



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

ANNUAL REPORT 2005
ON THE RADIATION AND NUCLEAR SAFETY
IN THE REPUBLIC OF SLOVENIA



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June 2006

Prepared by the Slovenian Nuclear Safety Administration in cooperation with:

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

The report was confirmed by the Expert Council for Radiation and Nuclear Safety on 25.5.2006.

June 2006

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URSJV NUMBER: URSJV/RP-066/2006

ISSN NUMBER: ISSN 1580-0628

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1. INTRODUCTION

The year 2005 was without major problems in the area of protection against ionizing radiation and nuclear safety in Slovenia. There were no events that would present radiological threat to the population.

The Nuclear Power Plant operated during the whole year without a refueling outage. The last such outage took place in September 2004. This was the first 18 months long fuel cycle, so the next refueling outage is foreseen for spring 2006. Because there was no outage break, the plant achieved a record 5.9 TWh production of electrical energy. There were three unplanned plant shutdowns during the year. The reason for the first automatic trip was a mistake during the testing of the main steam isolation valves. The second manual trip was necessary because of the breaking of the smaller pipe at the secondary side of the plant. The plant had to be shut down manually the third time due to the need to enter the containment and repair the bearing of the ventilation system. During the shutdowns there was no unnecessary radiological burden either to employees or to population. There were 10 unusual events registered during the year, which is more than in previous years. In most cases the reasons were failures of the equipment. The plant personnel is trying to correct the causes for these events. These are mostly connected with the ageing of the equipment.

In the middle of the year the Central interim storage for radioactive waste at Brinje close to Ljubljana got the license for trial operation. The Žirovski Vrh uranium mine got the license for final closure of the Jazbec mill railings pile.

The monitoring of radiological contamination of the environment and population in Slovenia did not show any deviation from normal values. There were no significant anomalies in the use of sources of ionizing radiation in industry and medicine.

The Agency for radwaste management continued the procedure for the selection of the site for final disposal of low and intermediate level radioactive waste. Eight local communities showed interest to host such a facility, while the Government of Slovenia selected three of them (Brežice, Krško and Sevnica) for further site investigations.

As the detection of orphan sources in the shipments of scrap metals continued to be a problem, the Government of Slovenia formed a special programme for reduction of risk from such events. In addition, the inspection enforcement has improved the situation in the field and uncontrolled sources have either been put under proper control or transferred to the Central interim storage of radioactive waste.

As decreased interest for nuclear activities needed for maintaining nuclear safety is becoming a serious long-term problem, a special working group of the Government of Slovenia has prepared measures to improve the situation.

Professionals in the field of nuclear safety in Slovenia are closely connected with the international community. In the spring of 2005, the Slovenian report was successfully presented at the reviewing meeting under the Convention on nuclear safety. Representatives of Slovenia are active in bodies of the European Union, in the committees of the Nuclear Energy Agency of OECD and in the West European Nuclear Regulator Association. In the fall of 2005, Slovenia became a member of the Board of Governors of IAEA for the period of two years.

This report contains the 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 the extended version is prepared (Ref. 1) consisting of all the details and data which would be of interest to a narrower group of professionals. It is available in electronic form on a CD-ROM or at the homepage 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 2005 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 2005, the Krško Nuclear Power Plant (NEK) produced 5,884,252.1 MWh (5.9TWh) gross electrical energy on the output of the generator, which corresponds to 5,613,655.1 MWh net electrical energy delivered to the grid. The annual production was 1.06 % more than planned. The reactor was critical for 8,696.88 hours or 99.28 % of the total number of hours in the year 2005. The thermal energy production of the reactor was 15,495,640.5 MWh.

The most important performance indicators are shown in Table 1, and their changes through 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 2005

Safety and performance indicators	Year 2005	Average (1983-2005)
Availability [%]	98.90	84.64
Capacity factor [%]	97.69	81.29
Forced outage factor [%]	1.10	1.23
Realized production [GWh]	5,884.25	4,696
Fast shutdowns – automatic [Number of shutdowns]	1	2.96
Fast shutdowns – manual [Number of shutdowns]	1	0.35
Unplanned normal shutdowns [Number of shutdowns]	1	1.00
Planned normal shutdowns [Number of shutdowns]	0	0.78
Number of events	10	4.13
Refueling outage duration [Days]	0	49.4
Fuel reliability indicator (FRI) [GBq/m ³]	$1.37 \cdot 10^{-3}$	$8.83 \cdot 10^{-2}$

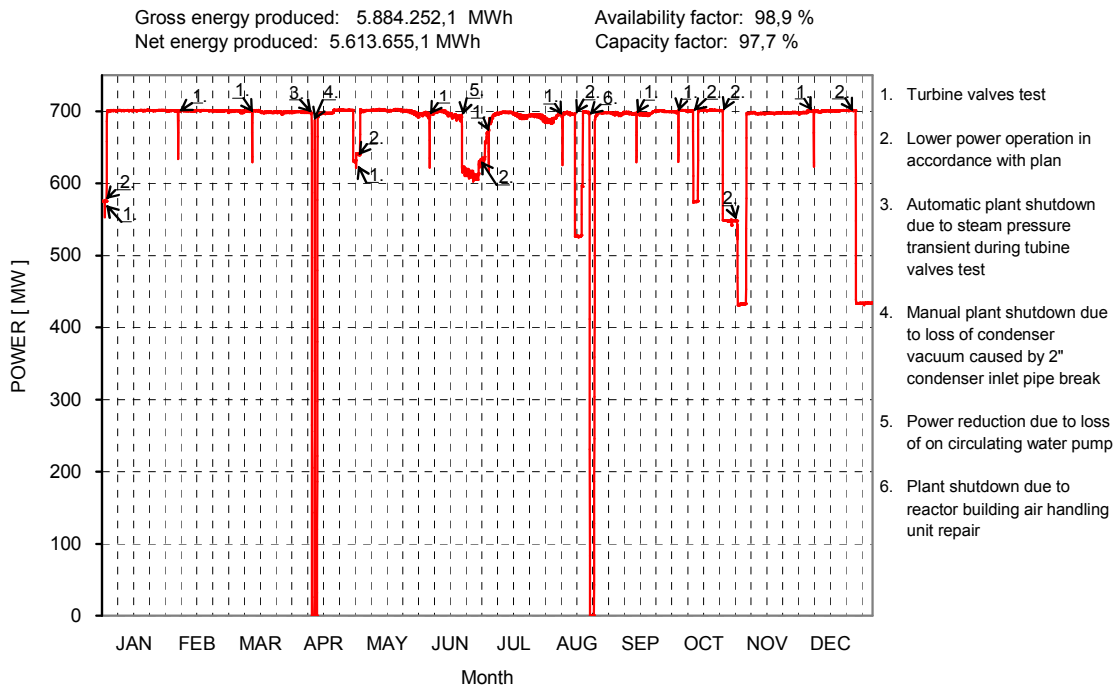
In 2005, there were three shutdowns in the Krško NPP. They are described in Table 2 and shown in the operating power diagram for the Krško NPP, in Figure 1. As the diagram shows, the power plant operated at reduced power in June due to the loss of one

condenser cooling pump. In addition, the power plant operated at reduced power due to a dispatcher request for lower power operation in April, May, August, October, November and December.

