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

Annual Report 2007
on the Radiation and Nuclear Safety
in the Republic of Slovenia

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ANNUAL REPORT 2007 ON THE RADIATION AND NUCLEAR SAFETY IN THE REPUBLIC OF SLOVENIA

June 2008

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

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

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1 INTRODUCTION

In the year 2007 there were no major problems in the area of protection against ionizing radiation and nuclear safety in Slovenia. There were no events either that would present a radiological threat to the population.

In October 2007 the Krško Nuclear Power Plant (NPP) finished the maximum operational period, namely 510 days without any shutdowns, when in October the outage started. In the year 2007 the Krško NPP produced 5.5 TWh of electrical energy in total. The outage lasted only a few hours longer than it had been foreseen. After 32 days the power plant restarted to supply electricity..

The monitoring of radiological contamination of the environment in Slovenia did not show any deviation from normal values. There were only minor difficulties with the licensees carrying out practices involving radiation and users of radioactive sources.

The process of siting of the repository for low and intermediate level radioactive waste has not been completed yet. At the end of the year 2007 the public debate on the Vrbina site (Krško municipality) started, and in the year 2008 this should result in acceptance of the site by the local community. Consequently, the site should be included in the National Spatial Plan, so that the construction process could start. At the same time the siting process on a similar location in the adjacent municipality Brežice continues, but these processes are lagging behind for several months.

By the end of the year a new Decree on checking the radioactivity for shipments of metal scrap was issued. With this Decree the likelihood of unintentional contamination of people due to orphan radioactive sources is substantially decreased.

In September the Republic of Slovenia successfully concluded its one-year presidency of the Board of Governors of the International Atomic Energy Agency (IAEA). In October, Dr. Andrej Stritar, the director of the Slovenian Nuclear Safety Administration (SNSA), was appointed as Chairman of the High Level Group on Nuclear Safety and Waste Management established by the European Commission. The main task of the High Level Group is to prepare a basis for better arrangements of these fields in the European Union

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

2 OPERATIONAL SAFETY

2.1 Operation of Nuclear Facilities

According to the Act on Ionizing Radiation Protection and Nuclear Safety, a nuclear facility is defined as "a facility for the processing or enrichment of nuclear materials or the production of nuclear fuel, a nuclear reactor in critical or sub-critical configuration, a research reactor, a nuclear power-plant and heating plant, a facility for storing, processing, treating or depositing nuclear fuel or highly radioactive waste, and a facility for storing, processing or depositing low or medium radioactive waste". Three nuclear facilities operated in 2007 in Slovenia: the Nuclear Power Plant Krško, the Research Reactor TRIGA of the Jožef Stefan Institute and the Central Interim Storage for Radioactive Waste at Brinje.

2.1.1 Nuclear Power Plant Krško

2.1.1.1 Operation and Performance Indicators

In 2007, the Krško Nuclear Power Plant (NEK) produced 5,695,020.1 MWh (5.7 TWh) gross electrical energy on the output of the generator, which corresponds to 5,428,193.2 MWh net electrical energy delivered to the grid. The annual production was 1.84 % more than planned (5,330,000 MWh). The reactor was critical for 8,020.87 hours or 91.56 % of the total number of hours in this year. The thermal energy production of the reactor was 15,755,185.6 MWh.

The Krško NPP staff is responsible for safe operation of the plant, while the Slovenian Nuclear Safety Administration (SNSA) carries out regulatory and inspection supervision. In 2007 the inspection performed 53 regular and one unannounced inspection surveys. There were no events requiring an emergency inspection survey. Inspection staff, other SNSA employees and experts of technical support organizations were present in the plant throughout the refueling outage.

From the point of view of radiation protection of exposed workers, the Krško NPP is also supervised by the Slovenian Radiation Protection Administration, which performed 5 inspection surveys in 2007 related to radiation protection education, preparation for and monitoring of the refueling outage, individual exposures of exposed workers and radiation protection provisions.

In 2007 there were no findings which would demand an urgent inspection action.

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

Table 1: The most important performance indicators in 2007

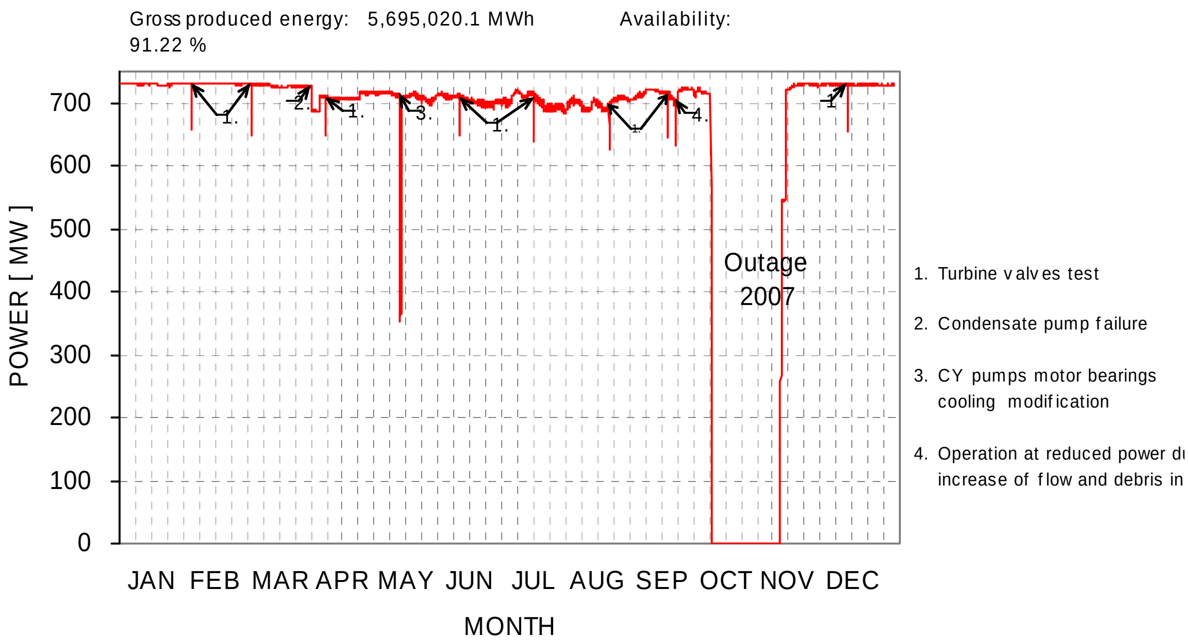
Safety and performance indicators	Year 2007	Average (1983-2007)
Availability [%]	91.22	85.12
Capacity factor [%]	93.04	82.21
Forced outage factor [%]	0.00	1.14
Realized production [GWh]	5,695.02	4,766.45
Fast shutdowns – automatic [Number of shutdowns]	0	2.73
Fast shutdowns – manual [Number of shutdowns]	0	0.33
Unplanned normal shutdowns [Number of shutdowns]	0	0.92
Planned normal shutdowns [Number of shutdowns]	1	0.80
Event reports [Number of reports]	5	4.24
Refueling outage duration [Days]	32	48.2
Fuel reliability indicator (FRI) [GBq/m^3]	$3.7{\cdot}10^{-3}$	$8.15{\cdot}10^{-2}$

Table 2: Time analysis of the Krško NPP operation in 2007

	Hours	Percentage
Number of hours in a year	8760	100 %
Duration of plant operation (on grid)	7990.7	91.2 %
Duration of shutdowns	769.3	8.8 %
Duration of the refueling outage	769.3	8.8 %
Duration of planned shutdowns	0	0
Duration of unplanned shutdowns	0	0

The shutdowns and low power operation are shown in Figure 1. It can be seen that the plant was shut down only once, due to the regular refueling outage which lasted between 6 October and 7 November. The nuclear power plant operated at reduced power in April, due to a failure of the condensate pump, in May due to a modification of condensate pumps bearings cooling and in September due to an increase of flow and debris in the Sava river. There were no unplanned shutdowns in 2007.

Figure 1: Operating power diagram for the Krško NPP in 2007



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

Figure 2: Fast reactor shutdowns – manual and automatic

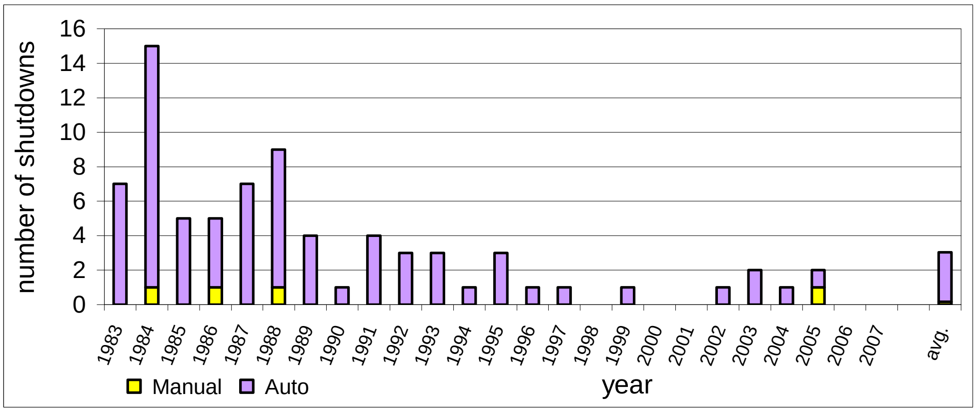
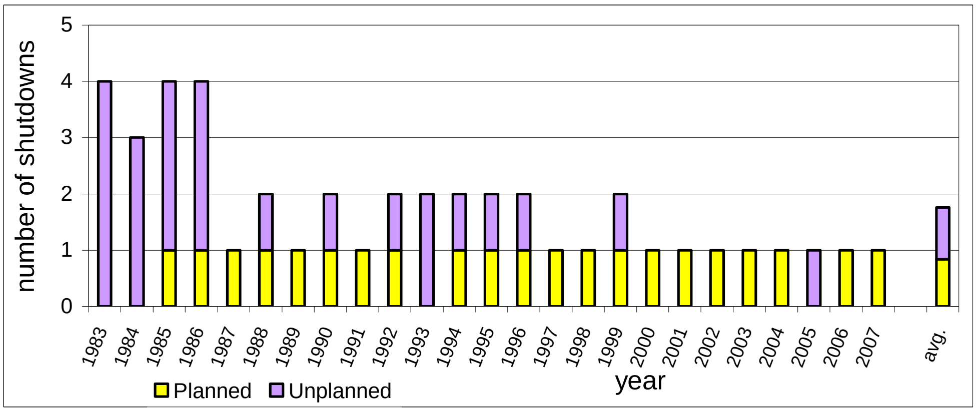


Figure 3: Normal reactor shutdowns – planned and unplanned



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. With normal reactor shutdowns the reactor power reduces gradually. Normal shutdowns are divided into planned and unplanned. Outage is a special type of a normal, planned reactor shutdown.

In Figure 2 we can notice gradual stabilization of fast reactor shutdowns (in the last decade the average is less than one per year). In the year 2007 there were no fast reactor shutdowns.

In Figure 4 the forced outage factor is shown. This factor is a ratio between the hours of duration of unplanned shutdowns and the number of hours in a year. For the year 2007 this factor is zero because there were no shutdowns.

Figure 4: Forced outage factor

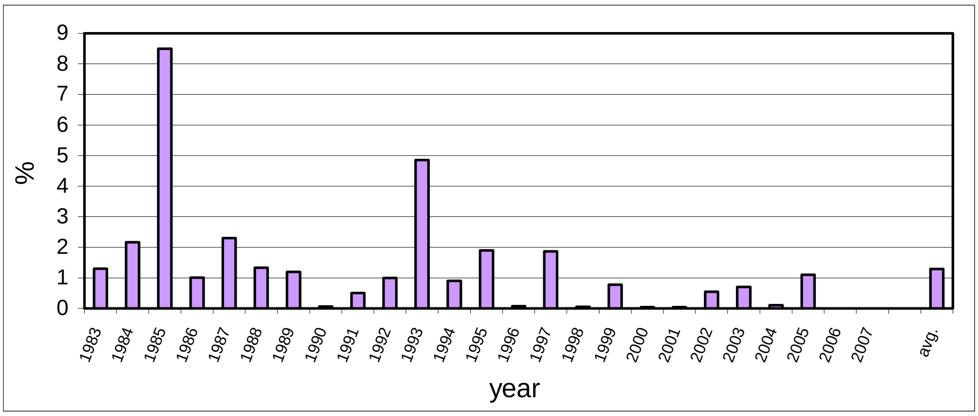
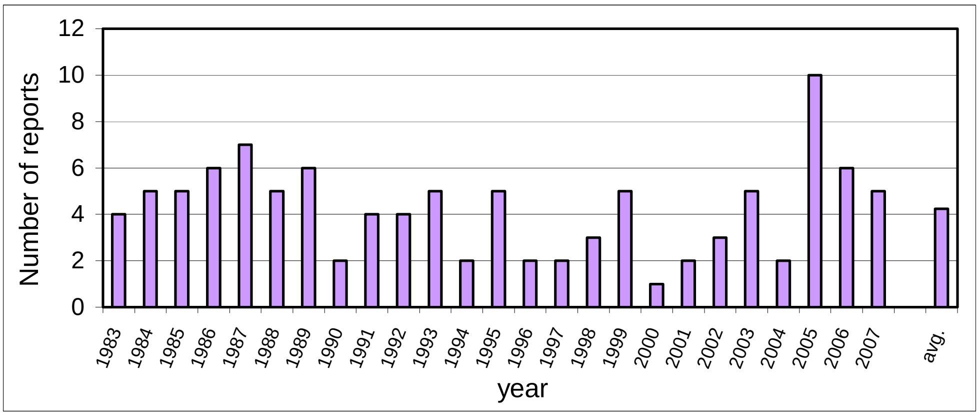


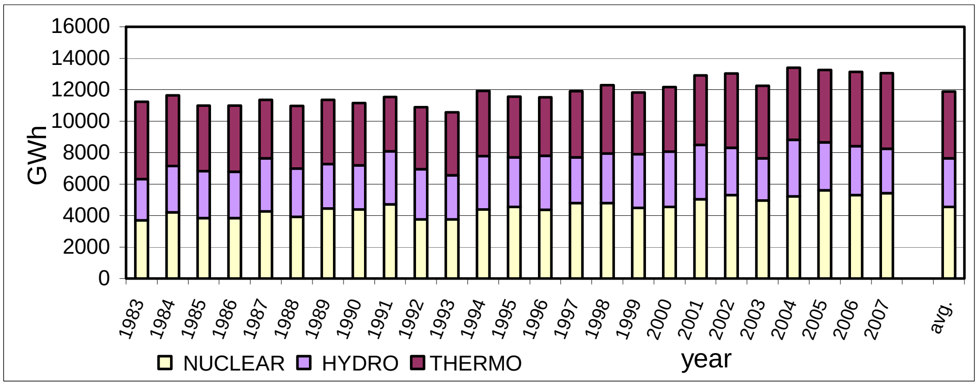
Figure 5 shows the number of abnormal event reports per year. In the year 2007 there were 5 abnormal events. The Krško NPP is obliged to report to the regulatory body about every event that could reduce nuclear safety. The abnormal events are described in detail in Chapter 2.1.1.2.

Figure 5: Number of abnormal event reports



In Figure 6, the comparison between the productions of electrical energy in Slovenia produced in nuclear, hydro and thermal power plants is shown. In recent years the production of electrical energy in Slovenia has stabilized at around 13 TWh. The production and the ratios of produced electrical energy in 2006 and 2007 were very similar.

Figure 6: Production of electrical energy in Slovenia



The collective exposure to radiation is shown in Figure 7. For 2007 it was 889 man mSv, which is above the target value of NEK (800 man mSv for the year 2007). This high value of collective exposure to radiation is mostly a consequence of the replacement of thermal isolation in the reactor building.

Figure 7: Collective exposure to radiation in the Krško NPP

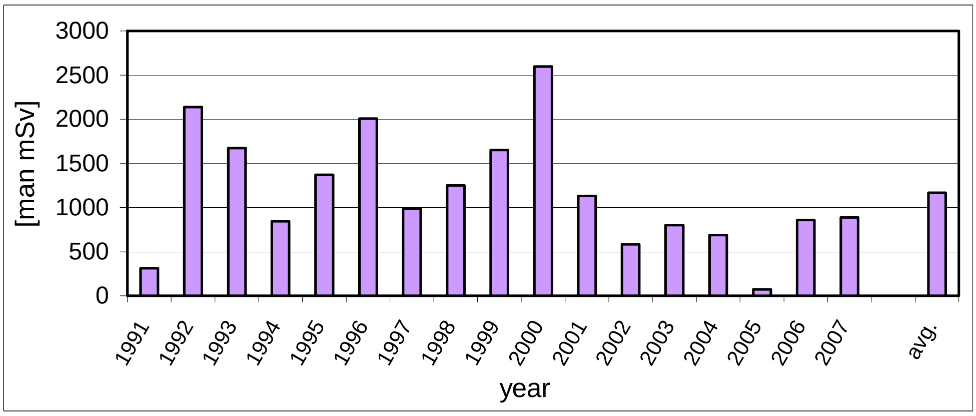
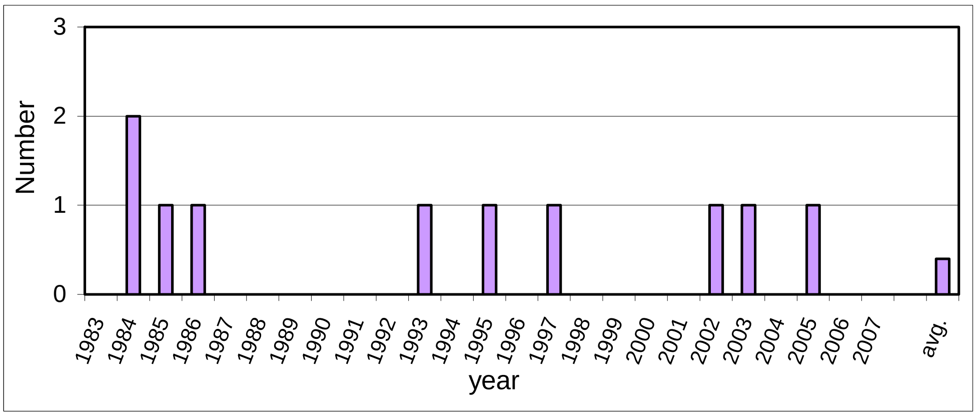


Figure 8 shows the number of unplanned actuations of the high pressure safety injection system. In the year 2007 there were no unplanned actuations of this system.

