009, the draft of the new Act on third Party Liability for Nuclear Damage was finalised. By the end of 2009, the inter-ministerial reconciliation was successfully concluded, except for the reconciliation with the Government Office for Legislation.

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/.

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 field 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.

In 2009, the Expert Council convened one regular and one correspondence session in 2009. In addition to the regular reporting of the SNSA Director on the news and developments in the field of radiation and nuclear safety between the meetings, the Council addressed the following areas: the monitoring of operation of nuclear facilities, drafts of new nuclear regulations and their status, the monitoring of the introduction of practical guidelines as a means of legally non-binding document of the SNSA, the preparedness and communication in the case of an emergency, and general questions on nuclear and radiation safety. In 2009, the Expert Council also reviewed and adopted the Annual Report on Radiation and Nuclear Safety in Slovenia for 2009, the act on third party liability, the regulation on factors of radiation and nuclear safety, the regulation on nuclear security following the start of operation of radiation and nuclear facilities, the regulation on changes and amendments to the regulation on monitoring of radioactivity, procedures of the SNSA in the case of an emergency, the SNSA procedure on the preparation of practical guidelines (OP 4.2) and practical guidelines themselves (PS 1.01).

It is worth mentioning that the Expert Council also considered general open issues on nuclear and radiation safety and the process of integration of the Republic of Slovenia into the OECD.

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 following areas: 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.

Legal bases for its administrative and expert tasks in the area of nuclear safety, radiation protection and inspection are provided by the legal frame, as presented in detail at the SNSA web site http://www.ursjv.gov.si.

At the end of 2009, the SNSA, an administrative body within the Ministry of Environment and Spatial Planning, had 45 employees, out of these 9 with a doctor's decree, 13 with a master's decree, 22 with higher or university education and the one with high-school education.

In December 2009, the SNSA successfully passed the second regular yearly control audit of the management system (the first was conducted in 2008), during which the transition to the new version of ISO standard 9001:2008 was made. During the audit, the Bureau Veritas found no incompatibilities and confirmed that the SNSA quality management system is in accordance with standard ISO 9001:2008.

The SNSA pays special attention to qualification in the area of nuclear safety and radiation protection. A number of its employees passed a special training course within the educational program of the US NRC or at the Nuclear Training Centre at Brinje near Ljubljana. Furthermore, the SNSA employees regularly participate at the seminars and workshops organised by the International Atomic Energy Agency, the European Commission or other international organisations. In 2009, the average SNSA employee spent 8 days in different kind of training.

The SNSA web site offers general information about the SNSA, information to the public, legislation, agreements and standards in this field, annual and other reports, information on meetings, information on 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 sites of other regulatory authorities, organizations and research centres. On the site's pages, all relevant information as required by the Act on the Access to Information of Public Nature is also available. Unfortunately, the English version is less comprehensive.

The Expert Commission for the Verification of Professional Competence and Fulfilment 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 the licenses for the Senior Reactor Operator, the Reactor Operator and the Shift Engineer of the Krško NPP. Seven candidates successfully acquired the extension of the Senior Reactor Operator license, six candidates acquired the license extension for the position of Reactor Operator and one candidate acquired the license extension for the position of Shift Engineer. In addition, four candidates passed the examination for the Senior Reactor Operator license for the first time. The SNSA granted the licenses for performing work and duties in the Krško NPP.

In autumn 2009, the Commission organized the initial licenses examination of qualification for new Reactor Operators. All four candidates successfully passed the examination and acquired their first Reactor Operator license. The licences were granted by the SNSA.

In 2009, there were no examinations for the license prolongation of operators at the TRIGA research reactor.

7.4 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.

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 2009, 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.

In 2009, the SRPA focused on assuring the quality of teletherapeutic radiological procedures and diagnostic procedures in nuclear medicine. The Administration provided financial means for the technical operation check of five irradiation facilities at the Institute of Oncology in Ljubljana. Furthermore, the project was carried out, within which the proposal for the protocol for the technical verification of gamma cameras was drawn up, and the checks were made in both University Medical Center in Ljubljana and Maribor, and General Hospital Celje. Moreover, the SRPA assured the implementation of the national Program for the systematic examination of working and living environment and raising public awareness about the means for the diminution of the exposure to natural radiation sources. Also, the means were assured for the surveillance and monitoring of the radioactivity in food stuff and drinking water in the Republic of Slovenia. Beside mentioned researches, the SRPA financed the preparation and statistical processing of data base for the European Radon Atlas and, in the field of non-ionizing radiation, the determination of general public exposure to high frequency electromagnetic radiation. In cooperation with the Institute of Non-Ionizing radiation, the Administration published a brochure about possible harmful effects of tanning beds.