Table 2: Shutdowns of the Krško NPP in 2005

Date	Duration [h]	Type	Mode	Cause
10. 4.	27.2	fast	automatic	Automatic plant shutdown due to steam pressure transient which occurred during the turbine valves test
11. 4.	20.8	fast	manual	Manual plant shutdown due to loss of condenser vacuum caused by 2-inch pipe break
20. 8.	48.4	normal	unplanned	Unplanned plant shutdown due to corrective maintenance of containment ventilation unit

Figure 1: Operating power diagram for the Krško NPP in 2005



In Figure 2, the production of electrical energy is presented for the years of commercial operation. In the year 2005, the plant operated without outage, so the production of electrical energy was proportionately higher and it reached a record value of 5.61 TWh.

In Figure 3, a comparison is shown for the production of electric power in Slovenia in nuclear, hydro and thermal power plants for the year 2005.

Figure 2: Production of electricity in the Krško NPP

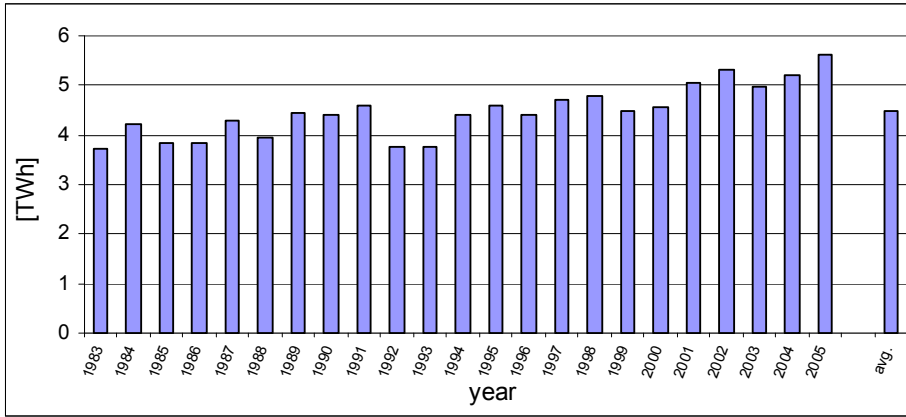
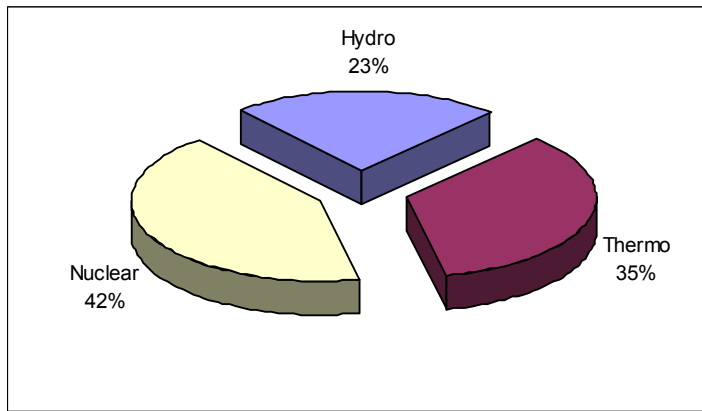


Figure 3: Comparison between different electrical energy producers in Slovenia for the year 2005



In Figure 4, the capacity factor is presented. In 2005, due to the 18 months fuel cycle there was no outage and the capacity factor reached its highest value ever, that is 97.69 %. The capacity factor is used world-wide as the main indicator of successful operation of the power plant.

Figure 4: Capacity factor at the Krško NPP

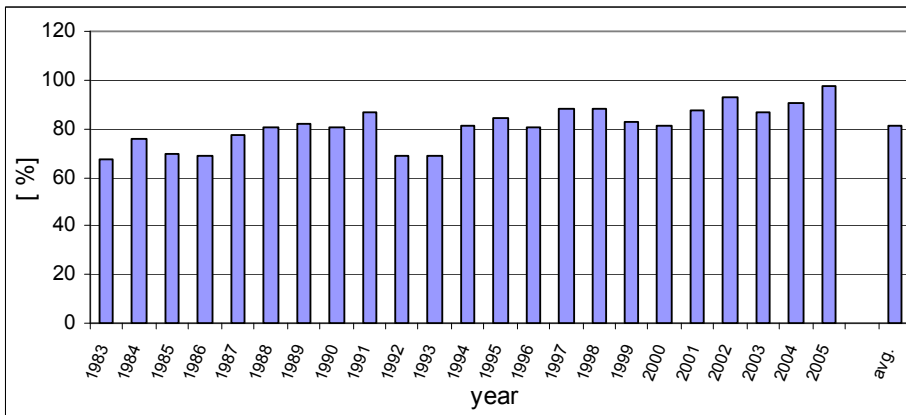
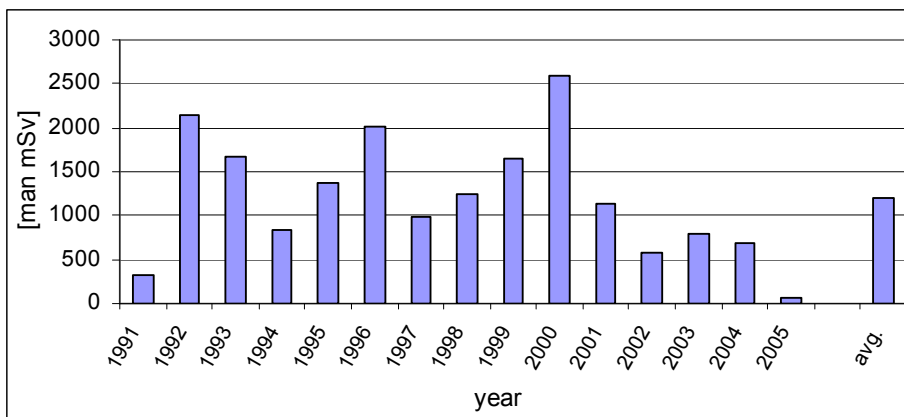
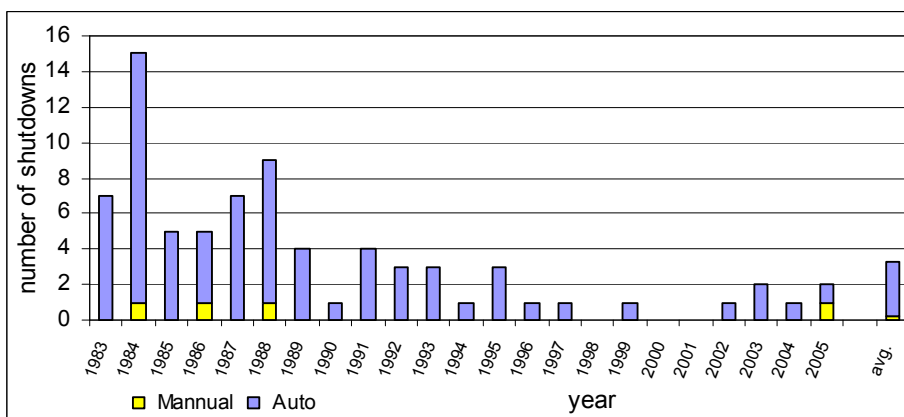


Figure 5: Collective exposure to radiation in the Krško NPP

The collective exposure to radiation is shown in Figure 5. For 2005 it was 72.4 man mSv, which is below the target value of INPO¹ (650 man mS) and below the target value of NEK (140 man mSv for the year 2005). The low value of the collective exposure to radiation is a result of fuel cycle extension and absence of outage, which contributes the most to this indicator.