Figure 8: Number of unplanned safety injection system actuations



2.1.1.2 Abnormal events in the Krško NPP

Event reporting is defined by the regulation, which also defines the types of abnormal events. In 2007 the Krško NPP reported 4 abnormal events, none of which caused an unplanned shutdown. Besides the mentioned events, the SNSA recognized another event for which the Krško NPP did not issue the regular report, but fixed the problem with corrective actions on the failed equipment.

All events and the proposed actions to correct the consequences of these events were followed by the SNSA. Three of the events were analyzed by the SNSA with engineering judgment, while the analysis of the forth event will be finished in 2008.

None of the events threatened nuclear or radiological safety.

Inoperable diesel fire protection pump

During the monthly test, on 9 March 2007, the diesel pump did not start on the signal of low water pressure in the fire protection system. Furthermore the motor rotation overspeed alarm was activated. The pump was declared operable after the post maintenance test, nearly 9 hours after the first unsuccessful start.

The SNSA performed engineering judgment of the event. The SNSA actions were limited to surveillance of the Krško NPP corrective actions.

Non-operable electric fire protection pump

On 5 June 2007 the electric fire protection pump was declared inoperable due to pressure switch deviation, discovered during the regular calibration. Deviation was discovered on the electrical resistance of the switch's contacts. The electrical contacts on the switch were cleaned and the pump was declared operable after approximately 3 hours.

High temperature in the main steam pipeline room

On 18 July 2007 the temperature in the main steam pipeline room exceeded 46 ^{o}C for more than 8 hours, after which the plant operated in limited conditions for 1 hour and 16 minutes, reaching the highest room temperature of 48.8 ^{o}C. While the administrative limit of 46 ^{o}C is defined to protect equipment during the entire plant life time, the equipment was designed for higher temperatures than the measured ones.

Similar events, caused by higher environmental daily temperatures, occurred in July 1999 and August 2001.

The SNSA performed engineering judgment of the event and follow-up corrective activities. Within the long term corrective activities the Krško NPP will perform an analysis of the additional room cooling modification and examine the possibility of a new, higher administrative technical specification temperature limit.

Slow closure of main steam isolation valves

At the beginning of the annual outage, on 6 October 2007, the main steam isolation valves test was performed while the plant was in hot stand-by mode. The criterion of 5 seconds for valve closure was not achieved since it took 5.1 seconds to close one valve and 6.1 seconds for the other valve. The criterion of 5 seconds was conservatively prescribed although in the safety analysis 6 seconds was presumed. Two additional tests were performed later, this time with the cold main steam pipelines. The measured closure was both times 3.6 seconds for one valve and 3.8 seconds for the other. The test was repeated during the plant's start up with the operating temperature of the main steam pipelines. The results were 4.3 seconds and 4.5 seconds respectively.

Degradation of a steam generator auxiliary feedwater nozzle

The second outage event was discovered on 15 October 2007 when two steel plates of dimension 150x70x2 mm were found in the steam generator. The pieces were found at the bottom of the sheet plate that divides the primary from the secondary side, stuck between the U-tubes. The broken vanes belong to the steam generator auxiliary feedwater intake nozzle. Afterwards the second steam generator auxiliary feedwater intake nozzle was also inspected and more cracks were found on the welds that connect the vanes to the nozzle.

Due to the nature of the event, the affected steam generator U-tubes were inspected with the eddy current method. On the 16 U-tubes 19 degradations, with 32 to 36% of wall thickness were detected. All 16 U-tubes (out of the total number of 5428) were preventively plugged despite the fact that the design limit of 50% of degradation was not detected.

After the consultation with the steam generator manufacturer, Areva, simplified auxiliary feedwater intake nozzles were built in. This temporary modification was granted by the SNSA till the beginning of the next outage, planned for April 2009. The manufacturer also prepared a safety analysis for the temporary modification.

The preliminary analysis of the cause of degradation of the auxiliary feedwater nozzle indicates a design or manufacturing error on the nozzles. The root cause analysis including the steam generator manufacturer's engagement is in progress.

2.1.1.3 Nuclear fuel integrity and reactor coolant activity

Integrity of fuel cladding is important because it prevents diffusion of radioactive substances to the primary coolant, and potentially to reactor containment and environment in the case of primary system leakage. Fuel cladding is the first of the three barriers that prevent radioactivity releases, and therefore special attention is given to fuel integrity. Each fuel element contains 235 fuel rods, and there are 121 fuel elements in the reactor core, so there are altogether 28.435 fuel rods.

In 2007, the Krško NPP operated in two cycles: cycle 22 and cycle 23. Cycle 22 was 18 months long and ended on 6 October 2007 with the refueling outage. After the outage the criticality of the reactor was achieved on 7 November 2007, when the new 18 months long cycle 23 started.

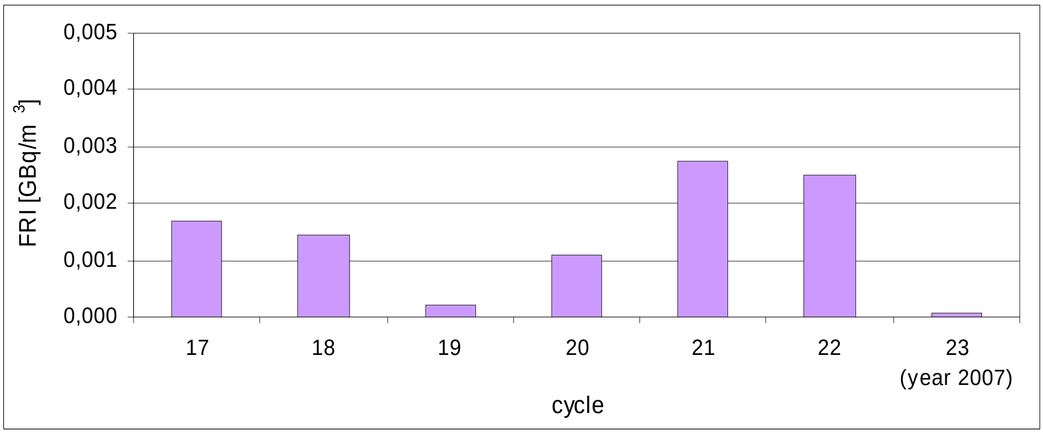
For cycle 23, which is the third 18 months long cycle, 53 fuel assemblies were replaced. Out of these, 20 fuel assemblies were 4.75% enriched and 33 fuel assemblies were 4.95% enriched.

The condition of fuel assemblies in the reactor (fuel integrity) is monitored by measuring the reactor coolant specific activities. It was estimated that there were four failed fuel rods at the end of 2006 and five to six failed fuel rods at the end of cycle 22. Detected leakage can occur on different fuel rods of the same fuel assembly or on different fuel assemblies. It is also possible that there are several defects on the same fuel rod. Relatively low values of specific activities of iodine isotopes in the primary coolant indicated that these fuel failures are of tight nature. Despite the fuel leakage the reactor coolant specific activities in cycle 22 reached less than 1 % of the authorized limit.

There were no leaking fuel rods in the core of cycle 23 at the end of 2007.

Fuel integrity is monitored by the fuel reliability indicator (FRI), which is derived from specific activities of radioisotopes in the primary coolant, which are released from fuel rods. The FRI that is below the value of 0.02 GBq/m^3 represents fuel with no failure according to an internationally adopted criterion. Monthly values of FRI increased during cycle 22 but have been relatively small, indicating the tight failures and small leakage. There was no fuel leakage in the cycle 23. The FRI reached just 0.2 % of the criterion for fuel without failures by the end of 2007.

Figure 9: Fuel reliability indicator (FRI) (when less than 0.02, the fuel is without failures)



During the 2007 refueling outage the tightness of all fuel assemblies of cycle 22 was examined, with special attention on the five fuel elements which were determined as leakers. The results showed a single leaking fuel rod in two fuel assemblies, and two fuel assemblies with five and four suspicious fuel rods, respectively. All failed and suspicious fuel assemblies were eliminated from further use.

The cause of fuel leakage was not determined. It is evident from the examination of the fuel and coolant activities analysis, that due to the very small extent of the leakage it is not possible to determine the root cause.

2.1.1.4 Refueling outage 2007

The 2007 refueling outage followed the 22nd refueling cycle. Outage duration was 32 days, from 6 October to 7 November 2007, which is a day more than it had been planned. During the whole 22nd refueling cycle, which lasted 510 days, the NPP operated reliably, without unplanned shutdowns and with no major equipment problems. This is a result of well planned and realized outage activities in 2006 and also on-line activities during operation in the 22nd refueling cycle.

The planned activities carried out during the 2007 refueling outage comprised regular maintenance, equipment inspections, major outage activities and implementation of design modifications. The following major outage activities were performed:

- replacement of 53 fuel elements and inspection of all fuel elements by visual and ultrasonic method,
- 5-year overhaul of the main generator, modernization of its rotor and electrical systems,
- integral containment leak rate test at a pressure of 3.14 kp/cm^2,
- detailed inspection of the reactor pressure vessel head,
- underwater visual inspection of the reactor pressure vessel surfaces,
- visual inspection of both steam generators' secondary side interior,
- secondary piping inspection and measurement of wall thickness, replacement of worn out piping, and continuation of preventive secondary piping replacement
- preventive inspection and renovation of the cooling tower duct, and both intake and discharge duct of the circulating water system,
- turbine overhaul of the auxiliary feedwater turbine-driven pump,
- auxiliary feedwater pumps overhaul and implementation of some modifications (installation of bushing for the lubrication ring and modification of bearing

housing),

- replacement of the moisture separator reheaters.

Major implemented modifications were the replacement of screen strainers, the replacement of thermal insulation in the reactor building, the replacement of three reheaters in the neck of the condenser and the replacement of the cooling water cleaning system at the condenser intake.

The reasons for a day's prolongation of the outage were unplanned restoration of corroded intake piping of the circulating water system, leakage of the reactor cavity sealing ring, replacement of auxiliary feedwater distributors in both steam generators and increased extent of welding works.

Figure 10: Two new moisture separator reheaters (blue color)

2.1.2 Modifications in the NPP Krško

The SNSA approved 10 modifications and agreed to 37 minor modifications at the NPP Krško. The NPP Krško found out during the preliminary safety evaluation that there was no open safety issue for 30 modifications, so it only informed the SNSA about those changes. During the year 2007 the NPP Krško opened 54 temporary modifications and closed 53 temporary modifications. On 31 December 2007 the number of open temporary modifications was 28.

During the operation in the 22nd fuel cycle 28 modifications were executed and during the following outage 41 modifications were executed. In the year 2007, the Krško NPP issued the 14th revision of the Updated Safety Analysis Report, in which all modifications confirmed until November 15, 2007 were considered.

The changes were carried out on 43 NPP systems. Equipment within the condensate and service water systems was replaced, mostly due to corrosion and erosion, and the measuring instrumentation was updated. Application of surveillance programs for secondary equipment has given expected results, preventing breakdowns due to aging and equipment exploitation. Upgrading of the instrumentation and regulation equipment is part of the program within which the NPP Krško is gradually replacing plant equipment. In this way it is solving the problem of maintenance and spare parts, and at the same time it is improving operation reliability. The fire protection system was upgraded and partly expanded.

NPP Krško modifications can be divided into:

- Modifications (improvements) of the original design, such as indicator location changes on the main control board, additional valves built in and equipment moved from one location to another.
- Modifications due to degradation surveillance (aging), such as replacement of moisture steam separators, motors of reactor cooling pumps, main feed water heaters, parts of pipelines, etc.
- Modifications due to malfunction during operation, such as replacement of the condensate system pump motor, which will be replaced during the 2009 outage due to the long purchasing time. The connections of the motor cooling water system were replaced. The connections caused leaking problems due to ageing and vibrations.
- Modifications due to safety improvements, such as replacement of the strainer in the containment sump and replacement of insulation in the lower part of the containment.
- Modifications due to gradual replacement of outdated instrumentation and regulation equipment.

NPP Krško modifications aim to improve the plant operation and nuclear safety and are not a consequence of poor plant conditions.

2.1.3 Environmental influence at the Krško NPP

There are some objects in the vicinity of the NPP Krško which are in the process of inclusion in the national spatial plan.

The Ministry of Defense is planning an **expansion of the Cerklje airport** and increase of its air traffic. Within the scope of preparations for the national spatial plan the SNSA, as one of the holders of spatial planning, has presented its guidelines. The guidelines require that the renovated airport has no negative impact on Krško NPP safety.

The SNSA has actively participated in the preparation process for the national spatial plan for the **Krško hydro power plant**. In November 2007 a partial construction permit was issued. The SNSA will determine the operating conditions of the Krško hydro power plant.

In November 2006 the preparation process for the national spatial plan for the **Brežice hydro power plant** started, of which the spatial regulation area reaches directly the Krško NPP area. The direct effect of accumulation onto the Krško NPP cooling water intake is important. In 2008 the SNSA will prepare guidelines with conditions for the Brežice hydro power plant construction and operation. A study of the influences of the Krško NPP to the environment, which will take into account the accumulation lake of the Brežice hydro plant, was ordered by the Ministry of Economy. The study demonstrated that by appropriate sealing of dikes at the accumulation lake of the Brežice hydro power plant the influence of the Krško NPP on groundwater would be lower than the present one. The problem of warming of the Sava river water in the accumulation has been exposed, as it has a return effect on Krško NPP operation due to requirements of the Krško NPP water management permit and assurance of Sava regime at the border point with Croatia.

2.2 TRIGA research reactor

The Jožef Stefan Institute, the TRIGA research reactor operator, adopted a long term strategy of reactor operation and decommissioning in 2007. The strategy states that the operation of the TRIGA reactor shall continue until 2016, followed by export of spent fuel to the USA in 2019. The Jožef Stefan Institute should prepare a draft plan for reactor decommissioning by 2008 and should submit an application for the program of a periodic safety review.

The TRIGA reactor operated for 155 days and released 226 MWh of heat in 2007. A total of 1554 samples were irradiated in the carrousel and F-channels (1300 samples), with the pneumatic post (250 samples) and with the fast pneumatic post system (4 samples). The reactor was mostly used as a neutron source for neutron activation analysis, performed by the Environmental sciences department and the Experimental particle physics department of the Jožef Stefan Institute. The TRIGA reactor was also used for the Krško NPP staff training, as part of the NPP technology course.

The TRIGA reactor operated only in stationary mode. There were no changes to the reactor core. There were no emergency events.

There were five forced (automatic) shutdowns in 2007, caused by loss of external power supply.

Ten unused fuel elements were exported to France for the TRIGA International Company in July 2007, lowering the costs of fuel storage and disposal. 506 kg of "yellow cake" (U_30_8) were exported along with the fuel.

There were 84 fuel elements on site on 31 December 2007, which were located in the reactor and in the fresh fuel storage. There were no spent fuel elements and no fuel elements were stored in the spent fuel storage pool. All fuel elements were of SS type with 20 % uranium content and 20 % enrichment. The radiation monitoring system in the reactor building and the reactor coolant activity measurements showed that there were no leaking fuel elements.

The TRIGA reactor staff did not change in 2007 and consisted of the head of the reactor centre (1/3 of full employment), four operators (rank shift supervisors) and a secretary (1/2 of full employment).

There were no design modifications of the TRIGA reactor in 2007 and there were no non-routine and first time tests. The staff performed periodic surveillance and control of the systems, structures and components that were important for safe operation of the reactor.

A sampling system for aerosols in the discharge channels of the reactor building ventilation system was replaced in 2007. This system is used by the radiation protection group of the Jožef Stefan Institute for monitoring.

The hot cells radiation facility merger with the nuclear facility of TRIGA Mark II research reactor was directed by a statutory order. The description and extent of the merged facility were given in the proposed safety analysis modification report for the TRIGA Mark II research reactor, which was submitted to the SNSA for review and approval by the Jožef Stefan Institute.

In 2007, the reactor operation produced approximately 50 liters of short lived low and intermediate level radioactive waste, which was submitted for storage to the Central Interim Storage for Radioactive Waste at Brinje, operated by the Agency for Radioactive Waste Management.

2.3 The Central Interim Storage for Radioactive Waste at Brinje

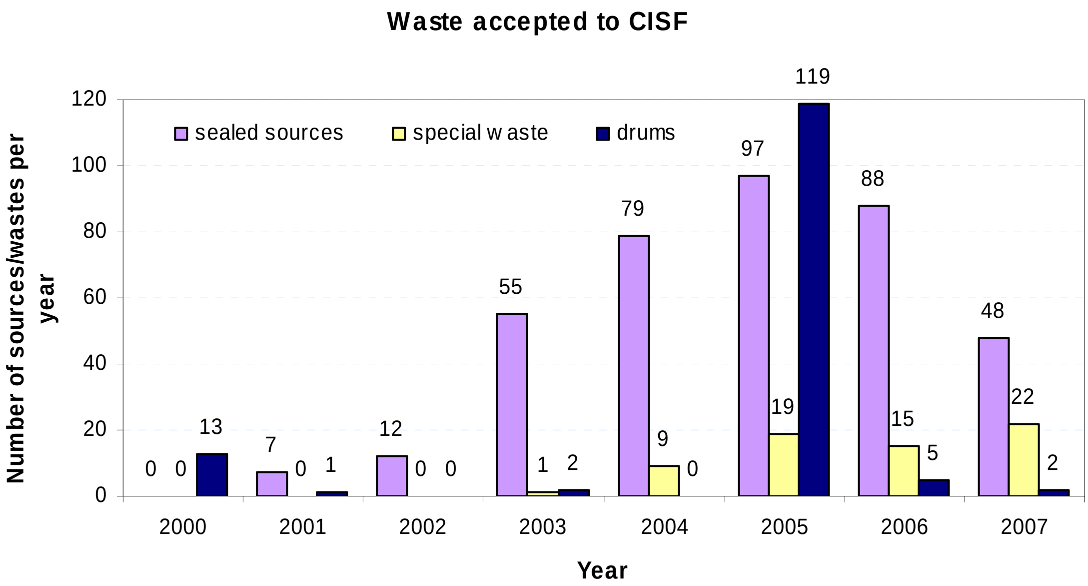
The Central interim storage for radioactive waste at Brinje (CISRW) is operated by the Agency for Radioactive Waste Management (ARAO). After a complete reconstruction of the storage in 2005 the ARAO obtained a license for trial operation and started regularly accepting radioactive waste from small producers. In 2007 the license for trial operation was prolonged for 6 months, till 8.1.2008.

According to trial operation findings, the system for air drying and keeping relative humidity of the facility was installed. Upgrading of the existent regulation system was done in compliance with the demand for isolation of the storage in case of ventilation breakdown and in case of emergency. The ventilation system in an engine room was also improved.

The ARAO started with the project "Improvement of the Management of Institutional Radioactive Waste in Slovenia", financed from the EU, during which final and detailed characterization of waste will be made. The procedure for the selection of contractors was finished and a contract with the consortium, composed of Belgian companies and the Jožef Stefan Institute, was signed.