The SRPA oversaw radiation practices in medicine and veterinary medicine and use of radiation sources in these activities, protection of exposed workers in nuclear as well as radiation facilities and radon exposure. Altogether 128 permits to carry out a radiation practice, 244 permits to use radiation sources and 10 permits to import radioactive sources, 145 confirmations of programmes of radiological procedures, 22 statements of consignees of radioactive materials and 221 evaluations of protection of exposed workers were granted, Out of these, 134 were for the use of X-ray devices in medicine, 8 for the use of open and sealed sources in medicine, 11 for performing a radiation practice in nuclear and radiation facilities and 68 in industry, research and other activities. In 2009, the SRPA issued an authorization to two natural persons.

Altogether, 162 inspections were carried out. Out of these, there were 15 in-depth inspections. In the medicine and veterinary medicine, 9 provisions requiring correction of established deficiencies were issued, as well as, one provision requiring prohibition of further use of obsolete device and 2 provisions requiring sealing of X-ray device.

Three inspections were carried out in the Krško NPP and one at the subcontractor.

Last but not least, the SRPA supervised the Žirovski Vrh uranium mine, 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.

From the reports of authorized experts, it can be concluded that there were no major changes in their implementation in comparison to previous years. Their staff maintains their competence and the equipment used was well kept and updated. The organizations established the Quality Management Programmes certificated in compliance with ISO 9001:2000. The authorized experts provided professional support to the Krško NPP by preparation of independent expertise. An important part of their work focused on an independent review and assessment of plant modifications. They also provided professional support to the administrative procedures related with the remediation of the mining waste sites of the Žirovski Vrh mine and to the activities of the Agency for Radwaste Management.

Research and development activities are an important part of their work. Certain organizations successfully participated in international research projects.

On the basis of the Act on Protection against Ionizing Radiation and Nuclear Safety, the SNSA authorized, by the end of 2009, twelve legal entities and three natural persons as Authorized experts for radiation and nuclear safety for the period of five years.

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.

In 2009, the SRPA did not issue any authorization for radiation protection experts.

Authorized dosimetric service

Authorized dosimetric service performs tasks related to the 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 2009, the SRPA did not issue any authorization for the dosimetric service.

Authorized medical physics experts

Authorized medical physics experts give advice on the optimization, measurement and evaluation of irradiation of patients, the development, planning and use of radiological procedures and equipment, as well as ensuring and verifying the quality of radiological procedures in medicine. Only natural persons can become authorized medical physics experts.

In 2009, the SRPA issued two such authorizations.

Authorized medical practitioners

Authorized medical practitioners carries out the medical surveillance of exposed workers. An authorization is issued by the minister of health on the recommendation of the SRPA and the Expanded professional collegium for occupational medicine.

In 2009, the SRPA did not issue any such authorization.

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 eight members. The Insurance Company Triglav, Ltd., the Reinsurance Company Sava, Ltd., the Adriatic Slovenica, Ltd., and the Reinsurance Company Triglav have the biggest shares in the Pool.

The Krško NPP third party liability cover is insured by the Nuclear Pool GIZ in the amount of 150 million SDR, in Euro equivalent (app. 163.2 million €).

The Nuclear Pool GIZ participates in the third party liability insurance risk up to its capacity level, while the rest of the risk is reinsured in 19 foreign pools. The most important are the British, the German, the Swedish, the Swiss, and the Japanese pool.

The TRIGA type Research Reactor third party liability cover is also insured by the Nuclear Pool GIZ in the amount of 5 millions SDR.

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 Treaty on Non-proliferation of Nuclear Weapons 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, North Korea and Israel). The current situation in Iran shows that their peaceful nuclear program is not always transparently presented to the IAEA. The United Nations Security Council adopted two additional resolutions, namely 1803 (2008) and 1835 (2008), about Iranian nuclear activities of international concern.

Slovenia fulfils completely its obligations as stated in international agreements and treaties. Together with other countries, it tries to prevent further expansion of nuclear weapons. Due to the potential misuse of radioactive sources, the international community, including Slovenia, has significantly reinforced the control of these sources.

Nuclear Safeguards

On the international level, nuclear safeguards are regulated with the Treaty on Non-proliferation of Nuclear Weapons and the Treaty Establishing the European Atomic Energy Community. In the process of accession to the EU, Slovenia had to rearrange the legal frameworks and now fulfils completely its obligations regarding the 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 the SNSA and international inspection.

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

In 2009, there were six joint IAEA/EURATOM inspections, during which no anomalies were found. In accordance with legislation, the Slovenian holders of nuclear material reported to EURATOM.

Due to the »non-side letter« mode of application of the Additional Protocol, the SNSA reports to the IAEA and in limited scope also to the EURATOM, as demanded in the Protocol.