In Figures 6 and 7, the number of reactor shutdowns is shown.

Figure 6: Fast reactor shutdowns – manual and automatic

There are two types of reactor shutdowns: fast and normal. Fast reactor shutdowns are caused by 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 normal, planned reactor shutdown.

In the year 2005 there were two fast shutdowns, one automatic and one manual, which is below the average, but higher than the last 10 years average.

In the year 2005 there was one normal unplanned shutdown.

¹ INPO is abbreviation for Institute of Nuclear Power Operations

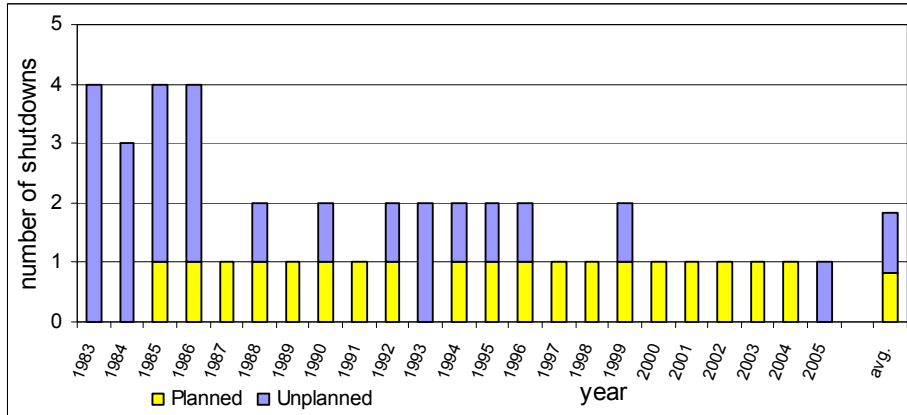
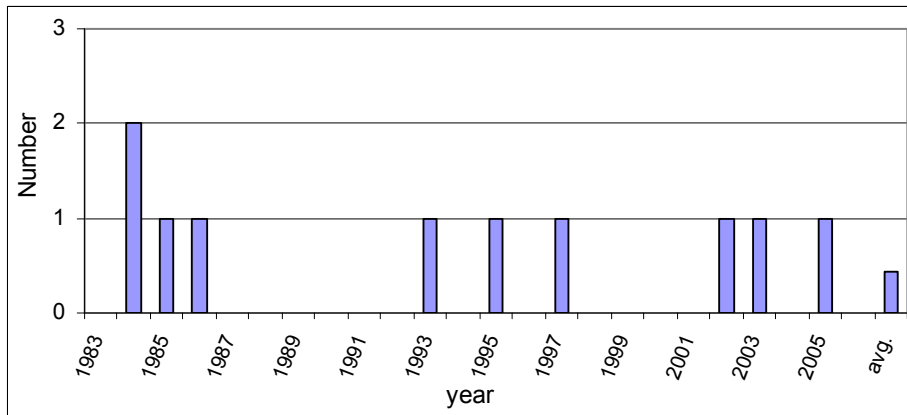
Figure 7: Normal reactor shutdowns – planned and unplanned

Figure 8 shows the number of unplanned actuations of the high pressure safety injection system. In the year 2005 there was one unplanned actuation, which occurred during the monthly turbine valves testing. The total number of actuations, from the beginning of commercial operation, is 10.

Figure 8: Number of unplanned safety injection system actuations

In Figure 9, the inoperability factor of the safety injection system is presented. Inoperability factors show preparedness of important safety systems to assure their function at the time of normal operation, as well as in the case of an incident.

In 2005 the value of the inoperability factor of the safety injection system was 0.0013973, which is higher than the last two years. This increment is caused by the absence of outage, due to which the extent of on-line maintenance and unavailability of equipment has increased. The target value of INPO is 0.020 and the target value of the Krško NPP is 0.005. The values of this factor were also in the past much lower than the target values.

Besides the inoperability factor of the safety injection system, we also keep track of the inoperability factor of the emergency electric power source and the inoperability factor of the auxiliary feedwater system. The values of these two factors did not increase in the year 2005.

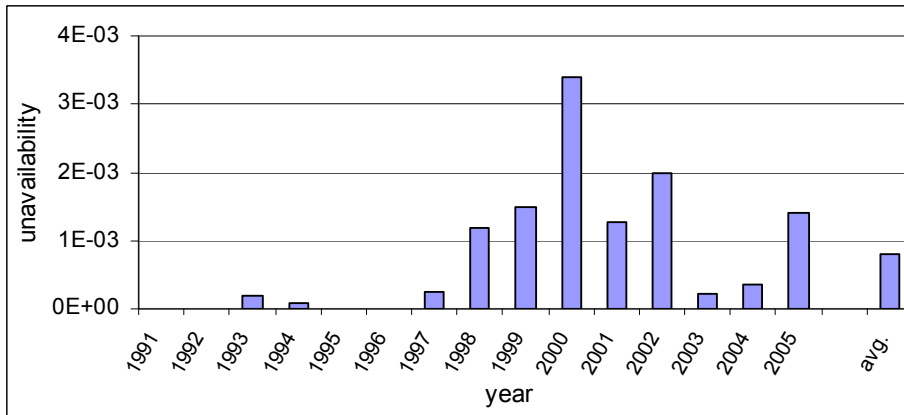
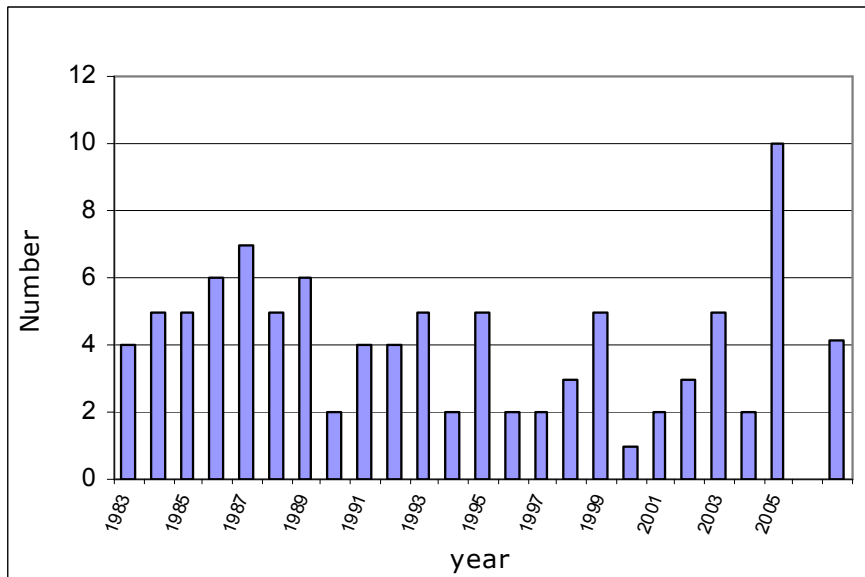
Figure 9: Inoperability of safety injection system