In 2007 the ARAO accepted for storage radioactive waste from 39 generators, in the form of 48 packaging units of sealed sources, 22 special waste items and 2 drums. The total volume of the waste stored was 2.6 m3. Also 873 ionizing smoke detectors were stored. At the end of 2007, a total of 848 packaging units were accepted, among which there were 305 drums, 210 special waste items and 333 sealed sources. The total activity of the 85 m3 waste stored is estimated at 3.6 TBq.

Figure 11: Number of radioactive waste items annually accepted in the Central interim storage at



Brinje

Remarks:

- In 2001 one drum was accepted as a result of repacking of radium sources
- In 2003 two 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

The ARAO performed an exercise on 14.12.2007. The basic scenario of the exercise was release of radioactive material from a drum and contamination of the area in front of the CISF entrance. The exercise has shown that the information system has to be improved.

2.4 Radiation practices and the use of sources

The Act on Protection against Ionizing Radiation and Nuclear Safety stipulates reporting an intention to carry out practices involving radiation or use of a radiation source, evaluation of protection of exposed workers against radiation, a permit to carry out a practice involving radiation and a permit to use a radiation source.

The nature and extent of radiation risk for exposed workers, apprentices and students based on the evaluation of protection of exposed workers against radiation shall be determined in advance. In addition, based on this evaluation a programme for optimization of radiation protection measures in all working conditions is made in advance. The document must be prepared by the applicant, who is obliged to consult an authorized radiation protection expert. The evaluation can be also prepared by an authorized expert in this field. The evaluation has to be approved by the Slovenian Radiation Protection Administration (SRPA), where in total 126 approvals were issued in 2007.

During the year 2007, the SNSA Inspection carried out 65 inspections and interventions of 48 legal persons connected with performance of a radiation practice in industry and research area, transportation of nuclear goods as well as transportation of goods containing, among others, radioactive materials. Additionally the SRPA Inspection carried out 10 inspections in medicine and veterinary.

The SNSA inspection carried out three unplanned inspections related to the illegal and unsuitable storage of a large number of ionizing smoke detectors containing ^{241}Am and ^{226}Ra. Detectors were stored in a business centre building in Novo mesto. The storage of smoke detectors at the CISF was paid by the owner of the building. Further legal proceedings will be carried out by the criminal police.

The SNSA Inspection also inspected research institutions using radiation sources after a minor fire in one of the laboratories of the Jožef Stefan Institute. It was determined that adequate procedures should be established in case of such emergencies.

In 2007 two inspections of radiation practices in mammography and use of X-ray mammography devices and one of use of a technically unsuitable diagnostic X-ray device were performed. In all cases provisions requiring implementation of legally prescribed conditions for radiation practices and the use of ionizing radiation sources were issued. In addition, seven inspections of the use of open and sealed sources in medicine were performed.

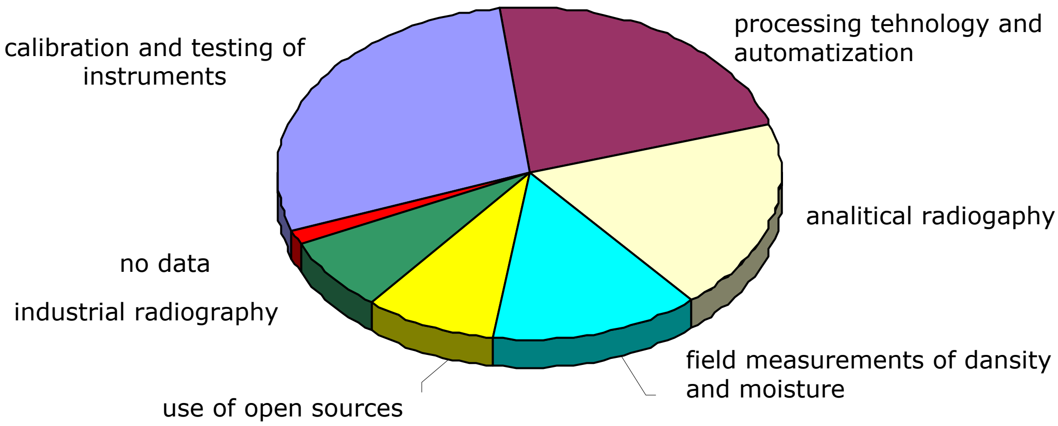
2.4.1 Use of ionizing sources in industry and research

In 2007, 62 licenses to carry out practices involving radiation were issued, 1 decree on cessation of carrying out practices involving radiation, 98 licenses to use a radiation source, 40 certificates of entry in the register of radiation sources, 6 approvals to external operators of practices involving ionizing radiation and 4 consents to construction in the area of restricted land use. The valid licenses issued in accordance with the act from 1984 have almost all been replaced by the new ones according to the 2002 Act.

In 2007, 78 organizations in the Republic of Slovenia used 168 X-ray devices in industry and research, most of them for industrial radiography, and for cargo and luggage inspection.

771 sealed sources were used in 91 organizations, the majority of them were used in technological and automation processes, field measurements of density and humidity, and industrial radiography. The devices used were industrial X-ray devices, devices containing ^{192}Ir radionuclide for non-destructive material inspection, devices containing ^{85}Kr, ^{241}Am, ^{60}Co and ^{90}Sr radionuclides in technological and automation processes, and devices containing ^{137}Cs and ^{241}Am/Be radionuclides for field measurements of density and humidity. Some organizations serviced smoke detectors containing ^{241}Am radionuclide.

Figure 12: Distribution of application of radioactive sources according to their purpose and mode of use, excluding x-ray devices and ionizing smoke detectors.



In accordance with the register of radiation sources, at the end of 2007 there were 25,443 detectors in use at 290 organizations. In addition there were 1,588 detectors stored at users' premises.

In 2007 the Institute of Occupational Safety performed 1,160 surveys at holders, while the Jožef Stefan Institute performed surveys of only 24 radiation sources.

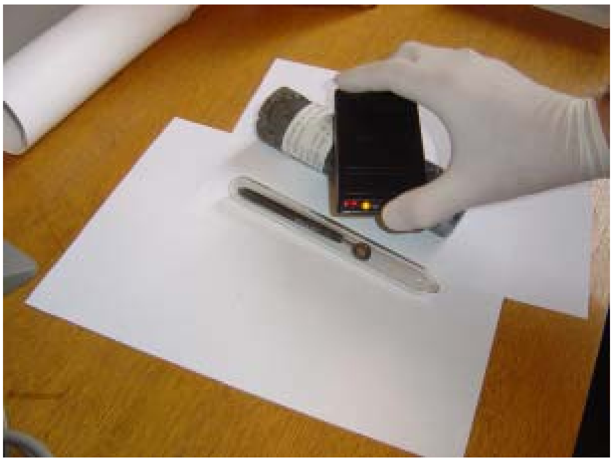
2.4.2 Interventions

Altogether 38 interventions were performed by the SNSA. This number is higher than the number of interventions in the last years because in 2007 the SNSA inspection focused on the investigation of sources at faculties and other research institutions in Slovenia. In many cases the manipulation of sources preformed by researchers does not follow contemporary standards. The Inspection service performed 19 inspections at the University of Ljubljana and University of Maribor. At altogether 18 inspections the employees of the universities were not aware that they possessed radiation sources or did not recognize that particular objects were in fact radiation sources. In addition, at the only inspection at which radiation sources were not found or identified it was established that the institution had handed over radiation sources without any safety measures to another faculty. The transfer took place as a result of a change in the educational programme.

At the Faculty of Medicine in Ljubljana the inspection found contaminated objects in a laboratory which was used by students. At the Institute of the history of medicine a particular interesting source was found, namely the oldest radiation source in Slovenia (a ^{226}Ra source) which had been bought already in 1902. It was used in ophthalmology.

In addition, at the inspection of the Faculty of Medicine a spot of a very highly increased dose rate at the neighbouring building, used by the Institute of Oncology Ljubljana, was detected. The dose rate was a consequence of numerous radiation sources inside the building whose shielding was not sufficient. Corrective actions were performed by rearranging the sources and shields without delay. The sources which are radioactive waste are to be stored in the Central Interim Storage of Radwaste in Brinje.

Figure 13: The first radiation source in Slovenia, 226Ra used in ophthalmology, which was bought already in 1902, stored at the Institute for history of medicine.



At inspections at the Faculty of Chemistry and Chemical Technology of the University of Ljubljana around 50 radiation sources were found which were not listed in the records of the faculty, among them a liquid source, as well as many sources related to research in the nuclear fuel cycle based on the uranium ore. Also a ^{99}Tc source with the activity of 2.52 GBq was found. Information about the exact date of its production was not available. As a consequence, it was only estimated that the source had been used around 25 years ago in chemical research.

At the Faculty of Natural Sciences and Engineering of the University of Ljubljana many radioactive geological specimens are used by professors as well as by students. They were located at the time of inspection at other sites, including exhibition areas. The faculty decided to keep around 250 samples which are used in the education process and to put all other radioactive specimens into a 200 l drum. The drum has already been taken over by the Agency for Radwaste Management.

Inspections were also performed at other research and educational institutions, among them at the Geological Survey of Slovenia, which has already delivered all its sources after the inspection, namely 106 kg of radioactive material, to the Agency for Radwaste Management.

In 2007 altogether 8 inspections were related to the transport of radioactive waste in Slovenia. Two times the enhanced dose rate was detected on trucks travelling from Croatia though the Gruškovje border crossing. Entrance to Slovenia was disallowed and a regulatory authority of Croatia was notified by the SNSA. In 2007 one radioactive source transported from Slovenia to Italy was stored in that country.

The Ecological Laboratory with a Mobile Unit (ELMU) performed two interventions:

- On 7 June 2007 metal objects made of aluminium and labelled »Radioactive« were found at the scrap yard Barje near Ljubljana. The contamination was detected but the activity was below the exemption level. In spite of this, the ELMU stored the objects which originated from the Jožef Stefan Institute.
- On 21 November 2007 workers at the Jožef Stefan Institute found a container which could contain a radioactive source. The container was already stored as scrap. The ELMU did not find the source in the container but in a thermal accumulation furnace. The ^{226}Ra source was identified, whose activity was 370 kBq (10 mikroCi). The detected dose rate at a distance of 10 cm was 11 μSv/h. No contamination was detected. Before its transportation to the Central Interim Storage of Radwaste, the source was temporarily stored at the institute.

2.4.3 Use of radiation sources in medicine and veterinary medicine

2.4.3.1 X-ray devices in medicine and veterinary medicine

According to data from the register of the Slovenian Radiation Protection Administration (SRPA), 795 X-ray devices and one cobalt therapeutic device were used in medicine and veterinary medicine at the end of 2007. The categorization of the X- ray devices based on their purpose is given in Table 3.

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

Purpose	Status 2006	New	Written off	Status 2007
Dental	382	50	35	397
Diagnostic	255	17	25	247
Therapeutic	7	3	1	9
Simulator	2	0	0	2
Mammography	35	4	1	38
Computer Tomography CT	21	3	2	22
Densitometers	35	7	2	40
Veterinary	31	13	4	40
TOTAL	**768**	**97**	**70**	**795**

With regard to use of x-ray devices in medicine and veterinary medicine in 2007 the SRPA granted 87 permits to carry out a radiation practice, 149 permits to use X-ray devices, 79 confirmations of the programme of radiological procedures, and 80 confirmations of the evaluation of protection of exposed workers against radiation.

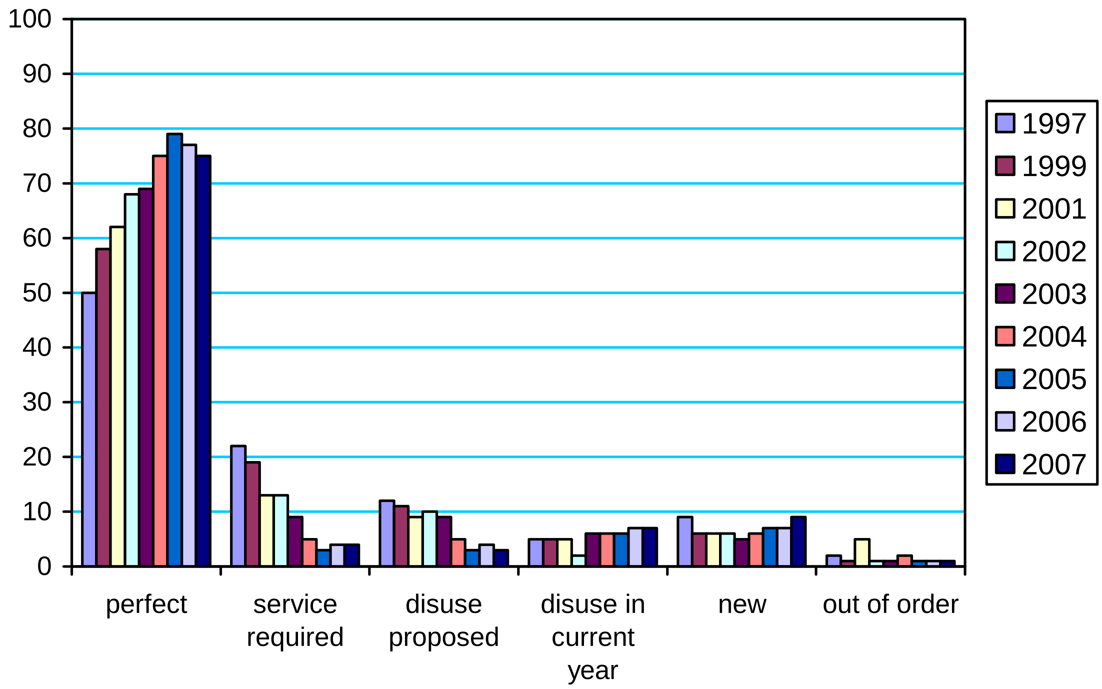
In medicine, 367 X-ray devices were used in private dispensaries and 389 in public hospitals and institutions. The average age of X-ray devices in the public sector was 9.6 years (9.9 years in 2006) and in the private sector 7.6 years (7.7 years in 2006). In veterinary medicine 30 devices were used, including one irradiation device and 10 devices in public hospitals and institutions. The average age of X-ray devices in the public domain was 11.2 years and 5.0 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	276 (80%)	9.7	101 (25%)	9.5	11 (100%)	8.0	10 (25%)	11.2	398 (50%)	9.6
Private	71 (20%)	7.1	296 (75%)	7.8	0		30 (75%)	5.0	397 (50%)	7.5
Total	**347**	**9.1**	**397**	**8.2**	**11**	**8.0**	**40**	**6.4**	**795**	**8.5**

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, to groups: "perfect", "service required", "disuse proposed", "disused in current year", "new" or "out of order". The analysis of data for the recent years is presented in Figure 14. It shows a stabilized percentage of the sum of perfect devices and new devices in the last three years.

Figure 14: Percentage of diagnostic X-ray devices according to their quality for the period 1997-2007



In 2007 two inspections related to the use of X-ray mammography devices were performed and one inspection of the use of a technically inappropriate diagnostic X-ray device. In all cases inspection provisions requiring implementation of legally prescribed conditions were issued. Fourteen requirements for submission of evidence on elimination of ascertained deficiencies were sent by the SRPA, based on surveillance reports of medical X-ray devices, done by the authorized institutions.

2.4.3.2 Unsealed and sealed sources in medicine

Seven hospitals and clinics in Slovenia use unsealed sources (radiopharmaceuticals) for diagnostics and therapy in nuclear medicine departments: the Ljubljana Medical Centre - the Department of Nuclear Medicine, the Institute of Oncology, and general hospitals in Maribor, Celje, Izola, Slovenj Gradec and Šempeter near Gorica. In nuclear medicine departments, altogether 5126 GBq of isotope ^{99m}Tc, 737 GBq of isotope ^{131}I, 114 GBq of isotope ^{133}Xe, 231 GBq of isotope ^{18}F and minor activities of isotopes ^{67}Ga, ^{111}In, ^{90}Y, ^{186}Re, ^{51}Cr, and ^{123}I were applied for diagnostics and therapy. Nuclear medicine departments, the Veterinary faculty and the Ljubljana Medical Centre – the Clinical institute for clinical chemistry and biochemistry used minor activities of isotopes ^{125}I, ^{14}C and ^{51}Cr for in-vitro studies.

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 of the Republic of Slovenia. At the Institute of Oncology a source with cobalt ^{60}Co with the initial activity of 290 TBq is used for tele-therapy and several sources of ^{192}Ir and ^{90}Sr with initial activities up to 40 GBq for brachitherapy. At the Clinic of Ophthalmology several sources of ^{106}Ru with initial activities up to 37 MBq for therapy of eye tumours were used, and at the Institute of Transfusion Medicine of the RS a device with ^{137}Cs with initial activity of 49.2 TBq was used for irradiation of blood components.

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

In 2007 10 permits to carry out a radiation practice, 4 permits to use radiation sources in medicine, 5 confirmations of evaluation of radiation protection of exposed workers, 5 confirmations of the programme of radiological procedures, and one confirmation on fulfillment of conditions for radiation practices for workers were granted with reference to the use of unsealed and sealed sources in medicine. Seven inspections of radiation practices and radiological procedures were carried out. Two decrees on abolition of ascertained deficiencies and 3 admonitions in the inspection minutes were issued.

No emergency events were reported to the SRPA in 2007. The medical departments with unsealed and sealed radiation sources were surveyed by the authorized experts of radiation protection; no major deficiencies were found.

3 RADIOACTIVITY IN THE ENVIRONMENT

3.1 Monitoring of environmental radioactivity

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

The results for 2007 showed that concentrations of both long-lived fission products in samples of air, precipitation, soil, milk and foodstuffs of vegetal and animal origin, as well as in feeding stuffs continued to decrease slowly and were mostly lower than before the Chernobyl accident. Exceptionally a specific surface activity of ^{137}Cs in the upper layer of uncultivated soil is still enhanced. On average, at the time of the Chernobyl accident approximately five times higher contamination (20–25 kBq/m^2) was measured in Slovenia if compared to the contribution of all nuclear bomb tests in the past. The highest contamination of the ground was measured in the Alpine and forest regions. This feature indirectly contributes to the enhancement of the contents of ^{137}Cs in forest fruits, mushrooms and game, in Alpine milk and in cheese. In 2007 no radioactive contamination of the environment was detected related to any recent 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 2007 the effective dose for an adult from external radiation of ^{137}Cs (mainly from the Chernobyl accident) was estimated at about 4.8 μSv, which is 0.2% of the dose received by an average Slovenian from natural background radiation. This value is higher than the one measured and calculated for the previous year (1.45 μSv), but the same as in the year 2005 due to inconsistencies of soil sampling on different pedologic basements. Until 2005 and again in 2007 the sampling site was at the street Cesta dveh cesarjev in Ljubljana, but in 2006 a new location at the Reactor Centre Brinje was chosen, where soil permeability for radioactive contaminants is higher.