The Comprehensive Nuclear-Test-Ban Treaty

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

In 2009, several meetings of working groups in the framework of the CTBT Organization took place. On the meeting on 26 May 2009, the signatory states condemned the North Korean nuclear test explosion carried out on May 25 as a serious violation of the principles of the Treaty and of the United Nations Security Council resolution 1718. Also, the signatory states called upon North Korea to accede to CTBT and comply with the international rules. The SNSA and the Ministry of Foreign Affairs are monitoring further development in this area.

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

On the basis of the Act on Export Controls of Dual-Use Goods (goods that can be used not only for civil but also for military purposes, including nuclear weapons, weapons of mass destruction), the Slovenian Government formed a Commission for Export Controls of Dual-Use Goods at the Ministry of Economy. In the work of the commission participate representatives of the Ministry of Economy, the Ministry of Foreign Affairs, the Ministry of Defence, the Ministry of the Interior, the Customs Administration, the SNSA, and the Slovenian Intelligence and Security Agency and the National Chemicals Bureau. A licence for export of dual-use goods, based upon the opinion of the Commission, must be obtained from the Ministry of Economy. In 2009, the Commission had 8 regular and 28 correspondence sessions, and one technical meeting.

In March and September 2009, the Ministry of Economy in co-operation with the information centre Center Evropa from Ljubljana, and together with representatives of the Ministry of Foreign Affairs, the National Chemicals Bureau, the Customs Administration and the SNSA prepared two one-day seminars on the export control of dual-use goods for the industry.

Physical Protection of Nuclear Material and Facilities

Since 2006, the provisions from two regulations in the filed of physical protection of nuclear material and facilities, issued on the basis of the 2002 Act, have been applied. State organisations and nuclear facility operators coordinated their activities with the provisions of both regulations. The operators prepared plans for the physical protection of nuclear facilities and send it to the Ministry of the Interior for approval. Based on the mentioned regulations, the training of security workers in nuclear facilities as well as transports of nuclear material was carried out.

The Inspectorate of the Ministry for Interior, together with the SNSA inspectors, carried out one inspection of the physical protection system and the work of the security service at the Krško NPP. No anomalies were found. Furthermore, the Commission for tasks in the area of physical protection of nuclear facilities and materials worked in compliance with its mission. A special attention was devoted to the coordination of work with other competent authorities. The commission also worked on preparations for the IAEA Physical Protection Appraisal Service (»IPPAS« follow-up mission) scheduled for April 2010.

After the required preceding activities, including the changes of the Penal Code were finished in the middle of 2009, the Slovene Parliament ratified the amendments to the Convention on Physical Protection of Nuclear Material.

At the Reactor Centre TRIGA, the system of physical protection was upgraded with the installation of additional technical equipment received through the technical assistance of the IAEA (»Remote Monitoring«). The installed surveillance equipment also covers a part of the Central interim storage for radioactive waste in Brinje.

The physical protection of a road shipment of fresh nuclear fuel from the port of Koper to the Krško NPP was carried out successfully.

In summer 2009, the Slovene representatives from the SNSA and the Police attended the annual meeting of the European Nuclear Security Regulators Association (»ENSRA«), held in the Netherlands.

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 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 the 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. By the end of 2009, twenty organizations were authorized for measurement of radioactivity in scrap metal shipments. Seventeen of these sent their annual reports to the SNSA. According to them, 26,346 measurements of shipments were carried out. In five cases, the dose rates were elevated due to: a discovery of depleted uranium, a contaminated stainless steel tube, a discovery of 27 ionising smoke detectors, contaminated aluminium bales, and a contaminated metal holder on a lorry.

To provide assistance and consultation, the SNSA gave to other state offices and private organizations, such as scrap recyclers and melting facilities, the telephone number of a 24-hour on-duty officer. In 2009, eleven calls were registered. One case, worth mentioning, occurred on 5 March 2009. In the Port of Koper, elevated radiation (20 μSv/h) was detected in the shipment of scrap metal. It was found that the material causing the radiation was uranium. In the later phase, the Agency for Radioactive Waste Management (ARAO) discovered 16.2 kg of depleted uranium together with three other contaminated items. All items were transferred to the Central interim storage for radioactive waste in Brinje. The SNSA reported about event into the IAEA Illicit Trafficking Database. The origin of depleted uranium is still unknown. There was no suspicion of any criminal activity.

On 25 May 2009, the Slovene customs officers at the Obrežje border crossings detected elevated radiation (227 μSv/h) in a Bosnian shipment of scrap metal. In the follow-up, the certified expert from the Institute of Occupational Health identified a lightning rod with a $^{152/154}$Eu source. On 15 June 2009, the source was transferred back to Bosnia and the case was handed over to the competent Bosnian authority. The SNSA reported this event to the IAEA Illicit Trafficking Database.