Figure 10 shows the number of abnormal events per year. In the year 2005 there were 10 abnormal events, which is the largest number till now. The Krško NPP is obliged to report to the regulatory body about every event that could reduce nuclear safety, which means it has to report about all unplanned shutdowns, about inoperability of equipment important to safety, and about unsuccessful or unperformed testing (there were more of these in the year 2005 than the year before). Abnormal events are described in detail in Chapter 2.1.1.2.

Figure 10: Number of abnormal events

Risk evaluation due to on-line maintenance

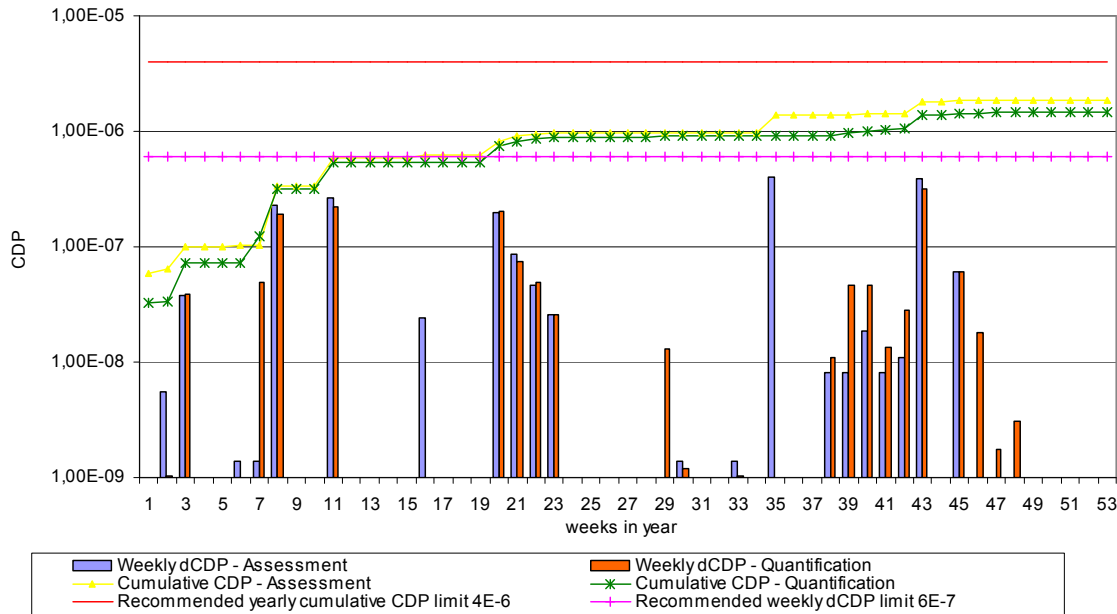
The purpose of on-line maintenance is to shorten the outage time by transposing certain maintenance activities from the outage to full power operation. Also surveillance testing and corrective maintenance can be performed at that time.

A list of components planned for on-line maintenance for the current cycle is prepared at the latest one month after the end of an outage. Working orders for surveillance testing and preventive maintenance are prepared four weeks in advance, while corrective maintenances are planned according to their significance. For all maintenances the increase of core damage probability (CDP) is assessed. CDP is a deciding factor when

deciding if and how the maintenance will be done. There are several limits for CDP values, such as instantaneous, weekly, yearly and rolling average of twelve weeks, which the plant must consider.

In the year 2005 the increase of CDP due to on-line maintenance was $1.45 \cdot 10^{-6}$, while the expected increment of CDP for the whole 21st cycle (till April 2006) was $1.6 \cdot 10^{-6}$. The target value for the yearly increment is $4 \cdot 10^{-6}$ /fuel cycle, which means that the increment for the year 2005 is within the limits. In Figure 11 the assessed and quantified values of weekly CDPs in 2005 are shown.

Figure 11: Weekly core damage probabilities due to On-line maintenance



2.1.1.2. Abnormal events in NPP Krško

In 2005, 10 abnormal events occurred at the Krško NPP. None of these events threatened nuclear or radiological safety.

These events and the proposed actions to correct the consequences of the events were reviewed and assessed by both the SNSA Inspection and the SNSA Division of Nuclear Safety. Five of these events were assessed through an in-depth analysis including a root cause analysis. Three events were analyzed by engineering judgment only.

Reactor shutdown due to a pressure drop in the main steam piping

On 10 April 2005 at 8:00 the regular monthly test of high pressure turbine stop, governor, reheat and interceptor valves began. Prior to the test the reactor power had to be reduced from 99.5 % to 90.5 %. During the test a particular couple of valves (stop and governor valve) is fully closed. To avoid transients the remaining three regulation valves are then temporarily set to a capability of automatic opening up to a maximum value of 160 %. After the first part of the test was completed successfully, the test continued with testing of reheat and interceptor valves. Before that the reactor power had to be increased back to 99.5 % and the stop and governor valves capability of automatic opening had to be reset to the value of 87 %. During that resetting a human error occurred. Instead of setting the value to 87 %, all of the regulation valves were closed down the value of 12 %, which caused a reduction in steam flow to the turbine. A transient of the reactor coolant system occurred and an automatic fast insertion of the control rods started. The reactor operator was unsure about the correct operation of the

control rods, so he switched the regulation of the control rods to the manual mode. This caused a further increase of primary coolant temperature and seven out of ten steam dump valves opened to provide cooling of the primary circuit. At that moment it was noticed that the opening value of the turbine regulation valves was too low and the staff reacted by opening quickly the valves. The effect was a large steam demand by both turbine regulation valves and steam dump valves, and due to a rapid drop of steam pressure in the main steam piping the reactor was shut down in a few seconds and safety injection actuated for approximately 3 minutes until the primary coolant pressure increased again to the proper value.

Nuclear safety was not threatened by this event. All responses of the safety systems were appropriate and no radiological releases to the environment occurred. Restart of the plant was performed the following day (11 April) at 2:02.

The event was analyzed by the Krško NPP and it was concluded that some long-term corrective actions are needed. Education and training of the operators need to be increased, emphasizing the importance of proper human actions. Simulator training should be used for training of routine activities. All procedures with reference to the changing of the value of the stop and governing turbine valves opening should be corrected in terms of pointing out that this is a critical step in performing the test. A modification of the turbine regulation system is planned and the man-machine interface of the main control board should be improved when the modification is installed.