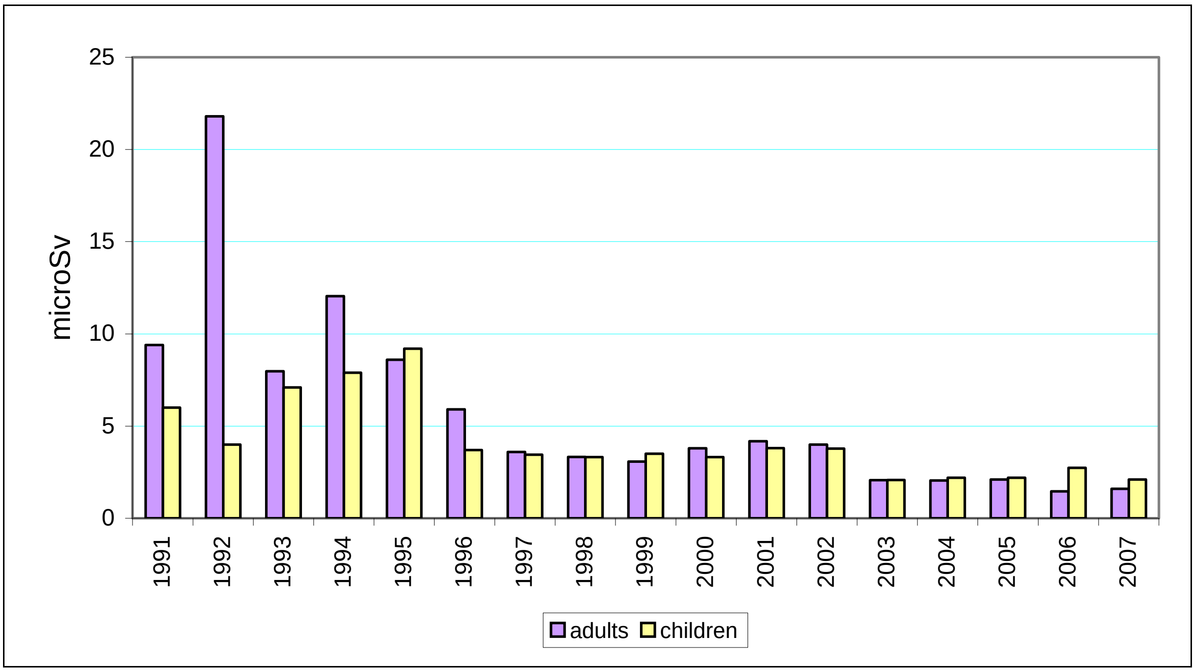
The annual dose from the ingestion pathway (food and drinking water consumption) was 1.6 μSv, which is the same as in previous years; radionuclide ^{90}Sr accounts for two thirds of the dose, while ^{137}Cs contributed the remaining third. The annual contribution due to inhalation of both radionuclides is only about 0.001 μSv, which is negligible if compared with radiation exposure from other transfer pathways. In 2007, the total effective dose to an adult individual of Slovenia arising from the global contamination of the environment with fission products was estimated at 6.4 μSv, as shown in Table 5. This is approximately a thousand times less than the average dose received by the Slovenian population from exposure to natural radiation in the environment (2500–2800 μSv). The effective dose for drinking water, taking into account natural and artificial radionuclides, was also estimated. It was shown that the limit value of 0.1 mSv per year due to water ingestion from local water supplies was not exceeded in any examined case.

During the interpretation of all dose estimates in this chapter, it is important to take into account the fact that the values are so low that it is very hard or even impossible to measure them. In the majority of cases, the final results are calculated using mathematical models, taking into account other available data, ones that can be measured. As a consequence, the uncertainties of thus calculated values are significant, which leads to variable results over the years. The important fact remains that all values are far below the exposure limits for population.

Table 5: Radiation exposure of population in Slovenia due to global contamination of the environment in 2007

Exposure by	Effective dose [μSv/year]	
	Adults	Children (7 to 12 years)
Inhalation (^{137}Cs, ^{90}Sr)	0.001	0.001
Ingestion: - drinking water (^{137}Cs, ^{90}Sr) - food (^{137}Cs, ^{90}Sr)	 0.048 1.55	 0.06 2.09
External radiation	4.8	4.8
Total in 2007 (rounded)	**6.39**	**6,95**

Figure 15: Annual exposure of members of the public in Slovenia to global radioactive contamination of the environment, taking radionuclides ^{137}Cs and ^{90}Sr into account



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

3.2 Operational monitoring in nuclear and radiation facilities

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

3.2.1 The Krško Nuclear Power Plant

The radiological situation in the surroundings of the nuclear power plant is monitored by means of continuous measurements of gaseous and liquid radioactive discharges and by carrying out radioactivity measurements of environmental samples. The concentrations 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 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. The results of environmental measurements during normal operation are used as a confirmation that radioactive discharges into the atmosphere and in aquifer were low. In case of emergency, the established monitoring network enables immediate sampling and analysis of contaminated samples.

Radioactive discharges

In 2007 the total released activity of noble gases to the atmosphere was 1.71 TBq, which resulted in an exposure of 0.15 µSv, or 0.3% of the limit set to 50 µSv per year. The released activities of iodine isotopes were 0.26% of the limit and were similar to the values from the previous year. Activity of the dust particles was 0.014% of the limit. Discharges of tritium into the atmosphere were within the usual values, as well as ^{14}C discharges, which were approximately the same as in previous years.

In 2007, in liquid discharges from the plant to the Sava river the activity of tritium (^{3}H) in the form of water prevailed with 21.7 TBq, which represents 48 % of the limit. This is the highest value ever and it is a consequence of the 18-month outage cycle.

The total discharged activity of fission and activation products was lower than in the previous year and was 0.122 GBq, which represents 0.1% of the operational limit value, while the activity of alpha emitters was under the detection limit.

Environmental radioactivity

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

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

No environmental measurement showed the presence of radionuclides that could be attributed to atmospheric discharges from the nuclear power plant. The measured radioactivity of radionuclides ^{137}Cs and ^{90}Sr is a consequence of global contamination and not a result of the nuclear power plant operation. On the contrary, a direct impact of liquid discharges was indicated as higher concentrations of tritium ^{3}H in the Sava river downstream the plant. The annual average of the concentration of tritium of 1.5 kBq/m^3 was measured at Krško, upstream the plant, while at Brežice, downstream the plant, the value of 8.5 kBq/m^3 was obtained. Tritium concentration was also measured in underground water (29 kBq/m^3), sampled at the VOP-4 borehole on the Slovenian side and Medsave on the Croatian side, yet these values are still much lower than the limit for drinking water (100 kBq/m^3). Radionuclide ^{58}Co was measured in air samples in October, although in low concentrations (1-3.5 µBq/m^3). Measurements of ^{14}C of vegetation samples in the year 2007 confirmed the results of a 2006 study, yielding slightly elevated concentrations in the vicinity of the Krško NPP.

Concentrations of other artificial radionuclides discharged to the river Sava (^{58}Co, ^{60}Co, and others) were measured below the detection limits in all samples. The concentrations of radioisotope ^{131}I in the Sava river were caused by discharges from the clinics of nuclear medicine in Ljubljana and Celje, not by the operation of the nuclear power plant. The concentrations of this radionuclide at Krško and at Brežice do not differ (Krško: 6.9 Bq/m^3, Brežice: 6.4 Bq/m^3).

The dose assessment of the public was based on a model calculation. The calculated dispersion factors for atmospheric discharges, based on real meteorological data, showed three most important pathways for public exposure that have to be taken into account, namely external radiation from clouds and deposition, inhalation of air particles with tritium and ^{14}C, and ingestion of food with ^{14}C. The highest dose (less than 2 µSv) was received by adult individuals due to ^{14}C intake with vegetable food ingestion and a lower dose was received due to inhalation of tritium. The dose assessment due to liquid discharges in 2007 showed their very low contribution to the population exposure: it was less than 0.01 µSv per year. The levels of external radiation in the vicinity of the structures (on-site) were higher than in the natural surroundings, but they were not measurable as far as the plant fence. It was estimated that the plant-related external exposure was of the order of magnitude of less than 0.1 µSv per year. This estimation is much lower than in recent years and it is now based on more realistic data.

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 2007

Type of exposure	Transfer pathway	Most important radionuclides	Effective dose [µSv/year]
External radiation	Cloud immersion Deposition	(^{41}Ar, ^{133}Xe, ^{131m}Xe) Particulates: (^{58}Co, ^{60}Co, ^{137}Cs…)	0.1 < 0.1
Inhalation	Cloud	^{3}H, ^{14}C	0.1
Ingestion (atmospheric discharges)	Vegetable food	^{14}C	< 2
Ingestion (liquid discharges)	Drinking water (the Sava river)	^{137}Cs, ^{89}Sr, ^{90}Sr, ^{131}I, ^{3}H	< 0.01
Total Krško NPP in 2007			**< 2***

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

From Table 6 it is clear that the total effective dose for an individual who lives in the surroundings of the Krško nuclear power plant is less than 2 µSv per year. This value represents about 4% of the authorized dose limit (50 µSv) or about five hundred times less than the dose received by an average Slovenian from natural background radiation (2500–2800 µSv per year).

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 along the reactor. Potential radioactive discharges at this location arise from the reactor, from the waste storage and from the laboratories.

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

Measurements of radioactive aerosol discharges into the atmosphere showed results below the detection limit, discharges of ^{41}Ar, calculated on the basis of the reactor operation time, were estimated to be 1.26 TBq for the year 2007, a small increase compared to the previous years. The external immersion dose due to ^{41}Ar discharges was estimated, by the same model as used in previous years, at approximately 0.32 μSv per year. A new method introduced in 2007, taking into account the Gaussian dispersion model, yields much higher values, i.e. 3.5 μSv/year. A conservative assumption was used for dose assessment to individuals of the population for liquid discharges: if the river water is ingested directly from the recipient river (Sava), the annual exposure is less than 0.0041 μSv per year. The total annual dose for an individual from the public, irrespective of the model used, is still a thousand times lower than the general dose limit for the public (1000 μSv) or the natural background radiation in Slovenia (about 2500–2800 μSv per year).

The monitoring programme 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 walls of the storage). Environmental concentrations of radionuclides were measured in the same scope as in previous years (in underground water from the two wells, in soil near the storage, external radiation at several distances from the storage, and dry deposition).

After the reconstruction of the storage in 2004, radon releases to the environment decreased from the annual average value of 75 Bq/s to 52 Bq/s in 2005, 35 Bq/s in 2006 and 31 Bq/s in 2007, or 0.98 GBq per year. Enhancement of radon ^{222}Rn concentrations in the vicinity of the storage was estimated by a model for average weather conditions, and was 3.6 Bq/m^3 at the distance of 30 m and about 1.3 Bq/m^3 at the distance of 50 m, i.e. at the fence of the reactor centre. In the waste water from the new drainage collector the presence of artificial radionuclides ^{241}Am, ^{134}Cs and ^{60}Co was measured as a consequence of cleaning the storage after the reconstruction. The decrease of artificial nuclide concentration continued, so ^{241}Am in ^{60}Co were not found in the December sample. Concentrations of nuclides were lower than the derived limits for drinking water.

For the dose assessment of the most exposed members of the public only inhalation of radon decay products and direct external radiation were taken into account. The most exposed members of the reference group are the employees of the reactor centre, who are potentially under the impact of radon releases from the storage. According to the calculation they received an effective dose of 3.3 μSv in 2007. The security officer receives about 1.6 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 0.07 μSv. These values are lower than in previous years, mostly due to lower radon releases. The annual effective dose collected by an individual from the public from natural background in Slovenia is 2500-2800 μSv.

3.2.3 The Former Žirovski Vrh Uranium Mine

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

Concentrations of radionuclides in some environmental media have partially decreased after the cessation of mine operation. The differences are most evident in lower values of long-lived radionuclides in air and surface water radioactivity, and they have been observed also for outdoor radon concentrations. Radioactivity of the surface waters in both streams in the last years has been slowly but steadily decreasing, especially ^{226}Ra concentrations in the Brebovščica, the main recipient stream: they are close to the natural background level. Only uranium ^{238}U concentrations in the Brebovščica stream (208 Bq/m^3) are still increased, because all liquid discharges from the mine and from disposal sites flow into it; these concentrations are even higher than the year before due to works at the disposal sites, bigger rinsing in the environment and lower precipitation. Radioactivity of sediments (^{238}U, ^{226}Ra) in the Brebovščica and Todraščica streams 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 the long-term average value concentration at the reference point, outside the mine influence (about 20 Bq/m^3). In 2007 the mine's contribution of radon to natural concentrations in the environment was estimated to be 9 Bq/m^3 .

Calculation of the effective dose for population takes into account the following exposure pathways: inhalation of long-lived radionuclides, radon and its short-lived progeny, ingestion (intake of food and water) and external gamma radiation. Radiation exposure of the population living in the vicinity of the mine was estimated to be 0.23 mSv in 2007. This value is roughly the same as in 2006 and is somewhat lower than the one calculated in the last decade. The most important radioactive contaminant in the mine environment still remains radon ^{222}Rn with its short-lived progeny, which contribute almost 4/5 of the additional exposure (Table 7).

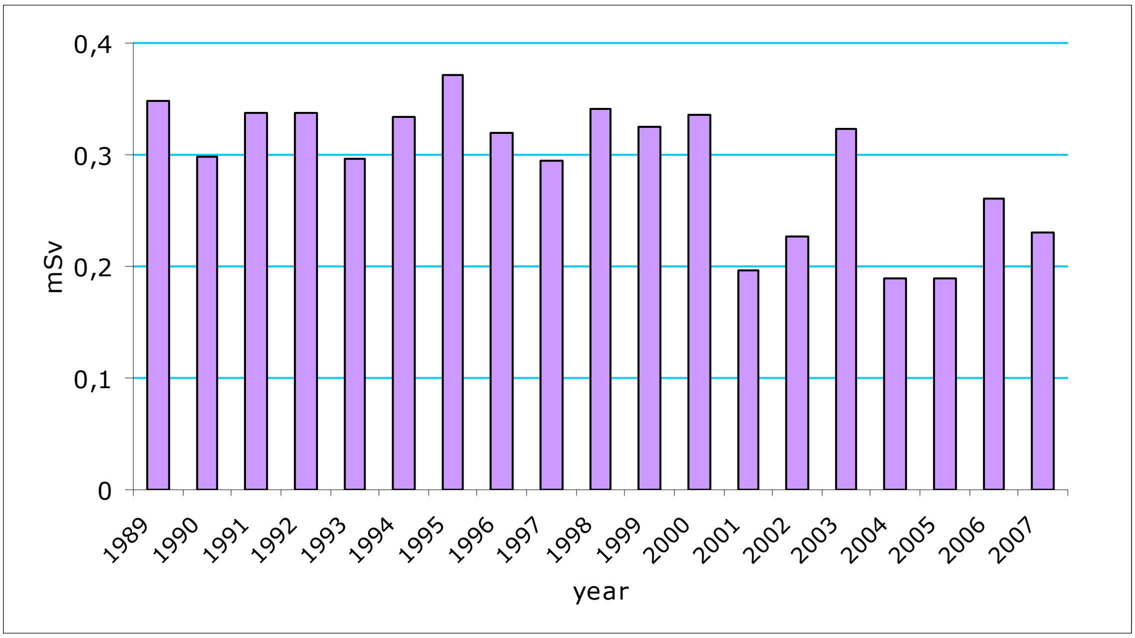
Table 7: Effective dose received by the average member of the public in the surroundings of the former uranium mine at Žirovski Vrh in 2007

Transfer pathway	Important radionuclides	Effective dose [mSv/year]
Inhalation	- aerosols with long-lived radionuclides (U, ^{226}Ra, ^{210}Pb)	0.0086
	- only ^{222}Rn	0.0046
	- Rn – short-lived progeny	0.186
Ingestion	- drinking water (U, ^{226}Ra, ^{210}Pb, ^{230}Th)	(0.014)*
	- fish (^{226}Ra, ^{210}Pb)	0.003
	- foodstuff (^{226}Ra in ^{210}Pb)	< 0.03
External radiation	- immersion and deposition of radon progeny	0.0026
	- deposition of long-lived radionuclides	-
	- direct gamma radiation from disposal sites	0.001
Total effective dose for 2007 (rounded):		**0.23 mSv**

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

The total effective dose for the adult individual in 2007 due to contribution of the former uranium mine is less than one quarter of the general limit value for the population (1 mSv per year). Doses for 10 year old children were first estimated this year to be 0.25 mSv, and 1 year olds received 0.28 mSv. This figure represents about 10% of the annual dose due to natural radiation background in Slovenia (2500–2800 μSv) or less than 5% of the natural background dose in the Žirovski Vrh environment during mining activities (5500 μSv). Annual changes of effective doses due to the mine contribution are shown in Figure 16.

Figure 16: Annual contributions to the effective dose received by the average member of the public, due to the Žirovski Vrh Mine



Measurements and dose estimations for the period of the last several years clearly show that the cessation of uranium mining and the restoration works carried out till now have decreased the environmental impacts and exposure to population. All these activities on the disposal sites during the previous years brought additional contribution of radon to the environment, which is the most probable reason for the higher assessment of the dose contribution, but it is still below the authorized limit value, which is 300 μSv per year.

3.3 Early warning system for radiation in the environment

The Slovenian on-line early warning system for radiation in the environment was established at the beginning of the last decade. The system is designed for immediate detection of raised levels of radiation and is one of the key elements of the alarming and reacting procedures in case of emergency. When radioactive releases into the environment occur, the levels of external radiation and concentrations of radioactive particles in the air are higher, since the air, ground, drinking water, food and fodder are contaminated by the fallout. They are managed by the SNSA, the Krško NPP, the EARS and each of the Slovenian thermal power plants. The SNSA collects, analyzes and archives data which are also presented on-line on the SNSA web pages. The corresponding alarm would be triggered in case of higher detected values.

In the year 2007 there were no events which would trigger 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 in the Joint Research Centre in Ispra, Italy, where the data from most European national early warning networks are collected. Slovenia has thus gained access to the on-line data of external radiation measurements from other participating countries. Additionally, Slovenian data are daily exchanged with the Austrian centre in Vienna, the Croatian in Zagreb and the Hungarian in Budapest.

3.4 Radiation exposures of the population in Slovenia

Every inhabitant of the Earth is exposed to natural and artificial radioactivity in the environment, a great part of the population receives radiation doses from radiological examinations in medicine, and only a small part of population is occupationally exposed due to work in a 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 and drink or through the skin. The data on population exposure are presented in the following subchapters, while the occupational exposures (to artificial and natural sources) and medical exposures are presented in Chapter 4.