In last years, improvement of detection capabilities at Slovene borders authorities is noticed. A great step forward has been achieved also by installation of additional radiation detection capabilities, at scrap dealers and recyclers.

9 RESEARCH ACTIVITIES

In recent years, the Slovenian Nuclear Safety Administration supported smaller research projects. In this manner, the Administration was trying to obtain the relevant data on specific technical issues, but at the same time directed and maintained scientific knowledge in Slovenia. Unfortunately, due to cuts in financing, the possibility of funding such research is radically reduced. In 2009, there were no new studies and only the studies commissioned the previous year were concluded.

Radionuclide ^{129}I in Slovenian sea

Among globally spread radionuclides generated in nuclear fuel reprocessing plants, are also two fission products ^{85}Kr and ^{129}I. The radionuclide ^{129}I (iodine) is dispersing into in the environment mostly through liquid discharges, and party, by discharging into the atmosphere.

As a result of direct liquid discharges from reprocessing plants in Great Britain and France, the level of contamination with ^{129}I in the seas in Northern Europe fairly high. For the southeast part of Europe, there has been so far no data on this radionuclide. The reason for this are very low concentrations of the radionuclide in the environment which can not be detected by conventional laboratory methods and measuring devices.

At the Jozef Stefan Institute, the specific radiochemical method with neutron activation for determination of ^{129}I in very low concentrations was developed. The initial part of the research consisted of the determination of ^{129}I concentrations in the sea water along the Slovenian coast. The concentration was mostly ranged from 3-14 mBq/m^3. Such concentration is much lower from that in the Channel (530 mBq/m^3), where the sea water is under the influence of the French fuel reprocessing plant. In the sediments, the concentration was from 0.4 to 1.2 µBq ^{129}I per milligram of dry sample. Also the content of ^{129}I in edible mussels (*Mytilus galloprovincialis*) has not been measured until then and ranged from 0.7 to 6.2 µBq per milligram g of edible part of mussels, expressed on dry matter. ^{129}I is most concentrated in the algae, since the concentration in the brown algae (Fucus virsoides) was from 2.2 to 3.1 µBq per milligram of dry weight. This is several orders of magnitude less than in northern European seas. From the perspective of radiological exposure of the population, concentrations of ^{129}I in the Slovenian sea are small. The effective dose from the intake of mussels is of the same magnitude as the doses caused by intake of plant foods contaminated by the Chernobyl radionuclide ^{137}Cs.

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

Already in 2005, the Slovenian Government approved the starting points for the sustainable assurance of supporting activities in the field of nuclear and radiation safety and appointed a working group to prepare the programme. Based on this programme, within the targeted research programme Competitive position of Slovenia in 2006–2013, the thematic cluster with following chapters was tendered:

– Safety questions on the technologies of nuclear and radiation facilities,
– Safe disposal of radioactive waste and spent fuel,
– Radiation monitoring in the environment.

Three long-term joint projects of the Jožef Stefan Institute and the Institute of Occupational Safety were selected by tender. The research funds were provided by the SNSA and the Slovenian Research Agency. The selected projects are:

– Structural properties of concrete and seepage of water through the concrete structures,
– Developing the necessary skills to monitor, evaluate and control the management of

aging nuclear facilities, and

- Determination of the relation between the ^{129}I and ^{127}I in the marine and terrestrial environment in Slovenia.

In 2009, the projects have been successfully managed and gave the expected results. They were given a positive evaluation by the SNSA, which consequently approved their continuation and funding.

10 INTERNATIONAL COOPERATION

10.1 International Atomic Energy Agency

In 2009, Slovenia successfully cooperated with the International Atomic Energy Agency (IAEA) in various fields. Traditionally, the Slovenian delegation attended the regular annual session of the General Conference. The most important Slovenian activities are as follows:

- In 2009, Slovenia received 19 individual applications and one group application for training of foreign experts in our country. 11 trainings were implemented, two applications were rejected, while six individual applications and one group application are waiting for realization in 2010. Two applications from 2007 and 2008 were also realized in 2009.
- Slovenia submitted 2 new proposals for research contracts, which were prepared at Jožef Stefan Institute. Ten research contracts were in progress from the previous years, while two research contracts were completed in 2009.
- 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, which both were started in 2009. All projects from the previous cycles were completed.
- Slovenia continues with its active policy of hosting activities organized by the IAEA. In 2009, Slovenia hosted six such events, i.e. workshops, courses and meetings.
- In 2009, three Slovenian experts, appointed to the Nuclear Standards Committee, Waste Standards Committee and Radiation Standards Committee, actively participated in activities of the three committees.