The SNSA performed an in-depth analysis of this event. The results of the SNSA analysis supported the proposed corrective actions of the Krško NPP.

Reactor shutdown due to the loss of vacuum in the condenser hotwell

On 11 April 2005 at 22:28 an unusual noise was heard from the turbine building and the operator in the main control room noticed a level drop of the condenser hotwell. The staff in the turbine building found a steam leak near the seal of low pressure turbine No. 2. Due to the loss of vacuum in the condenser hotwell the operators started both vacuum pumps. Later on two operating feedwater pumps were shut down and the third feedwater pump in standby started. Because of an increased loss of condenser vacuum and continued steam leak, the operator shut down the reactor manually at 22:30.

Nuclear safety was not threatened by this event. All responses of the safety systems were appropriate and no radiological releases to the environment occurred. Restart of the plant was performed the following day (12 April) at 13:07.

A detailed examination found a break on a two-inch pipe located after a damper on a line connected to condenser A. This line is only opened at the plant startup to provide venting of the steam moisture separator. The pipe break was caused by material fatigue due to oscillations which were amplified additionally by the two-phase flow during the startup. Modification of the pipe was already performed in 1999 by adding an additional pipe support. Six other pipes from the lines before and after the damper were also checked since they are subjected to similar operating conditions. Other actions included a repair of two weld positions on the joint of a flange and the damper.

The SNSA performed an in-depth analysis of this event together with the previous event described above. It was found that the corrosion erosion monitoring system of the NPP Krško would not be able to find such a crack in the pipe caused by fatigue. Therefore the SNSA suggested to the Krško NPP to perform a periodic examination of the venting lines in order to discover any cracks that might be caused by material fatigue.

Nonexecution of the supervising test during the forced shutdown on 10 August 2004

On 26 June 2005, the SNSA was informed by the NPP Krško about a non-executed supervising test of the by-pass main steam valves automatic closure using the auxiliary relay. A forced shut down of the plant was performed on 10 August 2004 and the test should have been executed before the plant start-up. Since the period of the plant shutdown was short (approximately 6 hours) it was, in accordance with the procedure,

not obligatory to execute the prescribed 17 supervising tests. However, the supervising test of the by-pass main steam valves should have been executed, but it was not. As until the outage in September 2004 the main steam by-pass valves were closed all the time (therefore in their safe position) the event did not jeopardize the plant's safety.

Due to this event the NPP Krško will improve the emergency procedures and procedures about informing provisions in case of changes in the plant's operating condition.

High temperature in the turbine auxiliary feedwater pump room (triple event)

High temperature was noticed several times in the NPP Krško turbine auxiliary feedwater pump room: on 30 May 2005 (duration of high temperature was 8.3 hours), 23 June 2005 (duration was 139.5 hours) and 22 July 2005 (duration was 184.5 hours). The temperature of 40 °C in minimal duration of 8 hours (which was the case in these events) is considered a high temperature. The highest temperature noted was 49.5 °C.

The problem of high temperature had occurred in the NPP Krško already several times in recent years, mostly in rooms with steam pipes (the limiting temperature is 46 °C) and in the turbine auxiliary feedwater pump room (the limiting temperature is 40 °C). In May 2005 the NPP Krško performed analyses for limiting the temperature to assure safe system operation. The upper temperature limit for some motor valves and pneumatic valves is 49 °C. The conservative value of 40 °C was used and the temperature measuring point was set at the higher part of the room, near the main steam pipe. An extra sensor was positioned near the safety features and its measured values were 4.5 °C lower. This confirms that the environmental high temperature did not affect the safety equipment. The NPP Krško has already improved the functioning of the ventilation units as a corrective action. In addition, directing grids are used for better air distribution. The NPP Krško is planning to cool the rooms by spraying of water mist (as a short-term corrective action). It is planning to modify ventilation and to set the temperature sensor nearer the safety equipment (a long-term corrective action) and considering the change of the limit temperature from 40 on 46 °C. This change, however, would require the administrative procedure of changing technical specifications.

The SNSA made comprehensive analyses of all three events. Additionally, the SNSA is planning to closely follow the implementation of the NPP's suggested corrective actions and to inspect the temperature in the above mentioned rooms.

Inoperable diesel fire protection pump due to over exploitation

Due to gradual degradation of its hydraulic characteristic (since outage 2000) the Krško NPP decided for repair of the diesel fire protection pump on 30 May 2005. . The action plan of repair consisted of two phases: cleaning of the suction basket and changing of the pump in case of unsuccessful result of the first phase. The pump testing, after cleaning of the suction basket, was unsatisfactory, therefore the pump was replaced.

On 27 July 2005, the SNSA found out that the diesel fire protection pump was inoperable and that the Krško NPP had not reported this. After that the Krško NPP send a report of inoperability of the diesel fire protection pump, on 22 August 2005. The SNSA made an analysis of the event and found out that the action plan of repair was not properly reflected in the working order. The working order did not mention that there were two phases of repair. The plant corrective program, dated on 3 March 2005, did not mention pump replacing. On-line maintenance did not contain pump replacing because the pump was replaced with a working order of first priority. The SNSA inspection then gave verbal admonition to the Krško NPP due to its untimely reporting.

Shutdown of the diesel generator

On 7 July 2005, the regular monthly test of the diesel generator was performed. After one hour operating period the revolutions of the diesel generator should be reduced from 750 1/min to 450 1/min. The generator should then operate for 10 minutes at lower revolutions and then stop. During the test the diesel generator stopped without the intermediate 10 minute phase and due to that it was declared inoperable. During the investigation of the failure, the control circuit, the time delay relay and the stop relay

were reviewed. A detailed review of the stop relay in laboratory revealed a tiny foreign body of ferromagnetic material between the anchor of flexible contact and the coil core. The relay had been manufactured with a closed housing, therefore it is likely that the foreign body was inside the relay already since its manufacture. If the relay had broken down during an abnormal event, the shutdown of the diesel generator would not have been possible.

Inoperable diesel fire protection pump due to the failure of the revolutions counter

On 18 July 2005, during the fire protection pump maintenance, an instrument for counting the revolutions broke down. On 20 July the instrument was removed and taken to the workshop for repair. When the head engineer for control testing later saw that the measuring instrument had been removed, the pump was declared inoperable at 15:00. The next day the instrument was repaired and the pump declared operable. The NPP Krško did not report the cause of the instrument's breakdown. The NPP plans to build an automatic controller of revolutions into the fire protection pump. The SNSA made an independent analyses and found out that a SNSA inspection had already discussed a similar event. On 6 January 2005, the NPP gave a corrective order for repairing the same instrument (at that time the test was made using an additional revolution counter). Due to its unreliability, a working order was issued for the same instrument on 1 June 2005. Inoperability was declared 2 days after the time the instrument became inoperable. Among the NPP corrective actions there is no measure that would assure a more reliable workers' response.