Exposure to natural radiation

According to the data of the United Nations Scientific Committee on Effects of Atomic Radiation (UNSCEAR) the average annual effective dose from natural sources to a single individual is 2.4 mSv, varying according to different locations from only 1 mSv 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). The dose amount due to intake of food and water is about 0.4 mSv per year. The annual effective dose of external radiation originating from soil radioactivity, building material in dwellings and from cosmic radiation together was estimated at 0.8 to 1.1 mSv. In 2007 the Slovenian Radiation Protection Administration (SRPA) continued with the implementation of the governmental programme in the area of radon exposure. This programme comprises monitoring of the working and dwelling environment as well as informing the public about the measures for the decrease of exposure due to the presence of natural radioactive sources. In the scope of this programme, measurements in altogether 53 objects were performed and the accumulated effective doses were assessed for the employees; in schools and kindergartens also for children.

Population dose due to global contamination

Particularly people from the Northern Hemisphere are still exposed to ionizing radiation from global contamination of the environment as the consequence of past atmospheric nuclear bomb tests and the nuclear accident in Chernobyl. The last estimation of this exposure showed that in 2007 the average individual dose to the population from long-term radionuclides ^{137}Cs and ^{90}Sr in our country was near 6.4 μSv. External radiation contributed 4.8 μSv, while the exposure dose due to intake of food and water was estimated at 1.6 μSv. Due to lower contamination of the ground with ^{137}Cs the population in urban areas is less exposed than the one in rural environment.

Radiation exposure of population due to human activities

Radiation exposures due to the regular operation of nuclear and radiation facilities are usually attributed only to local population. Exposures of particular groups of population as a consequence of radioactive discharges from these objects are described in the chapters on operational monitoring. In Table 8, the annual individual doses are given for the adults of the reference groups of population living in the vicinity of particular nuclear and radiation installations in Slovenia. For comparison, also an average annual dose for individuals related to global radioactive contamination of the environment (nuclear tests and the Chernobyl accident) is shown. The highest exposures of the population are recorded for the individuals living in the surroundings of the former uranium mine at Žirovski Vrh, and are slightly below one tenth of the exposure due to natural sources.

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

Table 8: Population exposures due to the installations discharging radioactivity to the environment, and due to global contamination in 2007 (the annual dose limit for the population is 1000 μSv, the natural background radiation is 2500-2800 μSv)

Source	Annual dose [mSv]
Rudnik Žirovski Vrh	0.23
Chernobyl accident and nuclear tests	0.0064
Krško NPP	0.002
TRIGA reactor	0.0035
Central Storage of Radioactive Waste	0.0033

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 2007 were the Institute of Occupational Safety (IOS) and the Jožef Stefan Institute (JSI). Limited approvals were granted to the Krško Nuclear Power Plant (for thermo-luminescent dosimetry) and to IOS (internal dosimetry for workplaces in mines). Currently 8,300 persons have their records in the central register, including those who ceased using sources of ionizing radiation in previous years. In 2007, the dosimetric service at the IOS performed measurements of individual exposures for 3,500 workers employed at around 700 enterprises. The JSI monitored the exposures of approximately 500 radiation workers. The Krško Nuclear Power Plant (Krško NPP) performed individual dosimetry for 985 plant personnel and outside workers, who received an average dose[1] of ionizing radiation of 1.11 mSv. In other working sectors the average annual effective dose due to external radiation was the highest for workers in industrial radiography, namely 1.18 mSv, while the employees in medicine received on average 0.33 mSv. The highest average value of these, 0.65 mSv, was recorded for nuclear medicine workers.

The highest collective dose due to external radiation was received by radiation workers in the Krško NPP (889 man mSv) and in the medical sector (393 man mSv). Exposures in industry and in education, research and other activities were 82 man mSv and 27 man mSv, respectively.

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

At the Žirovski Vrh Mine the highest annual individual dose was 0.47 mSv, and the average for a group of 95 workers was 0.17 mSv. The collective dose was 16.4 man mSv.

In the other two mines (the Mežica Lead and Zinc Mine in closure and the Idrija Mercury Mine in closure) a total of 61 workers were exposed in 2007. On average they received 0.14 mSv and the collective dose was 6.7 man mSv.

41 out of 119 tourist workers in the Karst caves received an effective dose above 5 mSv, while 10 of those received doses exceeding 10 mSv, with the highest individual dose being 16.3 mSv. The collective dose was 466 man mSv, with an average dose of 4.13 mSv.

In 2005 the SRPA carried out a study related to the exposure of individuals in the Karst caves. The findings show that the doses received due to radon exposure, assessed according to ICRP 65[2], 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 by the ICRP 32 model. For this reason,

[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.

the doses for workers in Karst caves are for the first time calculated according to ICRP 32. Doses calculated in such a manner are thus twice higher than those calculated according to ICRP 65, used in the past.

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

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

	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	187	574	171	52	1	0	0	0	985
Industry	345	98	25	1	0	0	0	0	469
Medicine and veterinary	1820	1130	65	2	1	0	1*	0	3019
radon	20	173	41	35	5	1	0	0	275
Education, research and other	317	163	4	1	0	0	0	0	485
TOTAL	**2689**	**2138**	**306**	**91**	**7**	**1**	**1**	**0**	**5233**

MDL - minimum detection level
E- effective dose in mSv received by an exposed worker
* The inspection process showed that only the dosimeter was exposed to the ionizing radiation, not the worker. In spite of that, the value 24.72 mSv was included in the statistics.

Education of workers using sources of radiation is in accordance with regulations. Minor deficiencies have been found regarding timely refreshment of knowledge and skills. Training, refreshment courses and tests were carried out by the approved technical support organizations, namely the IOS and the JSI. In 2007 a total of 1262 participants attended courses on ionizing radiation protection.

In 2007, 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,
- Health Centre Škofja Loka.

Altogether 2688 medical examinations were carried out.

Diagnostic reference levels for X-ray examinations

Medical applications of ionizing radiation are by far the largest man-made source of radiation exposure for the population. After the introduction of the concept of diagnostic reference levels by the International Commission on Radiological Protection in 1996 the process of patient exposure optimization has been enhanced. Local performance in patient exposure for a particular type of X-ray examination in a radiological department can be assessed by comparison of the mean patient dose to the diagnostic reference level derived from relevant regional or national data. The results of the extensive five-year national patient dose survey in Slovenia have been reviewed. The introduction of the national diagnostic reference levels will increase the awareness of the decrease of patient doses in Slovenia. Their proper use should promote good radiological practice by reducing doses where current practice is not optimized. The program was continued in the year 2007 with data sampling which will be evaluated in the next period.

5 RADIOACTIVE WASTE MANAGEMENT AND MANAGEMENT OF NUCLEAR AND RADIOACTIVE MATERIALS

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

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

In 2006, the National 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 (NPVO). ReNPROJG is an extensive and detailed document setting goals and tasks in the field of radioactive waste and spent nuclear fuel management.

Regarding the implementation of the National Programme, activities on the site selection for the LILW repository were carried out in 2007. It was decided that the research reactor TRIGA will operate until 2016. The SNSA issued a consent for the mining works for the closure of the Boršt depository of hydrometallurgical tailings. The CISF was on a trial period.

The preparation of the Operational Programmes of the National Programme on Radioactive Waste and Spent Nuclear Fuel Management which assures all the objectives from the Resolution, for a period from 2006 to including 2009, was finished in the beginning of 2007. The programmes were not adopted yet but they are already implemented. With the annual revision of the programmes and with the analysis of the current situation in the field, some proposals on further work or changes of provisions on particular programmes will be prepared in the next period of time.

5.2 Radioactive waste and irradiated fuel at the Krško NPP

In the past years, volume reduction of LILW radioactive waste was achieved by means of compression, super-compaction, drying, incineration, and melting, so that the total volume of waste accumulated at the end of 2007 amounted to 2,174 m^3. The total gamma and alpha activity stored were $1.93 \cdot 10^{13}$ Bq and $2.22 \cdot 10^{10}$ Bq, respectively. In 2007, 228 standard drums containing solid waste were stored with total gamma and alpha activity on 31.12.2007 $2.4 \cdot 10^{12}$ Bq and $3.13 \cdot 10^{9}$ Bq, respectively.

5.2.1 Management of low and intermediate level waste

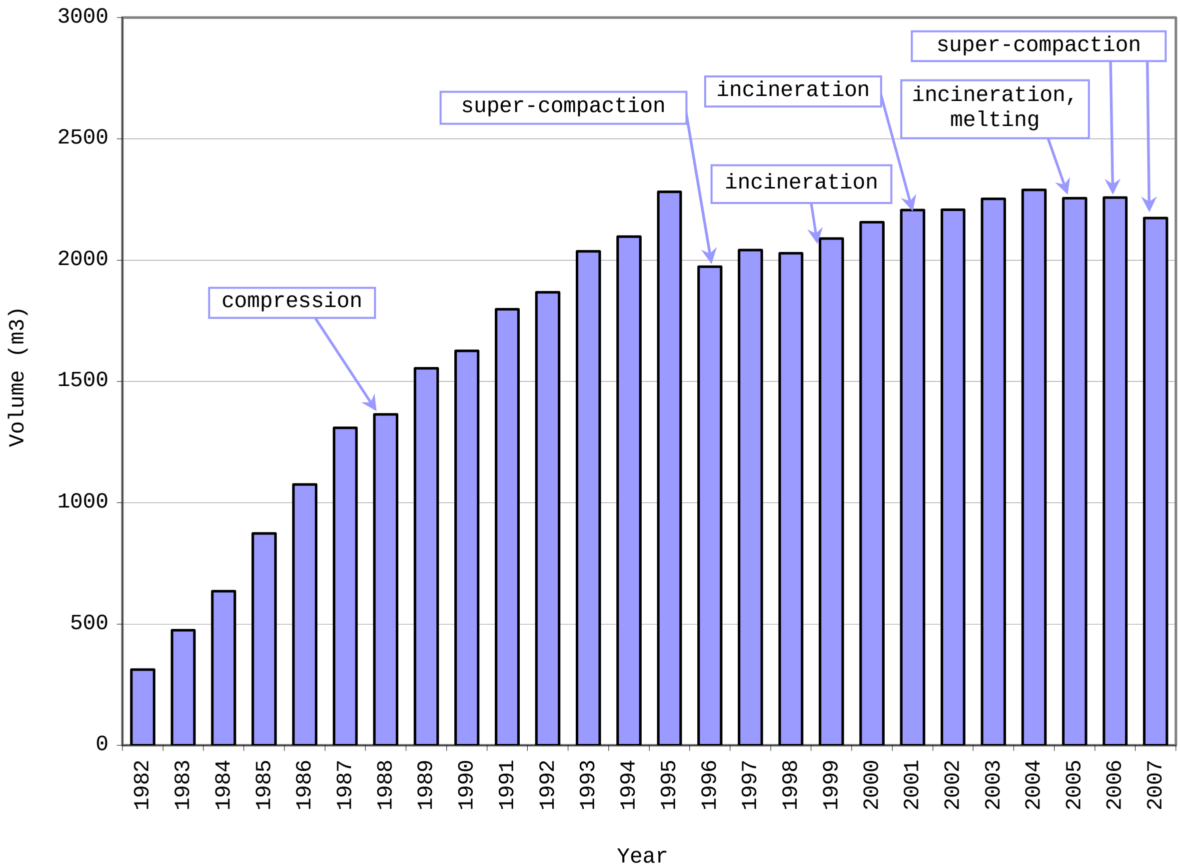
Figure 17 shows the accumulation of low and intermediate level radioactive waste in the storage at the Krško NPP. Periodical volume reductions with compression, super-compaction, incineration, and melting are denoted. The lower waste volume accumulation rate after 1995 results from a new in-drum drying system (IDDS) for drying of evaporators concentrate and spent ion exchange resins. In 2007 the drying of spent ion exchange resins which were temporarily stored in RADLOK containers in radioactive waste storage was finished.

Because the working capacity of the existing IDDS system is insufficient for drying backlog sludges and sediments, the Krško NPP hired a mobile IDDS unit, which in the year 2007 performed the drying of 97 drums of sludges and sediments and reduced the volume of waste to 15 drums.

In 2006 the Krško NPP started continuous compression of radioactive waste with their own super-compactor installed in the storage facility. In the year 2007 there were 1,101 standard drums with compressible wastes, other wastes and evaporators concentrate compressed.

Secondary waste sent for incineration and melting in October 2005 to Studsvik in Sweden was returned to the Krško NPP in December 2006 and stored in the radwaste storage facility in 2007. 149 standard drums which will be sent for incineration and melting in Sweden, are temporarily kept in the multipurpose building (decontamination facility).

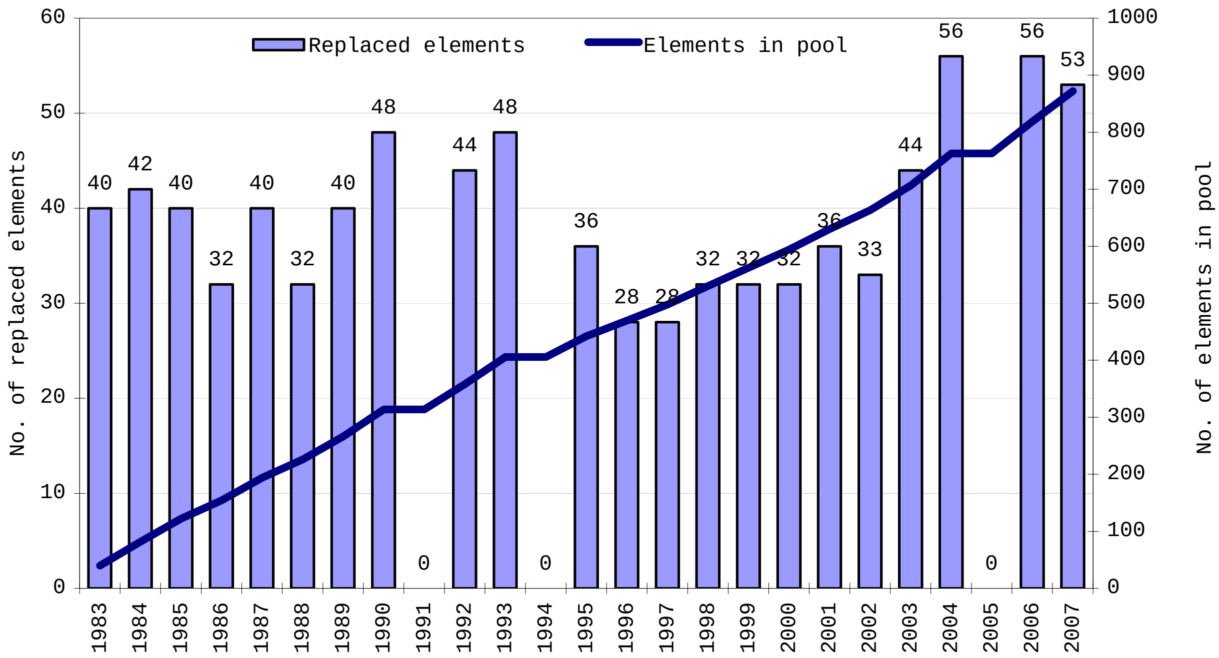
Figure 17: Accumulation of low and intermediate level radioactive waste at the storage in the Krško NPP



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 2007, 53 fuel elements were replaced during the regular outage. At the end of 2007 there were 872 fuel elements stored in the spent fuel pool. Figure 18 shows accumulation of spent fuel at the Krško NPP.

Figure 18: The annual discharges of spent fuel assemblies and accumulation of spent fuel assemblies in the Krško NPP spent fuel pool



5.3 Radioactive waste at the Jožef Stefan Institute

During the operation of the reactor in 2007, approximately 0.05 m3 short-lived low and intermediate level waste was produced and handed over to the Central Interim Storage Facility at Brinje.

The Institute decided to stop the research in the field of uranium extraction for nuclear technology. The decommissioning of buildings, where the activities were held in the past, had to be performed. There were two containers, with about 1m3 of solvents containing uranium that had to be removed. The solvents were chemically treated and uranium was transformed into solid state. The containers were decontaminated. A layer of soil under the containers was also removed. Among others about 2m3 of various solid materials contaminated with short and long-lived radionuclides were sorted and repacked. The technological hall was radiologically improved and let for unrestricted use. The decommissioning and decontamination of all buildings where the research was going on in the past is now finished. 31 drums of low level waste with natural radionuclides (remains of uranium ore) and 2 drums with short–lived waste were filled up and the latter will be handed over to the ARAO. Additionally the ARAO isolated 9 drums and one plastic container which also contain natural radionuclides. Altogether 40 drums and the plastic container result from research with uranium originating from Žirovski Vrh, and disposal of the waste at the Jazbec depository would be reasonable. Agreement about this intention has not been reached yet.

In the framework of the above mentioned activities about 500 kg of yellow cake, a special form of uranium which is an intermediate product between the uranium ore and uranium for nuclear fuel elements production, was exported to France.

5.4 Radioactive waste in medicine

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

5.5 Public service for radioactive waste management

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

5.5.1 Operation of 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. The ARAO devoted a lot of intention to the activities needed for obtaining the license for use and operation of the CISF. Unfortunately, at the end of trial operation the ARAO was not able to apply for the license for operation. Consequently, the SNSA extended the trial operation for six months.

To assure efficiency, traceability and control over the efficiency the ARAO developed a new information system. The system supports the process of handing, transport, reception, preparation and treatment of waste in the CISF.

5.5.2 The process of site selection for the disposal of low and intermediate level radioactive waste

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

The activities were carried out at two locations: Vrbina (Krško municipality) and Vrbina Šentlenart (Brežice municipality). The latter was proposed only in the beginning of 2007. After the re-evaluation of a comparative study the site was approved by the government in August. The SNSA issued guidelines which determine the contents and scope of the Special Safety Analysis for siting the LILW repository, with the intention of preparing a spatial plan of national importance for settling the LILW repository in Vrbina Šentlenart (Brežice).

In the framework of a detailed plan for the Vrbina site (Krško), reports were submitted to the Ministry of the Environment and Spatial Planning – the Directorate for Spatial Planning. The Study of Alternatives for a repository at the potential Vrbina site (Krško) proposed underground silos as an optimal alternative. In February 2007 the Krško municipality held the 2nd Spatial Conference, at which a public debate about the Study of Alternatives was performed. The condition for the debate about the LILW repository in the Krško municipality was the agreement with the Government on additional funds for local infrastructure. The agreement and the confirmation of the protocols for the extra infrastructure funding was not signed before December 2007. The completed draft version of the Spatial Plan of National Importance for the Vrbina site was prepared in November 2007.