In 2009, the Board of Governors convened at five regular sessions and three extraordinary sessions, three times as the Board of Governors' Programme and Budget Committee and once as the Board of Governors' Technical Assistance and Cooperation Committee. The Board of Governors considered the budget proposal for 2010 and 2011, the IAEA Annual Report, the Report on Technical Cooperation, safeguards in Iran and Syria and the lack of cooperation of Democratic People's Republic of Korea with the IAEA. The IAEA General Conference appointed Mr. Yukia Amano as the Director General. Mr. Amano started his term of office in December 2009.

At the invitation of the IAEA in 2006, the Slovenian experts started to cooperate in a national project of the Republic of Serbia called VIND (Vinča Institute Nuclear Decommissioning). Activities under the VIND project started in the 2003-2004 cycle of technical cooperation and assistance. In January 2009, the representatives of the Serbian regulatory body visited the Slovenian Nuclear Safety Administration, the Nuclear Training Centre of the Jožef Stefan Institute and the Agency for Radwaste Management. They were also given a technical tour of the Central Interim Storage of Radioactive Waste at Brinje. Within the framework of the IAEA expert mission, a visit of the Slovenian experts to Belgrade was organized in July 2009. The experts assisted the Serbian colleagues in granting a license for repackaging of spent fuel from the Vinča research reactor. The collaboration also included the assistance of Slovenian experts in the inspection control of fuel repackaging. Furthermore, the experts made a review of the draft program of the radioactive waste storage trial operation.

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

In 2009, Republic of Slovenia continued its well-developed cooperation with the Nuclear Energy Agency (NEA) - Organization for Economic Co-operation and Development

(OECD). In NEA, Slovenia has the observer status. 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 are comprised of experts from member states as well as observes. The Committees represent specific international forum for exchange of experiences and knowledge regarding specific technical issues.

In April 2009, the SNSA convened the meeting of all Slovenian representatives in committees and working groups of NEA. Despite the fact that the committees cover very different areas and interests, the invited experts agreed that the representatives need to be diligent. They emphasized the importance of setting the priorities including their coordination. These priorities would provide a guideline about the areas to be financed in the future, because for the time being, the only Slovenian expenses are the cost of participation at the meetings and the payment for the observer status in the NEA.

10.3 Cooperation with the European Union

Working Party on Atomic Questions (ATO)

In the first half of 2009, France handed over the EU presidency to the Czech Republic. The main activity during Czech presidency in the Working Party on Atomic Questions (ATO) was drafting the Nuclear Safety Directive[3]. This task was successfully concluded with the adoption of the directive on 25 June 2009. The document was published in the EU Official Journal in July.

In the second part of 2009, Sweden took over the presidency. Their agenda included the preparation of a negotiation position between Euratom and Russian Federation and negotiations between Euratom and Canada. The Council adopted Conclusions on the security of supply of radioisotopes for medical use. The major problem is that most of reactors producing isotopes for medical use are rather old, and the production is concentrated in a couple of centres, thus any shutdown of such reactor causes serious disruption in the supply of isotopes on a world scale.

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

High-level Group on Nuclear Safety and Waste Management (ENSREG) had four meetings. ENSREG is chaired by Dr. Andrej Stritar, the SNSA Director, who was elected for another two year term of office in autumn 2009.

The work of the High-level Group focused on the preparation of the proposal for Nuclear Safety Directive, adopted on 25 June 2009. In the first half of 2009, ENSREG was finalizing its first report on ENSREG activities[4], which was handed over to the European Commission and the European Parliament. The most emphasis in the report is put on the harmonization of national nuclear safety legal systems and practices. In the last two years, the communication in the area of nuclear safety among Member States improved significantly In particular increased the use of best standards and learning from each other. Also, Dr. Andrej Stritar presented the report to the Committee on Industry,

[3] COUNCIL DIRECTIVE 2009/71/EURATOM of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations.

[4] Report of the European Nuclear Safety Regulators Group, July 2009

Research and Energy (ITRE) of the European parliament.

Consultative Committees under the Euratom

Within the framework of the European Atomic Energy Community Treaty (Euratom), there are at present active 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.

Committee under the Article 31 prepares recommendations for the European Commission regarding legal acts in the field of radiation protection and public health. In 2009, the Committee dealt mainly with the draft of the amended Directive on Basic Safety Standards for Protection against Ionizing Radiation (the so-called BSS Directive).

Euratom requires from Member States to establish a system of radiation monitoring in the environment and consequently to report to the European Commission within the Committee under the Article 35 and 36. The European Commission can verify the existence and compliance of such system with the Community requirements (art. 36). Such verification took place in Slovenia in 2006.

Committee under the Article 37 held two meetings in 2009. 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.