Inoperability of air-conditioning in the main control room

On 14 October 2005 from 10:53 till 12:24 inoperability of the main control room air-conditioning was declared. Trains were exchanged after the end of the annual refit of cooling unit B. Train B was loaded and train A unloaded. In the next 30 minutes cooling unit B failed and recovered several times without any alarm or operator action. Inoperability of train B was proclaimed and an unsuccessful attempt to recover train A followed. At this time the alarm of low oil temperature went off. In accordance with the technical specifications, the preparations for power reduction and plant shutdown started within one hour. After 97 minutes train A was successfully recovered and the plant was able to continue operating. Although the cooling of the air-conditioning system had been reduced, interrupted operation of train B helped maintaining low temperature in the main control room.

Investigation of the cause of the alarm showed that the trigger set point of the thermal controller for protection against water freezing was incorrect. The trigger point was 7 °C instead of 5 °C.

Shutdown of the reactor due to repair of a cooling unit of the containment ventilation system

On 18 August the Krško NPP informed the SNSA and the public about a plan to stop the production due to a repair of a cooling unit of the containment ventilation system. Shutdown was necessary to assure safe access and corrective actions on the cooling units in the reactor building. Shutdown was planned for a period of lower consumption of electric energy. The NPP was shut down manually on 20 August 2005 at 3:00 and returned to the electricity net at 3:00 on 22nd August 2006. The planned shutdown did not jeopardize nuclear safety.

The SNSA controlled all activities during the shutdown. The cause of damage of the cooling unit was a damage on the lead bearing. Due to that the housing of the bearing was also damaged. The NPP repaired the damage and examined the bearings of the other cooling units.

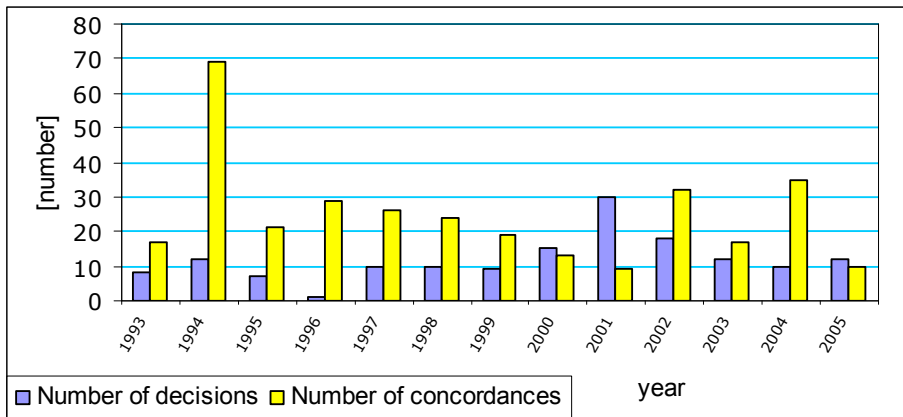
2.1.1.3. Modifications in the Power Plant

Besides the daily overseeing of the nuclear power plant operation, the SNSA paid special attention to overseeing modifications and improvements in the power plant which arise from operational experience, on the basis of world practice and the latest findings in the nuclear field. Changing of the project and design basis of the nuclear facility or the conditions of exploitation of the nuclear power plant are among the most important activities which can influence nuclear safety. Due to this fact all modifications have to be under rigorous control and properly documented.

Following proper administrative procedures, the SNSA approved 12 modifications on the facility, and agreed to 10 other modifications. For 2 modifications, the NPP Krško found out during the preliminary safety evaluation that there was no open safety issue, so it only informed the SNSA about those changes. In the year 2005, the SNSA also approved 4 changes of conditions and limits for operation, which were the consequence of modifications in the power plant. Figure 12 shows the number of approved modifications through the years.

In the year 2005, the Krško NPP issued the 12th revision of the Updated Safety Analysis Report, in which all modifications confirmed until 31 October 2005 were considered.

Figure 12: Modifications approved by concordance or decision



2.1.1.4. Periodic safety review (PSR) in the Krško NPP

In the year 2005, the SNSA approved the final report of the Krško NPP PSR, which lasted from 2001 till 2004. The main finding of the final report is that there are no major safety deficiencies and that the plant operates safely. The report also identifies possible improvements. Most of these improvements are suggested in the maintenance and testing procedures area, control and surveillance procedures for safety related equipment, probabilistic safety assessment and control of material ageing. The SNSA also approved the action plan, which consists of 119 actions which are to be implemented by December 15, 2010. The Krško NPP shall prepare annual reports by every January 30th, containing the implemented action plan improvements for the expired year, until all the recommendations from the action plan are implemented. The Krško NPP shall prepare the report of the next PSR by December 15, 2013.

2.1.1.5. Inspections

During the year 2005, the SNSA Inspection at the Krško NPP carried out 53 planned and two unplanned inspections. After the 2004 outage, the plant passed over to an 18-month cycle, therefore there was no outage in 2005.

Unplanned inspections were carried out after the safety injection actuation and the plant shutdown on 10 April 2005, and after the manual shutdown due to the loss of vacuum in the main condenser and tube rupture on the main condenser on 11 April 2005.

2.1.2. Research Reactor TRIGA

2.1.2.1. Operation

The Reactor TRIGA Mark II of the Jožef Stefan Institute operated in 2005 for 176 days and released 258 MWh of heat. Irradiations were performed in the carousel and F-channels (940 samples), with the pneumatic post (324 samples) and with the fast pneumatic post system (442 samples). In 2005 the Reactor TRIGA was mostly used as a neutron source for neutron activation analysis and material research.

The reactor operated according to the programme approved by the reactor manager and the section for ionizing radiation protection. The reactor operated mostly in stationary mode. In pulse operation mode, 10 pulses were performed. For special requirements of experiments, two core design changes were performed. In the year 2005 there were no abnormal events which could affect nuclear safety and no major failures of reactor components.

In 2005 there were four automatic shutdowns, which is seven less than the previous year. Most of the automatic shutdowns were caused by loss of power supply and local power supply failure. The electronic controller, whose failure was the main source for most of the shutdowns in 2004, was replaced by the reactor operators.

2.1.2.2. Fuel

The number of fuel elements did not change in 2005. By the end of the year there were 94 fuel elements at the site, which were located in the reactor or at the fresh fuel storage. There were no spent fuel elements. The radiation monitoring system in the reactor building and the activity measurement of reactor coolant showed that there were no damaged fuel elements in the year 2005.