In the framework of the Detailed Plan of National Importance the SNSA gave its opinion on the Environmental Report on 29 January 2007, a part of which is a Special Safety Analysis, which dealt with the acceptability of the repository from the nuclear and radiation safety point of view. The analysis confirmed that the highest radiation exposure for the critical group of population would be below 0.3 mSv/year, the limit determined in the guidelines for this nuclear facility. The SNSA determined that the Environmental Report was suitable for proceeding with the preparation of the Detailed Plan of National Importance, pointing out some deficiencies. There is a risk that a further detailed analysis, which will be prepared in the framework of the Environmental Report and Safety Analysis preparation, will complicate the development of the project at this site.

In 2007, the ARAO prepared the »Preliminary acceptance criteria for the LILW repository«. Due to the fact that these criteria were unclear, proposals for further activities were prepared. Work on the 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, continued. During the first year, the fundamental principles of the degradation processes of metal and concrete materials used in the engineer barriers of LILW repositories were described. The most important parameters which influence the development and speed of degradation were presented. With regard to various types of repositories the critical degradation processes and the method of measurement of these processes were determined.

In 2007, collaboration with two local partnerships Brežice and Krško municipalities, continued. The purpose of this local partnership is to enable collaboration between the municipalities and the local public in the process of site selection. Many presentations, exhibitions and round tables about radioactive waste management took place. There was also an excursion to a similar repository abroad. People from both local partnerships participated in the excursion. Representatives of local partnerships are also involved in some international projects. The local partnerships, Brežice and Krško, prepared independent studies about the influence of the repository on the local community.

5.6 Remediation of the Žirovski Vrh Uranium Mine

The remediation of the Žirovski Vrh uranium mine has been in progress since 1992. Since then, the uranium processing plant and the mine, together with the accompanying objects, have been successfully decommissioned and deconstructed.

In 2007 the activities in Žirovski vrh mine were mainly focused on remediation of both depositories, the Boršt depository for hydrometallurgical tailings and the Jazbec depository for mine tailings.

In November 2006 the RŽV applied for the consent to the mining works for the closure of the Boršt depository for hydrometallurgical tailings and attached the required project documentation, which was later adequately supplemented. Analyses of potential emergencies (earthquake; lasting heavy rain; storm; landslide; lasting drought; combination of earthquake, lasting heavy rain and storm; occurrence of liquefaction of hydrometallurgical tailings; reduction in functioning of drainage systems; airplane crash; unauthorized human intrusion and loss of institutional control) showed that the consequences of such events would be limited, affecting only a few percent of the cover and the piles, respectively. According to the Supplemental Detailed Plan issued in May 2003 by the Ministry of the Environment and Spatial Planning, doses to the members of the public should not exceed 0.3 mSv/year. Since after the finalization of works Boršt is to become part of the national infrastructure, long-term institutional control and remediation of consequences resulting from emergencies shall be guaranteed. The SNSA issued the consent to the mining works for the closure of the Boršt depository in April 2007.

After the finalization of mining works for the improvement of the Jazbec depository for mine tailings and the Boršt depository for hydrometallurgical tailings, the license for closure will have to be obtained from the SNSA. The license is a prerequisite to obtain a final provision on cessation of rights and obligations according to mining regulations and for the conveyance of the facility to the national infrastructure.

The Žirovski Vrh mine proposed that all the waste and remains of uranium ore originating from Žirovski Vrh and (due to technological and research activities) at the Jožef Stefan Institute, the Geological institute and the Faculty of Natural Sciences and Technology, as well as the remains of uranium ore stored in the CISF, could be deposited at the Jazbec depository. It is stored in 40 drums and a plastic container containing remains of the ore and waste coming from testing of ore characteristics. The Žirovski Vrh mine prepared some changes to the (???) project for the closure of the Jazbec depository and some changes to the Safety Report for the Jazbec depository. The project was stopped due to the resistance of the local community.

On 18 September 2007 there were strong precipitations very near the former uranium mine, causing devastation in the town Železniki. A question was raised as to what would happen with the Jazbec and Boršt depositories in case of similarly strong precipitations there.

When improvement of the Jazbec and Boršt depositories was being planned, such precipitations were taken into consideration, which is evident from the Safety Reports. With the improved construction arrangements the body of the depository will be secured against damage in case of strong precipitations. A suitable drainage system, taking into consideration water reserves and possible precipitations, is envisaged. Furthermore, the hydrological situation at Žirovski Vrh is very different and much smaller than the one in the valley of the river Selška Sora.

The devastation that took place in Železniki could not occur in the Boršt and Jazbec depositories even with the same amount of precipitation. That was confirmed in the year 2004, when in spite of a similar amount of daily precipitation no serious damages occurred on the depositories. The detailed inspection of the depositories, carried out after September 2007, did not show any damage.

The funds for performing the planned activities, for ensuring safe working conditions of the staff and external workers and for limiting the effects of the mine to the environment were assured in full and in time.

5.7 Transboundary Movement of Radioactive and Nuclear Materials

The SNSA issues permits for the import and export of radioactive and nuclear materials, with the exception of medical appliances, which are regulated by the Ministry of Health – the Slovenian Radiation Protection Administration (SRPA). In 2007 both regulatory authorities validated 75 declarations of consignees in accordance with Council Directive (EURATOM) No. 1493/93 of 8 June 1993. This standard document of declaration shall be valid for a period of not more than three years

Besides shipments in and shipments out of the Member States, in 2007 the SNSA and the SRPA issued 11 permits for import and 2 permits to the Jožef Stefan Institute for the shipment of technical uranium concentrate and non-irradiated fuel elements to France.

The Krško NPP imported 53 fresh fuel assemblies in September 2007.

In 2007 no transit permits were issued.

5.8 The Fund for decommissioning of the Krško NPP and for the deposition of radioactive waste from the Krško NPP

The Fund for decommissioning of the Krško NPP and for the deposition of radioactive waste from the Krško NPP collects financial resources for decommissioning of the Krško NPP and for the safe deposition of LILW and spent nuclear fuel. In 2007 the Krško NPP delivered one half of electric power to Slovenian and one to the Croatian utility. GEN Energija, Llc. was liable for the payment of the regular levy to the Fund in 2007 in the amount of 0.003 EUR for every kWh of electric power received from the NPP. By the end of the year GEN Energija, Llc. contributed in due time the total amount of 8,144,088 EUR, which is 4.07% more than in 2006.

In 2007 the Fund invested in accordance with the long term strategy and the investment policy. For the sake of safety of investments, the Fund has at least 30% of financial investments in securities issued or warranted by the EU or OECD member states.

On 31 December 2007, the Fund managed 145,733.127 EUR of financial investments, 15% of which was invested in banks in the form of deposits and CDs, 30.31% in state securities, 19.65% in other bonds, 9.22% in mutual funds, 19.74% in investment funds, 4.71% in stock and 1.36% in gold and precious metals. The value of the financial portfolio in 2007 amounted to 150,369,630 EUR .

The Fund’s portfolio is formed in accordance with the strategy and the investment policy for 2006 and guarantees stable long-term incomes.

Considering the stock market exchange rates of the Fund’s portfolio on 31 December 2007, the selling of all securities would have resulted in 4.6 million EUR of capital profit. The yield of the entire portfolio of the Fund for 2007 amounted to 6.39%, which is 2.1% more than the previous year. The entire income of 13,824,537 EUR from the funding in 2007 was 0.06% lower than planned. The expenses in 2007 were 33.55% lower than planned and amounted to 5,267,367 EUR. Income from financing in 2007 amounted to 8.1 million EUR. In 2007, the Fund for Decommissioning of the Krško NPP realized 5.9 million EUR of capital profit.

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

Construction of the LILW repository is expected to take place between 2007 and 2013. It is foreseen that the site for the repository shall be known by 2008 and the construction shall be finished in 2010 (the legislative requirement is 2013). Because of the high costs related to the construction of the repository, an estimation of the costs and a solvency plan for that period was prepared by the Fund. It is estimated that around 85.45 million EUR will be earmarked for projects of the ARAO. According to that the Fund will have to adapt the time schedule of investments, which can result in lower profit for individual investments.

6 EMERGENCY PLANNING AND PREPAREDNESS

Emergency planning and preparedness is an important part of the comprehensive system of ensuring a high level of nuclear and radiation safety. It is necessary that planning activities are done round-the-clock to provide an effective response in case of a major radioactive release.

Within the scope of nuclear and radiation emergency preparedness the **Administration of the RS for Civil Protection and Disaster Relief** (ACPDR) continued its permanent activities in amending and updating the national, regional and municipal emergency plans, as well as harmonizing other plans with the National Nuclear Emergency Response Plan. The number of written and harmonized plans in municipalities increased by about 40% compared to the previous year. The National Nuclear Emergency Response Plan is published on the web page of the ACPDR. The web page also has a guidance for the population on what to do in case of a nuclear emergency.

The Members of the Civil Protection who have a specific role during nuclear and radiological emergencies have been trained in different programs in the Training Centre for Protection and Rescue at Ig. Their outdated equipment was replaced with new equipment, including new protective (gas) masks.

Under the provisions of the Agreement between the Governments of Croatia and Slovenia on Co-operation in the Protection against Natural and Civilization Disasters, the subcommittee responsible for the harmonization of emergency plans had a meeting in April 2007. The meeting focused on the information exchange between the two parties in case of a nuclear emergency in the Krško NPP. The subcommittee meeting concluded that the competent authorities in Slovenia would consider the Croatian request that the Krško NPP should send the information about the emergency to both the Slovenian Notification Centre and the State Notification Centre of Croatia.

The Slovenian Nuclear Safety Administration (SNSA), as a regulatory body that during an emergency provides professional support to the National Civil Protection Headquarters, maintains its own emergency response system. During an emergency the SNSA completely transforms its operational structure and uses its set of emergency procedures prepared in advance. Some new procedures were prepared in 2007 and some of the existing procedures were improved. The emergency plan contains also specific procedures for the maintenance of the whole structure of the SNSA in case of an emergency.

In 2007 the activities of the **NPP Krško** in the area of emergency preparedness focused on the maintenance of the existing preparedness and accomplishing professional training, drills and exercises. Besides the training, there were also all-year maintenance and inspections activities of the operability of the centres and the equipment used for emergency response, updating of the documentation in the centres, monthly tests of communication systems and tests of the emergency personnel response.

The Yearly Exercise NEK 2007 was conducted on 10 December 2007 from 14.15 to 20.00. Besides the NPP Krško and technical support organizations, the SNSA also participated as a full scope participant. With the function of receiving and dispatching of information, the Notification Centre of the Republic of Slovenia and the Regional Notification Centre from Brežice were also included.

The exercise was a regular yearly test of maintenance of emergency preparedness of the NPP Krško.

The dynamics of the exercise was based on a pre-prepared scenario of events and failures in the technological process that was first tested on the simulator. The scenario required immediate declaration of the second level of emergency – site emergency followed by the third level of emergency – general emergency. Related to the scenario adequate operating, corrective and protective measures were taken on the site; the intervention personnel and the centres for the control of the event participated; the assessment of radiological consequences was made and external institutions were activated for notification.

The exercise demonstrated good preparedness of the plant and the participating external institutions in all components of the control of emergency that were tested. Some minor deficiencies were established, particularly in the elements that are not tested every year and in the elements that were modified immediately before the exercise. The deficiencies were planned to be eliminated within the Corrective Programme of the NPP Krško, regular maintenance activities and within the implementation of the training programme.

The Reactor Infrastructural Centre of the Jožef Stefan Institute organized its facility exercise to test response in case of fire. On 21.4.2007 real intervention of fire-fighters was requested by the Reactor Security Staff in a laboratory which does not belong to the reactor (i.e. is not part of the nuclear installation). Faulty equipment was smouldering, but the fire did not break out, and the safety of the nuclear installation was not compromised. The police closed the nearby roads due to the fire-fighters intervention, which was observed by the population in the vicinity and caused some concern because they assumed some serious accident had happened in the reactor. This event revealed shortcomings in informing the population.

The new vehicle of the **Ecological Laboratory with the Mobile Unit** (ELMU), which was handed over by the ACPDR to the Jožef Stefan Institute at the end of 2004, was completely furnished with the necessary equipment. Internal training in dose rate and surface contamination measurement for ELMU team members was organized. The ELMU took part in one field exercise in the vicinity of the Krško NPP, and participated in an international inter-comparison measurement exercise of mobile units in Austria.

A mobile unit is maintained also by the Institute of Occupational Safety. In 2007 it took part in two field exercises in the vicinity of the Krško NPP, and successfully participated in the exercise in Austria.

7 CONTROL OVER RADIATION AND NUCLEAR SAFETY

7.1 Legislation

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

Based on the ZVISJV, twenty-one implementing regulations were adopted at the beginning of 2007, namely four governmental decrees, six regulations issued by the minister of the environment, nine issued by the minister of health and two issued by the minister of the interior.

In 2007 the adoption of implementing regulations continued and the following regulations were issued:

- Decree on checking the radioactivity for shipments of metal scrap (Off. Gat. RS, 84/07),
- Regulation on the monitoring of radioactivity (Off. Gaz. RS, 20/07),

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

7.2 The Expert Council for Radiation and Nuclear Safety

The Expert Council for Radiation and Nuclear Safety provides expert advice to the Ministry of the Environment and Spatial Planning and to the Slovenian Nuclear Safety Administration in the 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 2007, the four-year terms of the chairman and two members of the Council expired. The minister of the environment and spatial planning re-appointed Matjaž Ravnik as the chair of the Council and Božidar Krajnc as a member of the Council, while Irena Mele was appointed as a new member. Their term of office lasts six years. Two other members of the Council are Borut Mavko and Gregor Omahen.

The Expert Council met twice in 2007. In addition to the regular report of the SNSA Director to the Council on the situation in the field of radiation and nuclear safety between the meetings, the Council considered the following subject areas: monitoring of operation of nuclear facilities, drafts of new nuclear regulations and their status, strategic questions with regard to ensuring nuclear and radiation safety, general questions on nuclear and radiation safety. In 2007, the Expert Council also considered and adopted the Annual Report on Radiation and Nuclear Safety in Slovenia for 2006 and the Report of the Republic of Slovenia to the Fourth Review Meeting of Contracting Parties of the Convention on Nuclear Safety.

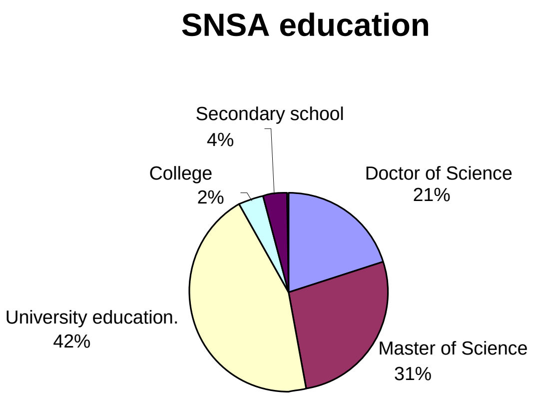
7.3 Slovenian Nuclear Safety Administration

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

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

The structure of SNSA's employees at the end of 2007 was as follows:

	No.
All employees	48
Doctor of Science	10
Master of Science	15
University education	20
College	1
Secondary school	2



In the year 2007 the SNSA management decided to acquire the certificate according to the requirements of the standard ISO 9001:2000 »Quality management systems – Requirements. In September 2007 the external pre-certification audit took place and in December 2007 the SNSA successfully acquired the **ISO 9001:2000** certificate for the management system.

The Expert Commission for the Verification of Professional Competence and Fulfillment of Other Requirements in respect of Workers Performing Duties and Tasks in Nuclear and Radiation Facilities (the Commission) carried out the 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 extension of the Senior Reactor Operator license, four candidates acquired the extension of the Reactor Operator license and six candidates acquired the extension of the Shift Engineer license.

The SNSA granted the prolongation of licenses for performing duties and tasks in the Krško NPP to the operators in the NPP.

No examinations for the license prolongation of operators at the research reactor TRIGA were performed at the Jožef Stefan Institute in the year 2007.

7.4 The Slovenian Radiation Protection Administration

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

The Expert council for radiation protection of people was nominated by the Minister of Health on 19.9.2005. The Expert council advises the Ministry of Health and the SRPA on topics related to radiation protection of people, radiological procedures and use of radiation sources in medicine and veterinary medicine.

As a special operational unit within the SRPA, the Inspectorate for radiation protection is competent for the control of sources of ionizing radiation used in medicine and veterinary medicine and for the implementation of legislation in the field of protection of people against ionizing radiation. In 2007, the SRPA had five employees, four of them holding the Ph.D. degree in science.

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 and health physics experts, to dosimetric services and health surveillance services; it was engaged in the transfer of EU legislation in the field of protection against ionizing radiation, in performing inspections, informing and increasing awareness of the public about procedures of health protection against harmful effects of radiation, and in co-operation with international institutions involved in radiation protection.

The SRPA continued with providing monitoring of foodstuffs and drinking water and in collaboration with the International Agency of Atomic Energy carried out the project "Analysis of patient exposures at interventional cardiac procedures".

The SRPA controlled radiation practices in medicine and veterinary medicine and use of radiation sources in these activities. Altogether 97 permits to carry out a radiation practice, 153 permits to use radiation sources, 3 permits to import radioactive sources and 84 confirmations of programmes of radiological procedures, 85 evaluations of protection of exposed workers, and 65 statements of consignees of radioactive materials were granted. 10 inspections were performed in medicine and veterinary medicine and 3 decrees requiring correction of established deficiencies were issued.

With regard to radon, the SRPA supervised the Žirovski Vrh Uranium mine, the Mežica Lead and Zinc Mine in closure, the Idrija Mercury Mine in closure, the Postojna Cave, the Škocjan Caves, and primary schools, kindergartens, hospitals and other public buildings with increased radon concentrations.

The SRPA issued 126 confirmations of evaluation of radiation protection of exposed workers (80 with regard to use of x-ray devices in medicine, 5 with regard to use of unsealed and sealed sources in medicine, 5 for carrying out radiation practices in nuclear and radiation facilities, 2 with regard to radon exposure and 36 for radiation practices in industry, research and other activities).

The SRPA issued altogether 13 authorizations to performers of professional tasks in the radiation protection domain. Ten authorizations to radiation protection experts were granted (8 authorizations to individuals and two authorizations to legal entities).

Inspection surveillance was increased by 21% compared to 2006 (altogether 139 inspection procedures) and the number of granted permits and confirmations increased by 19%. Appropriate safety was assured in carrying out radiation practices and the use of sources of radiation in medicine and veterinary medicine. The SRPA carried out supervision together with the professional organizations that regularly verify the state of affairs in this field. Records of radiation sources used in medicine and veterinary medicine were kept. Development of and input into the Central Records of Personal Doses of exposed workers were also performed.