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 the assistance to the third countries in the area of nuclear and radiation safety. In 2009, the consultative committee INSC discussed annual action plan, which consisted of six national and regional projects, as well as strategic plan for cooperation of the Community with the third countries in the period 2010-2013, indicative programme of projects for years 2010-2011, and the draft Terms of Reference of INSC.

The Consultative Committee Euratom-Fission (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 2009, the Committee held two meetings.

Assistance to the countries of Western Balkans

In 2009, the SNSA, together with consortium partner GmbH from Vienna, carried out the project The Assessment of in the Western Balkan countries, which was financed by the European Commission, The main goal of the project was to prepare action plan for the improvement of the state of radiation and regulation infrastructure in Albania and former Yugoslavian states. The plan defines the scope of professional assistance in the future. The states differ greatly in the field of regulation of radiation activities, but most countries need to complement the relevant legislation strengthen regulatory bodies and inspection, improve the radioactive waste management, complete plans and procedures in the cases of an emergency, and strengthen the radiation control of the population and workers, as well as in medicine.

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. The standards which

WENRA prepared in the past years were extensively used for writing of the two important regulations on nuclear safety in Slovenia. With these two regulations the Slovenian legal framework was harmonized with the practice of other EU countries.

In 2009, WENRA dealt mainly with the safety requirements for new reactors and with reference standards for radioactive waste disposal safety. Also, countries without nuclear power plants were invited to become associated members in WENRA. Austria, Ireland, Luxembourg, Norway and Poland accepted the invitation and participated as associated countries. WENRA decided to also invite observer countries, such as Armenia, Russian Federation and Ukraine, to steep up contacts with these countries.

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.

In 2009, the regular annual meeting was in Brussels in Belgium, but there was no representative from Slovenia. Meeting took place on 4 and 5 June. The main general topics were legislation, licensing and operational experience exchange, while more specific topics included new nuclear power plants, licensing of radioactive waste repositories and third party liability.

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.

After 2007 Brussels Conference, the 2009 conference was organized in Toronto, Canada, but due to economical reasons, the SNSA did not send a representative.

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. In 2009, the meeting of ENSRA was held in Almelo, the Netherlands.

10.5 Co-operation 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.

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

At the end of 2009, the Joint Convention was effective in 53 countries, including Slovenia. The Third Review Meeting took place from 11 to 20 May 2009 at the headquarters of the International Agency for Atomic Energy in Vienna. 45 delegations of contracting parties to the Joint Convention were present.

For Slovenia, the Joint Convention applies to the safety of the spent fuel management in the Krško NPP and in the IJS Research Reactor, the safety of the operational waste in the Krško NPP, the decommissioning waste from the Žirovski Vrh Uranium Mine, and the waste from small non-power applications are stored in the Central Interim Storage for Radioactive Waste in Brinje. In 2008, The SNSA prepared The Third National Report with contributions from the SRPA, the Krško NPP, the Jožef Stefan Institute, the Agency for Radwaste Management, the Žirovski Vrh Mine Llc, and the Institute of Oncology. After the presentation of the Slovenian report, the reporters on the review meeting concluded that Slovenia presented a comprehensive national report which satisfactorily addresses all relevant issues in the area of the safety of spent fuel management and radioactive waste management, and that the situation in the country in this regard is well controlled. Furthermore, Slovenia is encouraged to continue working with Croatia to find an agreeable solution for the liabilities resulting from the joint ownership NPP in Krško.

On the closing plenary session, the general conclusion was that despite the positive trend, the conditions in some countries and in some areas would still need improving. Slovenia was requested to report at the Fourth Review Meeting, scheduled for May 2012, on the status of the final site approval and construction of the LILW repository, on efforts to improve cost estimates of geological disposal and future liabilities, on implementation of the agreement with Croatia in the area of waste management and disposal, on the update of the Krško NPP decommissioning as well as on the update on LILW and SF disposal programme, and on the disposal of LLW with natural radionuclides that originates from the Žirovski Vrh mine.

Bilateral Co-operation

In the beginning of June 2009, quadrilateral meeting with the Czech Republic, the Slovak Republic, and Hungary was organized in Trenčin, Slovakia. Main topics of the meeting were activities and news related to regulatory bodies themselves, interesting events in the nuclear power plants, and news in the area of regulations and international cooperation. In addition, information was exchanged about the new nuclear power plants, planned or under construction, and about planned power uprate of the NPPs. All these issues present challenges to the regulatory body. Also, the Czech Republic presented its experiences managing the EU Presidency.

In October 2009, 11th bilateral meeting between Austria and Slovenia took place in Portorož. Both sides described the main developments in the field of legal framework and administration, radiation monitoring, emergency preparedness and waste management. Slovenia notified Austria that the Krško NPP planned to file an application for approval of ageing programme, which is a prerequisite for the plant life extension. Slovenia also provided an extensive description of licensing of a new nuclear power plant.