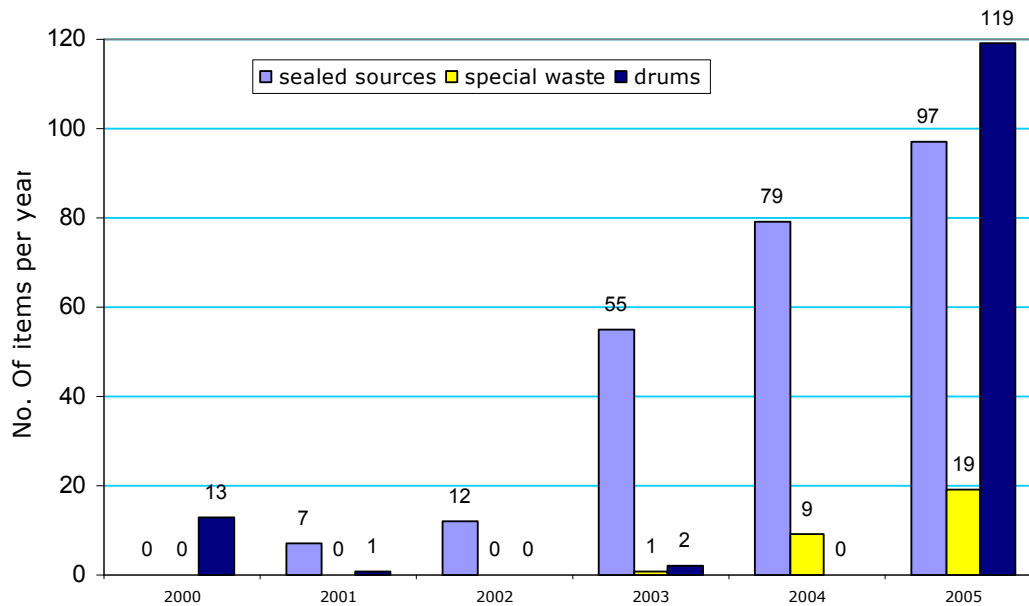
In 2005 the inventory and nuclear material status reporting to the EUROATOM (European Commission) was conducted electronically by the specially protected software installed by the EUROATOM. The Jožef Stefan Institute is obliged to report monthly about the fuel and other nuclear material status to the EUROATOM and also to the IAEA.

2.1.3. The Central Interim Storage for Radioactive Waste at Brinje

The Central interim storage for radioactive waste at Brinje (CISRW) is operated by the Agency for Radioactive Waste Management (ARAO). In previous years a complete reconstruction of the storage was done and the ARAO applied for an approval of starting a trial operation. In June 2005 the SNSA issued consent to start the trial operation for a period of 2 years. On the basis of the consent the Ministry of Environment and Spatial Planning issued a license for trial operation. The analyses and experiences from the trial operation will be used to update the Safety Analysis Report when the ARAO applies for a license for operation.

The ARAO acquired funds in the frame of the European Commission's PHARE programme for the project of "Characterization of Institutional Low and Intermediate Level Radioactive Waste in the Central Storage Facility for Waste from Small Producers in Slovenia at Brinje". To the overall fund of 320,000 € Slovenia contributed about 50,000 €. The works were carried out by Institut National des Radioelements from Belgium, where characterization of a part of radioactive waste from the CISRW took place in the Hot Cell of the Jožef Stefan Institute (JSI). Because the Hot Cell does not have the license for operation, the JSI applied and obtained a special license for operation limited to the period of duration of the project.

During the project 77 drums, 253 sealed sources and 41 units with ionizing smoke detectors were characterized. The resulting products are shown in Figure 13.

Figure 13: 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 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 the other users

In April 2005 the ARAO bought a transport vehicle for dangerous substances. Additionally two transport containers for unprotected sources were purchased with technical assistance of IAEA.

In 2005 ARAO radioactive waste from 58 users was accepted in the CISRW, 97 sealed sources, 19 units of special wastes and 119 drums, respectively. Volume of accepted waste was 28.8 m³. There were also 380 smoke detectors accepted and larger number of dismantled ones. As a result of a circular letter regarding the use of DRM-3 radiation detectors, 36 calibration sources Sr-90 were accepted in CISRW. At the end of 2005 there were 665 package units from which 297 drums, 171 special waste and 197 sealed sources stored in CISRW, respectively. The total activity of all waste amounted to 4 TBq.

2.1.3.1. Inspection surveillance

The SNSA inspection performed one planned inspection of the ARAO and the Central interim storage for radioactive waste at Brinje (CSRAO). The characterization of low and intermediate level waste was inspected.

In the course of planned inspections, SNSA inspectors dealt with regular ARAO activities with regard to performing their duty of dealing with radioactive waste: storage activities, training of employees for working in the storage, emergency preparedness and review of control of radioactivity of storage surroundings. No deficiencies or irregularities were found.

2.2. Radiation practices and the use of sources

The Act on Protection against Ionizing Radiation and Nuclear Safety recently introduced some changes on the administrative level, among them 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 expert in protection against radiation. If the applicant has insufficient knowledge and expertise related to the field of radiation protection, the evaluation can be prepared by an authorized expert in this field. Presently, there are two authorized institutions in Slovenia: the Jožef Stefan Institute and the Institute of Occupational Safety. The evaluation has to be approved by the Slovenian Radiation Protection Administration, where in total 124 approvals were issued in 2005.

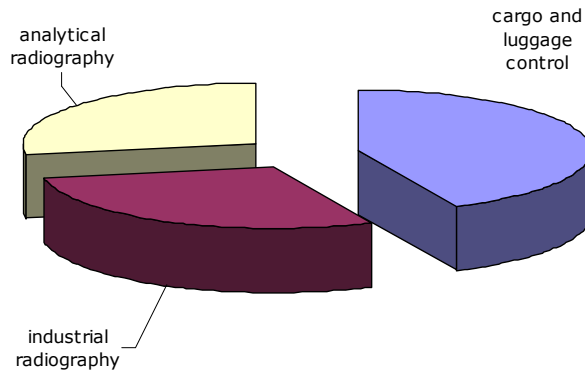
2.2.1. Use of ionizing sources in industry and research

Harmonization of the actual status with the legislation requirements in the areas concerning radioactive sources continued in 2005. In order to achieve the goal, the SNSA took appropriate and reasonable measures to minimize economic threats to companies and nevertheless maintain radiation safety of citizens and workers. Therefore the SNSA communicated the new legal requirements to the users of radiation sources through several means such as: issuing a monthly »Radiation News«, providing information on the SNSA website and sending letters to potential organizations carrying out radiation practice and to users of radioactive sources (official receivers, ionization smoke detectors service, and users of DRM radiation detectors with a calibration source).

In 2005, 43 licenses to carry out practices involving radiation were issued, 171 licenses to use a radiation source, 27 certificates of entry in the register of radiation sources, and 2 approvals issued to external operators of practices involving ionizing radiation. The valid licenses issued in accordance with the law from 1984 will be progressively replaced by the new ones.

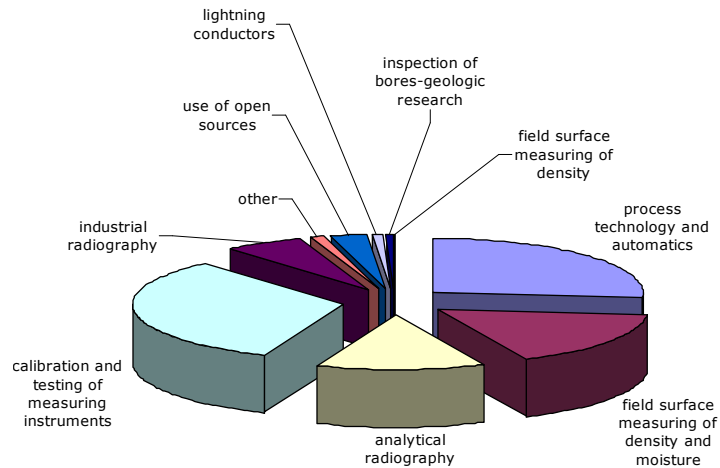
In 2005, 65 organizations in the Republic of Slovenia used approximately 140 X-ray devices in industry and research, most of them for industrial radiography, and for cargo and luggage inspection.