7.5 Authorized Experts

Authorized experts for radiation and nuclear safety

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

In 2007 the SNSA, based on applications and records on the fulfillment of the conditions, authorized for carrying out the work of authorized expert for radiation and nuclear safety in individual fields or in a number of fields of radiation and nuclear safety altogether eight legal entities and three individuals.

Based on yearly reports of authorized experts, the main conclusion was that there were no major changes in their performance. In the field of staffing they maintain their competence, the equipment used in their professional work was well maintained and updated. The organizations established the Quality Management Programmes certificated in compliance with ISO 9001:2000. The authorized experts kept providing professional support to the Krško NPP by preparation of expertise, safety analyses and project documentation; they also trained the plant's personnel in various professional areas. An important part of their work focused on an independent review and assessment of plant modifications. They also offered professional support to the remediation of the mining waste sites of the Žirovski Vrh mine and to the activities of the Agency for Radwaste Management.

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

Authorized radiation protection experts

Authorized radiation protection experts cooperate with the employers in drawing up assessment of the radiation protection of exposed workers. They give advice on the working conditions of exposed workers, the extent of implementation of radiation protection measures in supervised and controlled areas, examination of the effectiveness thereof, the regular calibration of measuring equipment, the control of operability of measuring instruments and protective equipment, and perform training of the 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 the 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 in their disposal appropriate measuring methods accredited against the standard SIST EN ISO/IEC 17025. Authorizations are limited to specific expert areas.

Based on the opinions of the Commission for verification of fulfillment of the conditions for carrying out the work of authorized radiation protection experts, the SRPA issued in 2007 authorizations for radiation protection experts to 8 individuals and two legal entities.

Authorized dosimetric service

Authorized dosimetric service performs tasks related to monitoring of the exposure of persons to ionizing radiation. An authorization can be granted only to legal persons if they employ appropriate experts and have in their disposal appropriate measuring methods accredited against the standard SIST EN ISO/IEC 17025. Based on the opinions of the Commission for verification of fulfillment of the conditions for carrying out the work of authorized dosimetric service, in 2007 the SRPA issued authorizations to three legal persons.

Authorized medical physics experts

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

In 2007 the SRPA did not receive any application for issuing an authorization for medical physics expert.

Authorized medical practitioners carrying out medical surveillance of exposed workers

In 2007 five organizations acquired an authorization for medical surveillance: the Clinical Institute for Medicine of Work, Traffic and Sport, ZVD, the Community Health Centre Krško (for the Krško NPP employees), the Community Health Centre Škofja Loka (for the Žirovski Vrh mine employees) and Aristotel Plc. from Krško.

In 2006 the SRPA, in cooperation with the Clinical Institute for Medicine of Work, Traffic and Sport, carried out training of physicians - specialists in

medicine of work, traffic and sport.

7.6 The Nuclear Pool GIZ

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

The Krško NPP third party liability cover is insured by the Nuclear Pool GIZ in the amount of SDR 150 millions, in Euro equivalent (app. 143,4 millions €). In 2007 the Nuclear Pool GIZ issued also an insurance policy for NPP Krško under the head of the transport of nuclear fuel, limited at amount of SDR 20 millions.

The Nuclear Pool GIZ participated in third party liability insurance risk up to its capacity level while the rest of the risk is reinsured by 17 foreign pools, the most important being British, German, Swedish, Swis and Japanese pool.

In 2007 the NPP Krško did not report any damage to the Nuclear Pool GIZ.

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

8 NUCLEAR NON-PROLIFERATION AND SECURITY OF RADIOACTIVE MATERIALS

International community has increased its attention to nuclear non-proliferation in the last few years. A violation of the nuclear non-proliferation treaty has been discovered due to the Gulf crisis, as well as of clandestine activities in North Korea. A few countries which are not contracting parties continue with their nuclear weapons programmes (India, Pakistan and Israel). The situation in Iran shows that their peaceful nuclear programme is not always transparently presented. Slovenia completely fulfils its obligations which derive from the adopted international agreements and treaties. Together with other countries it tries to prevent further expansion of nuclear weapons.

Due to potential misuse of radioactive sources, the international community has increased the control of these sources with significant activity. Slovenia amended its legislation in compliance with the EU commission and IAEA guidelines.

Nuclear Safeguards

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

In Slovenia, all nuclear material (fresh and spent fuel) at the Krško NPP, at the Jožef Stefan Institute and at other holders is under the supervision of international inspection.

The SNSA temporarily took over the responsibility of reporting for small holders until 19.3.2007. Due to the harmonization of reporting in accordance with the EU Council Directive, the SNSA handed over the responsibility to the small holders and sent notification to EURATOM. The reporting is mostly related to the radiation practices in industrial radiography, technological and automation processes and medicine (oncology). There are 11 responsible organizations, in addition to the ARAO as the operator of the CISF.

In 2007, IAEA inspections started to be performed in accordance with the integrated safeguards. There were seven IAEA inspections in 2007, one of them unannounced and without the presence of EURATOM inspectors. According to the Additional Protocol there were two inspections. No anomalies were found. The Slovenian users of nuclear material reported to IAEA in accordance with the Safeguards agreement. The increased number of inspections in 2007 is a result of following the EURATOM protocol on nuclear safeguards and setting up of new equipment for video control.

A minor problem occurred regarding relations between IAEA and EURATOM because EURATOM cannot participate in unannounced inspections due to logistic problems. The problem will be solved by setting up a new video control which will send the video display to EURATOM and IAEA in real time.

Due to direct application of the Additional Protocol, the SNSA shall, in accordance with the Protocol, continue to report to the IAEA directly.

The Comprehensive Nuclear Test-Ban Treaty

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

Several meetings of workgroups in the framework of the CTBT Organization took place in 2007. The SNSA, together with the Ministry of Foreign Affairs, followed the events in this area.

Export Controls of Dual-Use Goods

In the scope of international activities in this area Slovenia participates in the work of the Nuclear Suppliers Group (NSG) and the Zangger Committee. Our representatives regularly participate in the sessions of both organizations.

On the basis of the Act on Export Controls of Dual-Use Goods a special Commission for Export Controls of Dual-Use Goods, such as goods that can be used not only for civil but also for military purposes (nuclear weapons, weapons of mass destruction), operates at the Ministry of Economy. Representatives of the Ministry of Economy, the Ministry of Foreign Affairs, the Ministry of Defense, the Ministry of the Interior, the Customs Administration, the SNSA, the Slovenian Intelligence and Security Agency and the National Chemicals Bureau constitute the Commission. An exporter of dual-use goods must obtain a permit from the Ministry of Economy, which is issued upon expert findings of the Commission. In 2007 the Commission had 7 regular and 22 correspondence sessions.

Physical Protection of Nuclear Material and Facilities

From July 2006 the application of provisions for two regulations in the area of physical protection of nuclear material and facilities, issued on the basis of the 2002 Act, started. State administrative bodies and nuclear facility operators coordinated their activities with the provisions of both regulations. The operators prepared the plan for physical protection of nuclear facilities and handed it over to the Ministry of the Interior for approval. Following new regulations, additional training of workers performing physical protection of nuclear facilities took place in 2007. The required number of workers performing physical protection of nuclear material during transportation are appropriately qualified. The Inspectorate of the Republic of Slovenia for Internal Affairs performed an inspection of physical protection at the Krško NPP. The commission for performing expert tasks in the field of physical protection of nuclear facilities and materials worked in compliance with its mission. The commission works intensively on the coordination of work of various competent authorities.

Changes of the Penal Code of the Republic of Slovenia were prepared in 2007 and the ratification process of amendments to the Convention on physical protection of nuclear material can now be continued.

The physical protection of fresh fuel transportation for the Krško NPP was performed in 2007. In addition, physical protection of non-irradiated fuel elements from the TRIGA reactor and yellow cake from the Jožef Stefan Institute transportation to France was performed.

Illicit Trafficking of Nuclear and Radioactive Materials

The **Decree on inspection of radioactivity for scrap metal shipments** has been in force since the end of 2007. This decree determines the requirements and rules on radiation safety provisions which have to be considered by the consignee and the organizer of transport and import of scrap metal in the Republic of Slovenia. The purpose of the decree is to prevent overexposure of workers and the general public due to insufficient control over radiation sources of unknown origin, and to prevent high costs of decontamination. Eight organizations were authorized for measuring radioactivity in scrap metal shipments by the end of 2007.

To enable assistance and consultation, the SNSA gave other state offices and private organizations (scrap recyclers, melting facilities) the phone number of a 24-hour on-duty officer. Twelve calls were registered in 2007. Seven calls were due to contamination with natural radionuclides, two were due to unregistered radiation sources. In one case the radiation monitors registered a therapeutic dose of iodine received by a transit passenger travelling from Serbia. There were two truck shipments of scrub metal recorded in 2007. Both shipments were rejected on the Croatian-Slovenian border.

In 2007 the SNSA participated in an exercise called Adriatic Gates. The exercise was carried out at the port of Koper as part of the so-called Proliferation Security Initiative. The purpose of the exercise was to check the operation of Slovenian authorities competent for interception of dangerous shipments of nuclear and radioactive material. It was organized by the Ministry of the Interior, the Ministry of Foreign Affairs, the Ministry of Defense, the Slovene Intelligence and Security Agency, the Customs Administration, the SNSA and the ARAO.

There were about 120 cases of illegal trafficking reported to the IAEA Illicit Trafficking Database in 2007. IAEA estimates that as about 40% of all incorporate criminal activity. About 70 % of all were characterized as found or seized radioactive sources, for which no data on loss, theft or missing was recorded. Concerning nuclear material, the cases mostly involve unauthorized transfer or sale, while with regard to radioactive sources they mostly involve theft or unauthorized disposal.

9 RESEARCH ACTIVITIES

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

Radioactivity of river sediments in Slovenia as the consequence of a global and local contamination

In a research study, comprising 20 main water streams and all bigger polluters in Slovenia, samples of bottom and floating sediments were sampled and analyzed. Sediments are a good indicator of radioactivity contamination; however, they do not contribute much to the radiation exposure of humans.

The highest content of the long-lived fission radionuclide ^{137}Cs in sediments was measured in the Drava river (at Ruše: 47 Bq/kg, at Maribor: 36 Bq/kg), and somewhat lower in the Sava Dolinka river and the Savinja river (20-22 Bq/kg), all being attributed to the high Chernobyl contamination of the Alps. The average contents of ^{137}Cs in Slovenia are mostly between 5 and 15 Bq/kg.

The short-lived ^{131}I was another measured artificial radionuclide, found locally in water streams where liquid effluents from nuclear medicine departments of Slovenian hospitals were discharged. The highest content of ^{131}I was measured in the sediments of the Sava river (upstream the Krško NPP), the Savinja and the Ljubljanica river (5-13 Bq/kg). In rivers such as Voglajna, Paka and Selška Sora, contamination of sediments was caused by the dismissed patients with administered therapeutic doses of ^{131}I.

Elevated contents of some natural radionuclides in sediments, as a consequence of human activities, were found out in the Voglajna river downstream of the zinc factory in Celje (titanium oxide production) with the values for ^{238}U and ^{226}Ra of 92 Bq/kg, ^{228}Ra (62 Bq/kg) and for ^{228}Th (?). In the Paka river, downstream the fly-ash deposit of the Šoštanj coal-powered plant, natural contents of ^{226}Ra were enhanced by a half of its value, but only in floating sediments (61 Bq/kg). The floating sediments in the Poljanska Sora river also have by 20-30 % higher values of ^{238}U in ^{226}Ra than the sediments in the reference Selška Sora river, still indicating the impact of the former uranium mining at Žirovski Vrh. Technologically enhanced natural radioactivity was also observed in the sediments of the Rinža river at Kočevje (content of ^{226}Ra: 75 Bq/kg) and partly in the sediments of the Idrijca river (^{226}Ra: 47 Bq/kg) due to deposited roasted residues of mercury ore). The usual content of radionuclides ^{238}U in ^{226}Ra in sediments of Slovenian surface waters is 25 ±10 Bq/kg.

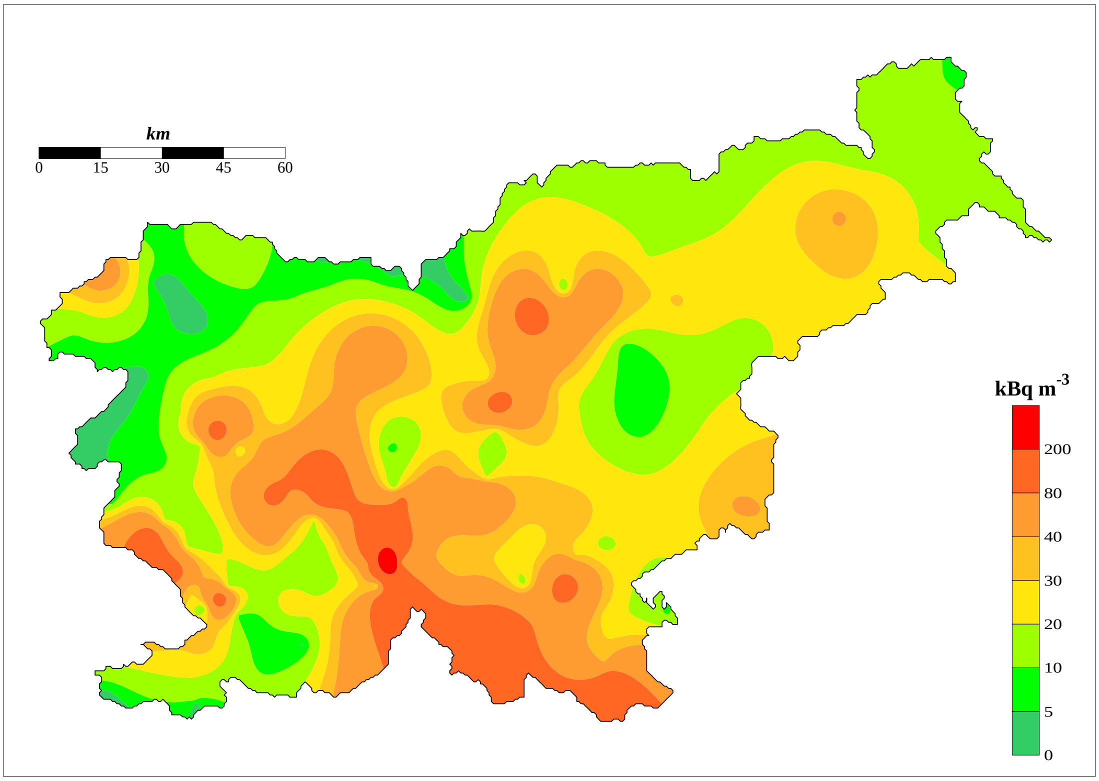
Radon potential in soils in the regions with enhanced indoor radon concentrations

In 2007 the research on radon ^{222}Rn concentrations in soils in Slovenia continued and mostly comprised the regions where in the past high indoor radon concentrations were measured; only in a small part of the programme the measurements were repeated at locations from the previous year. The measuring points were predominantly selected on the Carstic carbonated soils and along the tectonic faults.

The results showed that repeated measurements on the same locations were by a factor of 1.9 higher than in the previous year: the mean value in 2007 was 35.3 kBq/m^3, while in 2006 it was 19 kBq/m^3. The reasons for these higher and more realistic values were normal moisture and normally aerated soil because the measurements were carried out in a period of low rainfall. The analysis of the results showed that the highest values most probably exceed the value of 300 kBq/m^3. The geometric mean of the results was 31 kBq/m^3, while the arithmetic mean was 45 kBq/m^3.

More condensed measuring locations on the regions with previously ascertained high concentrations of indoor radon showed a more reliable situation of radon potential in this part of Slovenia. The map of soil radon is well harmonized with the map of indoor radon. In both cases the highest values were found in the south-western part of Slovenia, on carbonates (Figure 19). The high concentrations of soil radon could be explained also with the courses of numerous tectonic faults within this region.

Figure 19: Map of radon potential in soil in Slovenia (joint results from the 2006 and 2007 research).



Concentrations of natural and artificial radionuclides in the Slovenian Sea

Radioactivity measurements of the sea comprised samples of sea water, sediments, fish and mussels. Fish and mussels were sampled in the spring and in the autumn in the Gulfs of Koper and Piran.

Researchers from the Jožef Stefan Institute estimated that the contents of measured natural and artificial radionuclides in the samples of water, sediments, fish and mussels were low. The concentration of the ^{137}Cs radionuclide in sea water in the middle of the bays was 3 Bq/m^3 and 3.6 Bq/m^3, which is quite comparable with the results in the Italian and the Croatian part of the Adriatic Sea. In the sediments from the middle of the Gulf of Piran the samples' contents of ^{238}U 18 Bq/kg were considerably lower than at the Izola coast (120 Bq/kg), while the results for ^{226}Ra were even lower and more uniform: 19 in 23 Bq/kg. Higher values were measured for the ^{210}Pb radionuclide, i.e. 71 Bq/kg in the Gulf of Piran and 86 Bq/kg at Izola. Radionuclide content of ^{137}Cs in the sediments varied between 3 and 7 Bq/kg.

Radionuclide contents in fish and mussels were of two orders of magnitude lower. Radionuclide ^{137}Cs was measured in *Mugil cephalus* at 0.05 Bq/kg and the same results were obtained for the mussels *Mytillus galloprovincialis* (0.05 Bq/kg), while in the *Sardina pilchardus* fish twice as much of it was found (0.1 Bq/kg). Radionuclide ^{226}Ra was present in both fish species with about 0.5 Bq/kg, and with equal content also in *Mytillus galloprovincialis*. Radionuclide ^{210}Pb was measured in a little higher content in fish (about 1 Bq/kg) and mussels: in *Mytillus galloprovincialis* about 3 Bq/kg and in *Ostrea edulis* 1.6-4 Bq/kg. By far the highest content was measured for the radionuclide ^{210}Po, which is distributed especially in soft tissues. For both mussel species the values in the samples from October 2007 exceeded 100 Bq/kg. Uptake of polonium in mussels is extraordinarily high: according to the data taken from the literature the ratio between the concentrations in tissue and water varies from some 1000 to some 10,000. Researchers have also reported the exposure estimate: at an annual consumption of 5 kilograms of sea food the adult member of the public receives an effective dose of about 0.1 mSv due to ^{210}Po.