Intergovernmental Agreement on the Co-ownership of the Krško NPP

In 2009, 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 rights over the energy produced in the Krško NPP, were cooperating in an amicable spirit and were ensuring all necessary financial means for the operation of the Krško NPP. In 2009, the Assembly convened four times.

At the 19th session on 27 February 2009, the co-owner GEN Energija, Ltd proposed the correction of salaries and remuneration of the Managing Board, as well as of the meeting fees for the Supervisory Board. Proposal was in line with the recommendations of the Slovenian Government, therefore the payments to the managers and supervisors were reduced.

At the 20th session on 17 April 2009, the Annual Report 2008 was approved. The Annual Report 2007 was prepared by the Managing Board and the Supervisory Board issued a positive statement. In this session, the Assembly decided that the members of the Managing Board and of the Supervisory Board of 2008 are discharged. Also, the financial auditor was nominated and approved for 2009.

At the 21st session on 24 July 2009, the Assembly appointed Mr. Hrvoje Perharić as Managing Board Member for the period from 1st November 2009 to 1st November 2014.

At the 22nd session on 12 November 2009, the Assembly released three members of the Supervisory Board (Milan Mravak, Darko Dvornik and Kažimir Vrankić) and appointed new members (Leo Begović, Dubravka Lukačević and Kažimir Vrankić) for the period from 12th November 2009 to 6th April 2011.

In 2009, the Krško NPP Supervisory Board had four regular sessions and one extraordinary.

At its 1st extraordinary session on 17 April 2009, the Supervisory Board adopted the Information about economic operations for 2008 and gave consent for the short-term debt.

At its 33rd regular session on 29 January 2009, the Supervisory Board issued a positive opinion on the draft Annual Report 2008, proposed to the Assembly to appoint KPMG as financial auditor, adopted the investment program called Moving and Modernization of 110 kW House Load Switchyard, and adopted the Biannual Report on Modification Status II-2009 (July-December), Rev.1, as well as ISEG reports for December 2008, January 2009 and February 2009. Supervisors were notified about the activities and the status of outage 2009.

At its 34th regular session on 16 September 2009, the Supervisory Board adopted the business information for the period from 1. 1. 2009 to 30. 6. 2009 and the Biannual Report on Modification Status I-2009 (January-June), Rev. 0, as well as investment program Weld Cladding of the Pressuriser and adopted ISEG report for March-June 2009.

At its 35th regular session on 24 November 2009, the Supervisory Board appointed Leo Begović as the President of Supervisory Board, adopted the business information for the period from 1. 1. 2009 to 30. 9. 2009 adopted the Economy Plan for 2010, Rev.0, agreed with the pro-forma price of the available power and electrical energy for 2010, adopted the Long-Term Investment Plan of Technological Infrastructure of the Krško NPP for the Next Five Year Period (2010-2014), Rev. 7, and adopted the ISEG report for July and August 2009.

10.6 Use of Nuclear Energy in the World

At the end of 2009, there were 29 countries operating 438 nuclear reactors for electricity production. In 2009, two new nuclear power plants were put in operation, one in Japan and one in India. The operation of two nuclear power plants in Japan and one nuclear power plant in Lithuania was stopped. Also, the construction of 11 new nuclear power plants started in 2009.of which 9 in China, one in Russia and one in the Republic of Korea. After a long break, the construction of a floating nuclear power plant in Russia and two nuclear power plants in Slovakia continued.

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

In the developing states, the interest for building new nuclear power plants and the extension of life time of existing plants is still rising. On some sites in the USA, the earthmoving works are already in progress, since they expect to get construction licenses shortly. The life cycles of 59 power plants have been prolonged from 40 to 60 years, but, soon, it is expected for all 104 power plants which are currently in operation. At the end of 2009, the Great Britain announced the building of 12 new nuclear power plants. After the elections in Germany, their policy on closing nuclear power plants was changed to the policy of long-term operation. The Swedish are also more favourable to the nuclear energy and have started to prepare legislation that will allow the building of new facilities on the locations of power plants that are currently in operation. In France, the first from the series of new power plants is under construction. Italy also changed its legislation to allow the building of power plants. New builds are planned in Poland, Hungary, Slovakia and Czech Republic. Romania is planning to continue the construction of two long-dormant projects. In Switzerland, the procedures for choosing the location for the new power plant are in progress. Lithuania, where the last operating power plant was stopped at the end of 2009, also prepares for the building of a new one.

Table 10: Number and installed power of reactors by countries

Country	Operational		Under construction	
	No.	Power [MW]	No.	Power [MW]
Belgium	7	5.902		
Bulgaria	2	1.906	2	1.906
Czech Republic	6	3.678		
Finland	4	2.696	1	1.600
France	59	63.260	1	1.600
Germany	17	20.480		
Great Britain	19	10.137		
Hungary	4	1.889		
Netherlands	1	487		
Romania	2	1.300		
Russia	32	22.683	8	5.944
Slovakia	4	1.762	2	810
Slovenia	1	696		
Spain	8	7.516		
Sweden	10	9.041		
Switzerland	5	3.238		
Ukraine	15	13.107	2	1.900
Europe total:	**196**	**169.748**	**16**	**13.760**
Argentina	2	935	1	692
Brazil	2	1.884		
Canada	18	12.569		
Mexico	2	1.300		
USA	104	100.683	1	1.165
America total:	**128**	**117.371**	**2**	**1.857**
Armenia	1	375		
China	11	8.438	21	20.920
India	18	3.987	5	2.304
Iran			1	915
Japan	54	46.823	1	1.325
Korea, Republic of	20	17.705	6	6.520
Pakistan	2	425	1	300
Taiwan	6	4.980	2	2.600
Asia total:	**112**	**82.733**	**37**	**34.884**
South Africa	**2**	**1.800**		
World total	**438**	**371.685**	**55**	**50.501**

Reference: International Atomic Energy Agency, end of 2009

10.7 Radiation Protection and Nuclear Safety World-wide

The International Atomic Energy Agency (IAEA) maintains a system for reporting the abnormal events in nuclear facilities, on the use of radiation sources and on the transport of radioactive material in the IAEA member states. The system is known as International Nuclear and Radiological 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 web 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 three INES reports on nuclear events were received by the IAEA NEWS in 2009. Six of them were not rated. Five reports were on events in nuclear power plants. The remaining eighteen were related to exceeded dose limits due to use of radioactive sources (8 reports), the potential exposure of the members of public (2 reports), traffic accident involved transport of radioactive source (1 report), stolen radioactive source (1 report), the contaminated vehicle and working area of a nuclear fuel production facility (2 reports). In the last two cases, there were no consequences for the workers and the environment.

Four events in nuclear power plants were rated as level 2 – incident, one was not rated. In the report, the problems mentioned were ensuring heat sink, the exposure of maintenance workers in excess of statutory limits, the problem in the transport in a facility, the incident in the use of radioactive equipment, and the minor fire in a facility. Incidents had no serious consequences to the safe operation of the nuclear power plants. The exposure of two workers exceeded statutory limits and one worker was slightly injured when extinguishing a fire.

Other radiation events were rated as follows: ten events as level 2 – incident, one as level 1 – anomaly and one as level 0 – below scale, no safety significance. Five events were not rated, which is not in compliance with the intent of the INES system and should not happen.

In 2009, Slovenia did not report to the NEWS, since there were no events which would be reportable in accordance with the criteria.

From the reports, a conclusion can be drawn that despite the control the management of radioactive sources widely used in industry, medicine and research is often deficient in the world and that the exposure of workers using the sources often exceeds the statutory limits. It is evident that control over scrap metal has improved, since there was only one such report in 2009 compared to several such reports in previous years. It is also evident that there are fewer reports on the events in nuclear power plants which could indicate that the safety of these facilities is increasing.

In the last few years, several accidental overexposures of industrial radiographers have been noted. In 2009, four events were reported to NEWS of some radiographers receiving doses assessed as exceeding statutory limits. The highest assessed dose to the hands in the range of 25 to 30 Sv was received by a worker in Pakistan.

The events reported to NEWS in 2009 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.

Year 2009 was marked by the event of 6 October which occurred at the nuclear facility dealing with Plutonium technology located in the Cadarache plant, France. The facility is currently in the process of dismantling. With a considerable delay, the Commissariat à l'Energie Atomique (CEA) informed the French Nuclear Safety Authority (ASN) that the amount of plutonium deposits in the facility glove boxes was underestimated. The amount of plutonium deposits was estimated to about 8 kg by the CEA during the facility operation. The amount of plutonium collected during dismantling activities greatly exceeds this value and is currently reaching 22kg. According to CEA, it could come to 39 kg.

Following this notification, the ASN performed a comprehensive inspection at the ATP facility on 9 October 2009. After the inspection, the ASN decided to suspend the ATP facility dismantling activities, as long as fissile material accountability is not verified. This incident had no impact on the environment or on the public. However, the underestimation of the amount of plutonium has led to deep reduction of the security margins provided by the facility design to prevent a criticality accident.

Since the terms of incident notification, as prescribed by regulations, were not observed, the ASN handed over the case to the public prosecutor. The ASN considers that the failure to detect this underestimation of fissile material amounts during dismantling activities and the late notification of this incident to the ASN have revealed weaknesses in the safety culture of both the licensee and the operator.

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