Targeted research programme "Competitive position of Slovenia in 2006–2013« - providing radiation and nuclear safety

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

Five long-term joint projects were selected:

1. Use of methods and techniques for ageing assessment and for nuclear safety assurance in nuclear and radiological objects (Institute for Metal Constructions, the Jožef Stefan Institute and the Institute for Materials and Technologies),
2. Improvement of nuclear safety using a probabilistic safety analysis (Jožef Stefan Institute),
3. Using reference benchmarks for managing nuclear facilities (Jožef Stefan Institute),
4. Importance of characteristics of natural and non-natural barriers for radiation waste disposal and spent fuel disposal (Slovenian National Building and Civil Engineering Institute),
5. Tracing of tritium in the vicinity of the NPP Krško (Jožef Stefan Institute).

The research projects are financed by the SNSA and the Slovenian Research Agency. The contractual obligations for 2007 were entirely fulfilled. Work of the research project contractors was assessed as good, and consequently continuation of project implementation and its financing is planned for 2008.

10 INTERNATIONAL CO-OPERATION

10.1 The International Atomic Energy Agency

The successful co-operation with the International Atomic Energy Agency continued. From September 2005 to September 2007 Slovenia was a member of the Board of Governors, which is the main policymaking body in the period between (?) two regular sessions of the IAEA's General Conference. As always, the Slovenian delegation attended the regular session of the General Conference.

Slovenia and the International Atomic Energy Agency closely cooperated in the following fields:

- Within the programme of technical co-operation in 2007 Slovenia received 20 applications for training of foreign experts in our country. 10 applications out of 20 were implemented in the same year, as well as 2 applications from the previous years. 1 IAEA application was rejected by Slovenia while 9 applications approved by our country will be implemented in 2008.
- Within technical co-operation in 2007 Slovenia submitted 2 new proposals for research contracts. 10 research contracts were going on, and 2 of them were completed in 2007. These research contracts had been signed between the IAEA and Slovenian organizations already in the previous years.
- In 2007, Slovenia submitted 4 new national technical assistance projects for the new cycle 2009–2011. 3 new technical assistance projects for the cycle 2007-2008 started with their activities, 3 projects were completed and 1 technical assistance project was rejected by the International Atomic Energy Agency.
- Slovenia continues with its active policy of hosting activities organized by the IAEA. In 2007, Slovenia hosted 6 regional workshops, training courses and seminars.
- In 2007, 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 September 2006, the Board of Governors of the International Atomic Energy Agency unanimously elected Dr. Ernest Petrič as chairman until the next General Conference in September 2007. Until September 2007 the Board of Governors met at four regular meetings and at a meeting of the Board of Governors' Programme and Budget Committee. In the period of ambassador Petrič's chairmanship, Dr. Andrej Stritar, the Director of the Slovenian Nuclear Safety Administration, managed the Slovenian delegation in the Board of Governors.

10.2 Organization for Economic Co-operation and Development – Nuclear Energy Agency (OECD/NEA)

The Nuclear Energy Agency (NEA) is a specialized agency within the Organization for Economic Co-operation and Development (OECD), based in Paris, France. 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 NEA Secretariat serves seven specialized standing technical committees under the leadership 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 member country experts.

Due to the fact that Slovenia is not a full member of the OECD, Slovenian experts have an observer status, which grants Slovenia access to almost all information. In 2007 Slovenia was invited to become a full member of the OECD. The Slovenian representatives have to continue with their successful work, so that Slovenia can also become a full member of the NEA when the OECD Council considers its request for NEA membership.

10.3 Co-operation with the European Commission

Working Party on Atomic Questions (ATO)

In the first half of the year the focus of the German Presidency was on the so-called »consultation process«, which dealt with the conclusions of the Working Party on Nuclear Safety (WPNS), which finished its term of office at the end of 2006. This process had brought consensus of Member States about how to proceed after WPNS. It was decided that a High Level Group (HLG) should be established, consisting of high level representatives from all Member States, to continue the work of WPNS with particular attention on harmonization of nuclear safety.

In the second half of the year, under the Portuguese Presidency, the main achievements and topics on the agenda were approval of the revised ESA (Euratom Supply Agency) Statute, agreement on partnership between Euratom and IAEA on safeguards, ratification of the amended Paris Convention in Member States and preparation of Euratom for the fourth Review Meeting of Contracting Parties under the Convention on Nuclear Safety.

Nuclear Energy Forum

The March European Council (Meeting of Presidents or Prime Ministers of the Member States) agreed with the proposal to organize a wide exchange of information, positions, concerns between all stakeholders on pros and cons of nuclear energy. The Governments of the Czech Republic and Slovakia offered to jointly host a Nuclear Energy Forum. In November the initial meeting took place in Bratislava.

Preparation for the Slovenian EU Presidency

2007 was the last year before the Slovenian EU Presidency in 2008. Among the main activities, which started in 2006 and were finished in 2007, were: assignment of duties to persons having an active role during the Presidency and training for those persons. The other important activities were: preparation of the programme of multilateral events, updating the "inherited" agenda in the area of nuclear safety and setting a new web page of the Ministry of Environment dedicated to the Presidency.

Establishment of a High Level Group for Nuclear Safety

In October 2006 the initial (kick-off) meeting of a High Level Group on Nuclear Safety and Radioactive Waste Management (HLG) was held in Brussels. The initiative to establish this group stemmed from the Council of the EU, and the European Commission was responsible for the establishment of such a group. The main task of HLG is to make a proposal to the Council and the European Parliament on how to regulate the area of nuclear safety in the EU.

This was the first meeting of high level representatives in the area of nuclear safety (mostly heads of regulatory bodies) from all 27 Member States, and the consensus on the permanent President of the HLG was not achieved. Sweden proposed to elect the Slovenian representative Dr. Andrej Stritar as the interim President and this proposal was adopted. The meeting decided to adopt HLG conclusions by consensus, and the interim president got the assignment to prepare the first draft of the HLG work programme by the next meeting in January 2008.

Consultative Committees of the European Commission

At the end of 2006 the Consultative Committee Phare/Tacis ceased to exist. The Consultative Committee Instrument for Nuclear Safety Co-operation (INSC) was established instead of it, but with its scope extended to all third countries and not only to the candidate countries and the Commonwealth of Independent States (CIS). The aim of the INSC Consultative Committee is to advise the European Commission on issues with regard to assistance to third states in the area of nuclear and radiation safety.

The Consultative Committee Euratom-Fission considered the technological platform "Sustainable Nuclear Energy".

10.4 Co-operation with other Associations

Western European Nuclear Regulator's Association (WENRA)

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

In 2007 Member State representatives met twice. They approved activities with regard to reference levels (i.e. informal nuclear power plants safety standards). All WENRA members committed themselves to harmonize their legislation with these reference levels by 2010. The above mentioned High Level Group on Nuclear Safety and Safe Management of Spent Fuel and Radioactive Waste brought an important incentive to WENRA activities, since the mandates of both groups overlap to a certain extent.

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

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

At the regular annual meeting in the Netherlands, the state representatives presented news in the regulatory area, maintenance and development of national nuclear safety competences and management of Safety Culture, highlighting the changing ownership structure of nuclear facilities. One of the topics was also the impact of a new nuclear build on the Regulatory Body and the associated challenges.

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. In October 2007 the International Conference »Nuclear Inter Jura 2007« took place in Brussels, attended by more than 400 experts from all over the world.

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.

Convention on Nuclear Safety – The Fourth Review Meeting

The date for the Fourth Review Meeting of Contracting Parties of the Convention on Nuclear Safety was determined to be from 14 to 25 April 2008 in Vienna at the IAEA Headquarters, pursuant Art. 20 of the Convention. The Slovenian Nuclear Safety Administration started preparations for the review meeting early in 2007. Seven months before the review meeting Slovenia handed over its national report on the steps taken and measures adopted to fulfill its obligations stemming from the Convention. In the subsequent months Slovenia reviewed the national reports of many Contracting Parties and exchanged with them written questions and answers.

Bilateral Co-operation

The quadrilateral meeting with the Czech Republic, the Slovak Republic and Hungary was organized in April 2007 in Portorož. The meeting agenda focused on recent developments in the regulatory bodies, discussion on events of interest at nuclear power plants and international co-operation.

In September a topical quadrilateral meeting was held in Budapest on issues related to regulatory overview of organizational changes in NPPs. The main topics were questions of ownership, reorganization of NPPs, adaptation to the market situation, changes in management in general and organizational changes in NPPs, safety culture issues and regulatory interaction with stakeholders.

In the bilateral meeting with Croatia both delegations presented recent developments in the field of nuclear safety. Croatia is actively preparing to join the EU. The European Commission approved co-financing of two projects: RODOS and modernization of the early warning network.

At the 9th bilateral meeting between Slovenia and Austria both sides described the main developments in the field of legal framework and administration, radiation monitoring, emergency preparedness, waste management and research reactors.

Intergovernmental Agreement on Co-ownership of the Nuclear Power Plant Krško

Operation of the NPP Krško in 2007 was in compliance with the adopted economic plan for 2007. Long-term investments were approved, the electricity price was determined by mutual consent, the personnel policy was harmonized and payment was made modally. Regular and comprehensive fulfillment of financial obligations by both investors ensured a high level of the plant's availability and safety. The bodies of the Krško NPP - the assembly, the supervisory board and the management - are composed based on the parity and act within the framework set by 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«). The Krško NPP assembly had three meetings; it adopted the Annual Report and elected the members of the supervisory board.

The supervisory board approved the decisions essential for the effective operation of the nuclear installation in due time. There were five regular meetings. The supervisory board followed the conduct of business and controlled the management of the Krško NPP. The management led business in line with the agreement on establishment of the Krško NPP and acted unanimously in decisions on the business policy, and was independent in its legal and operative business. The Intergovernmental Agreement provides, in the third paragraph of Article 11, that both contracting parties shall pass, within twelve months after entry into force of the agreement, adequate regulations to ensure the financial means for financing the expenses for decommissioning and for the disposal of radioactive waste and spent fuel. Each party shall regularly pay the financial means in its own special fund in the amount established by the NPP Krško Decommissioning and Disposal of Radioactive Waste Management and Spent Fuel Programme (hereinafter referred to as the Decommissioning Programme). Slovenia has its own Decommissioning Fund for the NPP Krško and the Gen-energija d.o.o. pays in the Fund on the regular basis for each kWh of electrical energy supplied by the NPP Krško.

On 3rd October 2007 the Croatian Parliament adopted the Act on the Krško NPP Decommissioning Fund and Radioactive Waste and Spent Fuel Management (Croatian Act on Decommissioning). The balance of the Croatian Decommissioning Fund was 34.1 mio EUR on 1st October 2007. The Croatian Power Company (Hrvatska elektroprivreda d.d. - HEP) should have begun with regular payments into the Croatian Decommissioning Fund in 2004. In 2006 the HEP began paying as stated in the Decree of 2006 into a separate account of the Ministry of Economy, Work and Entrepreneurship within the state budget. After the Croatian Decommissioning Fund had been established, the funds from this account were transferred to the Fund. In the next five years the HEP shall make up for the accumulated delay in 2004 and 2005 in paying to the Fund. The Decommissioning Programme is updated every five years and in the next revision the actual balance of the funds will be taken into account and compared to the final amount to be paid. By this updated data the new levy of each contracting party to be paid for each kWh supplied by the Krško NPP shall be re-calculated.

10.6 Use of Nuclear Energy World-wide

At the end of 2007 there were 31 countries operating 439 nuclear reactors for electricity production. In 2007 three new nuclear power plants were put in operation in India, China and Romania, with the total installed electric power of 1875 MW. Construction of six new nuclear power plants also started, two in China, two in the Republic of Korea, one in France and one (floating NPP) in Russia. In the USA after a longer break the construction of one NPP continued and the construction of another NPP was stopped.

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

In developed countries, interest in nuclear energy is again noticeable. In the USA the number of construction permit applications has been increasing, and in the UK an ambitious building programme for new NPPs has been announced.

Table 10: Number and Installed Power of Reactors by Countries

Country	Operational		Under construction	
	No.	Power [MW]	No.	Power [MW]
Belgium	7	5,824		
Bulgaria	2	1,906	2	1,906
Czech Republic	6	3,619		
Finland	4	2,696	1	1,600
France	59	63,260	1	1,600
Lithuania	1	1,185		
Hungary	4	1,829		
Germany	17	20,470		
Netherlands	1	482		
Romania	2	1,300		
Russia	31	21,743	6	3,839
Slovakia	5	2,034		
Slovenia	1	666		
Spain	8	7,450		
Sweden	10	9,014		
Switzerland	5	3,220		
Ukraine	15	13,107	2	1,900
Great Britain	19	10,222		
Europe total:	197	170,027	12	10,845
Argentina	2	935	1	692
Brazil	2	1,795		
Canada	18	12,589		
Mexico	2	1,360		
USA	104	100,582	1	1165
America total:	128	117,261	2	1,857
Armenia	1	376		
India	17	3,782	6	2,910
Iran			1	915
Japan	55	47,587	1	866
China	11	8,572	6	5.220
Korea, Republic of	20	17,451	3	2,880
Pakistan	2	425	1	300
Taiwan	6	4,921	2	2,600
Asia total:	112	83,114	20	15,691
South Africa	2	1,800		
World total:	**439**	**372,202**	**34**	**28,393**

Reference: International Atomic Energy Agency

10.7 Radiation Protection and Nuclear Safety World-wide

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

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

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

Twenty seven INES reports on nuclear events were received by the IAEA NEWS in 2007. Nine reports were on events in nuclear power plants, five of them related to the same event, the remaining 18 on damage of fuel elements in a research reactor (1 report), exceeded dose levels due to use of radioactive sources (5 reports), use of radiation sources in medicine (4 reports), lost or stolen radiation source (2 reports), source found in scrap metal (2 reports), contaminated consumer goods (1 report) and on operation outside limits and conditions at a former mixed oxide fuel facility (1 report).

One event in a nuclear power plant was rated as level 2 – *incident*, one as level 1 – *anomaly* and three as level 0 – *deviation/ no safety significance*. The reports were related to earthquakes close to nuclear power plants (5 reports), irregular performance of control rods (1 report), steam generator tube leakage (2 reports), and to reactor scram due to inadvertent opening of multiple SRV's (1 report).

The events outside the nuclear power plants were rated: one as level 3 – *serious incident*, 9 as level 2 – *incident*, four as level 1 – *anomaly*, one as level 0 - *deviation/ no safety significance* and three were not rated.

It can be concluded from the reports that the management of the radioactive sources which are widely used in industry and the control thereof are deficient in the world, and that often workers using the sources are exposed over the regulatory limits, and that often a source is lost during transport or stolen. It is evident that control over scrap metal has improved, since in the last two years the number of reports on sources found in scrap metal has decreased.

The events which were reported to NEWS in 2007 did not have any strong impacts on the environment. In five cases radiation workers received doses higher than the prescribed limit but this did not result in any lasting health effects. In three cases, in Belgium and France, the patients, due to a deviation of radiation therapy beam used in stereotactic radiosurgery in the hospitals, were improperly treated.

Slovenia did not report any event to NEWS in 2007 since there were no reports satisfying the criteria for reporting.

The most serious event in a nuclear power plant occurred in Japan. On 16 July, the region of the seven units at NPP Kashiwazaki-Kariwa was struck by an earthquake with its epicentre about 16 km north of the site. The magnitude of the earthquake was 6.8 on the Japanese Scale. Out of seven units, three were in operation, one was in start-up while the other three were in shut-down conditions for planned outages. The earthquake caused automatic shutdown of the operating reactors. The established ground motion significantly exceeded the design basis ground motion. The automatic shutdown of the operating reactors and the reactor in start-up proceeded without any problem and all the safety systems behaved in a satisfactory manner, during and after the earthquake. The three fundamental safety functions of (a) reactivity control, (b) removal of heat from the core and (c) confinement of radioactive materials were ensured. A small quantity of radioactive material was released to the environment, but the assessed doses to the public were well below the authorized limits.

The safety related structures, systems and components survived the earthquake, and they seem to be in a much better condition than expected. The economic damage on the facility was tremendous, since a long time will be needed to prepare the units for restart.

In the last few years several accidental overexposures of industrial radiographers have been noted. In 2007 three events were reported to NEWS where several radiographers received assessed doses in excess of the regulatory limits. The highest assessed dose of 718 mSv was received by a worker in Spain, and in the USA two workers received doses of 440-550 and 130 mSv respectively. Medical examinations showed no immediate health problems, but the events indicate a deterioration of safety culture.

11 LIST OF ORGANIZATIONS AND THEIR INTERNET ADDRESSES

Organization	**Internet Address**
Agency for Radioactive Waste	http://www.gov.si/arao
Milan Vidmar Electric Institute	http://www.eimv.si
ENCONET Consulting	http://www.enconet.com
Faculty of Electrical Engineering and Computing, University of Zagreb	http://www.fer.hr
Faculty of Mechanical Engineering, University of Ljubljana	http://www.fs.uni-lj.si/
IBE Consulting Engineers	http://www.ibe.si
Jožef Stefan Institute	http://www.ijs.si
Energy Institute	http://www.ie-zagreb.hr
Welding Institute	http://www.i-var.si
Institute of Metals and Technologies	http://www.imt.si
Institute of Metal Constructions	http://www.imk.si
International Atomic Energy Agency	http://www.iaea.org
Ministry of Agriculture, Forestry and Food	http://www.mkgp.gov.si/
Ministry of the Interior	http://www.mnz.gov.si/
Ministry of the Environment and Spatial Planning	http://www.mop.gov.si/
Ministry of Health	http://www.mz.gov.si/
Krško Nuclear Power Plant	http://www.nek.si
OECD Nuclear Energy Agency	http://www.nea.fr
Žirovski Vrh Uranium Mine	http://www.rudnik-zv.si/
United States Nuclear Regulatory Commission	http:/www.nrc.gov/
Slovenian Nuclear Safety Administration	http://www.ursjv.gov.si/
Slovenian Radiation Protection Administration	http://www.mz.gov.si/
Administration of RS for Civil Protection and Disaster Relief	http://www.sos112.si/slo/index.php
Slovenian National Building and Civil Engineering Institute	http://www.zag.si/
Institute for Occupational Safety	http://www.zvd.si/

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[9] NEK, Posebno poročilo o odstopanju št. 3/2006, št. 39010-5/2007/5.

[10] URSJV zaključno poročilo 3/07, št. 39010-5/2007/6/49.

[11] Letno poročilo NEK 2007, februar 2008.

[12] NEK, Posebno poročilo o odstopanju št. 3/2006, št. 39010-5/2007/5.

[13] URSJV, zaključno poročilo 3/07, št. 39010-5/2007/6/49.

[14] NEK, Posebno poročilo o odstopanju št. 4/2007, št. 39010-5/2007/7.

[15] URSJV, Zaključno poročilo 4/07, št. 39010-5/2007/8/16.

[16] NEK, Poročilo o tujkih v uparjalniku SG2 in popravnih ukrepih, št. 39010-7/2007/1.

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