Figure 14: Application of X-ray devices according to their purpose and mode of use.



642 sealed sources were used in 87 organizations, the majority of them were used in technological and automation processes, field measurements of density and humidity, and industrial radiography.

Figure 15: Distribution of application of radioactive sources according to their purpose and mode of use, excluding ionizing smoke detectors.



A special group of sources are ionization smoke detectors which contain radionuclide ²⁴¹Am. In accordance with the register of radiation sources at the end of 2005 there were 23,709 detectors in use at 258 organizations. In addition there were 1,500 detectors stored at users' premises. After the reconstruction of the CISRW at Brinje, handover of the spent sources from users to the ARAO increased.

In 2005 the Institute of Occupational Safety performed 1,027 surveys in industry and medicine. The Jožef Stefan Institute performed surveys of 3 sealed sources, 3 open sources, and 3 X-ray devices, respectively.

2.2.1.1. Inspections

In 2005 the inspectors of the SNSA analyzed 47 cases which were not related to nuclear

facilities. They carried out 45 inspections. The increase of cases in that year compared to the inspections performed in previous years is mainly due to the systematic inspection programme at the Jožef Stefan Institute. Since its establishment in 1949 the institute was involved in numerous nuclear research activities as well as other activities related to ionizing radiation. The inspectors found out that in many laboratories decommissioning of facilities or equipment was not carried out in accordance with contemporary safety standards.

The inspections of the SNSA were performed in close collaboration with the Agency for Radioactive Waste Management and both technical support organizations, namely the Jožef Stefan Institute and the Institute of Occupational Safety. The Institute of Occupational Safety was involved in eight cases, and the Jožef Stefan Institute in one case.

The inspection reported to the Police Station of Kranj that radioactive waste or sources were treated without taking into account the relevant legislation. In 2000, an unknown individual took four gauges with radioactive sources of low activities from an industrial storage. The case was dealt with by the Court of Kranj.

In all cases when sources were found during transport, the consignments were not allowed to enter the state but were sent back to the state of origin. In addition, the SNSA informed the regulatory authorities of the state of origin.

Inspections of the Jožef Stefan Institute

In 2005 the inspectors of the SNSA carried out 32 inspections at the Jožef Stefan Institute, while in 2004 there were only 4 inspections. In October 2004 the inspections found an increased dose rate at the surface of an unlabelled iron case on the location of the institute, namely Jamova 39, Ljubljana. Tens of unregistered sources were found in the case subsequently. The inspection continued with the systematic inspection programme of all laboratories as well as other organizational units of the institutes which carried out practices with an ionizing source. Only the Research Reactor TRIGA and the hot cells were not a subject of inspections. The inspection programme also included all research departments which were involved in the above mentioned activities in the past or developed from such departments. Two inspections were performed in collaboration with a chemicals inspector and a fire protection inspector.

The inspectors of the SNSA found many non compliances with the prescribed safety arrangements relating to ionizing sources and management of radioactive waste. Around 200 ionizing sources and radioactive waste packages were found by the inspectors, based on the analysis of documentation, research articles published in the past, interviews with present and past workers of the institute, as well as by inspections of premises. The inspections also found several contaminated laboratories and storages. None of these sources and radioactive waste packages were registered in the registry of the Radiation Protection Group of the institute and neither were they included in the application for a permit to carry out a practice involving radiation, issued by the institute at the end of 2004. The application was sent to the SNSA in order to harmonize the activities of the institute with the Act of Protection against Ionizing Radiation and Nuclear Safety, which was put in force in 2002.

The inspection issued around 400 orders related to findings concerning responsibilities at the institute, registers of sources and waste, decontamination of laboratories and storages, as well as preventive measures for the safety of workers and population. Contamination premises were found on two locations, namely at Jamova 39, Ljubljana, as well as at Brinje 40, Dol near Ljubljana. The inspection programme has not been concluded yet. The institute started immediately to carry out the activities in order to assure that the required orders would be implemented.

A big step towards a complete control over all sources of ionizing radiation in the country was achieved by the inspection programme implemented at the institute. The control should be based on contemporary international standards and the Slovenian Act of Protection against Ionizing Radiation and Nuclear Safety, which was put in force in 2002.

In the last fifty years of existence of the institute many generations of researchers using many different radioactive substances were involved. Due to the fact that no stringent legislative requirements were in force, many sources were simply abandoned. An abandoned source is potentially dangerous if it is used unintentionally. The top priority is to register all found sources in the register of the institute as well as in the state register at the SNSA. At the end of 2005 around 60 disused sources were stored in the Central Interim for Radioactive Waste at Brinje.

Other inspections

Inspectors of the SNSA analyzed an increase of radiation in a building of a company, namely Recinko d.o.o. in Kočevje. The increase was caused by the building materials originating from a mine. The building is not used any more. Inspections were also carried out at the Institute for Mining Geotechnology and Environment, the National Institute of Chemistry and Sintal d.o.o.. At all inspections, orders related to legislative requirements concerning the use of ionizing sources were issued. In addition, eleven consignments containing recycling metal materials were rejected by the Italian authorities at the Italian border due to suspicion that they contained radioactive materials. In cases when radioactive sources were found, the inspectors of the SNSA required their storage at the Central Interim Storage for Radioactive Waste at Brinje. In some cases materials with enhanced natural radioactivity were present, and these requirements were not issued. The inspectors also intervened in three cases related to consignments of recycling metal materials at the Croatian border, when the dose rate at the surface of the consignments was enhanced. Entry to Slovenia was not allowed. Inspectors also analyzed two cases related to an enhanced dose rate in Ljubljana, but no source was found.

2.2.2. Use of ionizing sources in medicine and veterinary medicine

2.2.2.1. X-ray devices in medicine and veterinary medicine

According to data from the register of Slovenian Radiation Protection Administration (SRPA), 758 X-ray devices were used in medicine and veterinary medicine at the end of 2005. 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 purpose

Purpose	Status 2004	New	Written-off	Status 2005
Dental	371	22	17	376
Diagnostic	260	14	17	257
Therapeutic	4	2	0	6
Simulator	2	0	0	2
Mammography	32	3	1	34
Computer Tomography CT	18	4	2	20
Densitometers	30	7	3	34
Veterinary	26	4	1	29
TOTAL	743	56	41	758

In 2005 the Slovenian Radiation Protection Administration granted 42 permits to carry out a practice involving radiation, 82 permits to use X-ray devices in medicine and veterinary medicine, 73 confirmations of evaluation of the protection of exposed workers against radiation and 45 confirmations of the programme of radiological procedures.

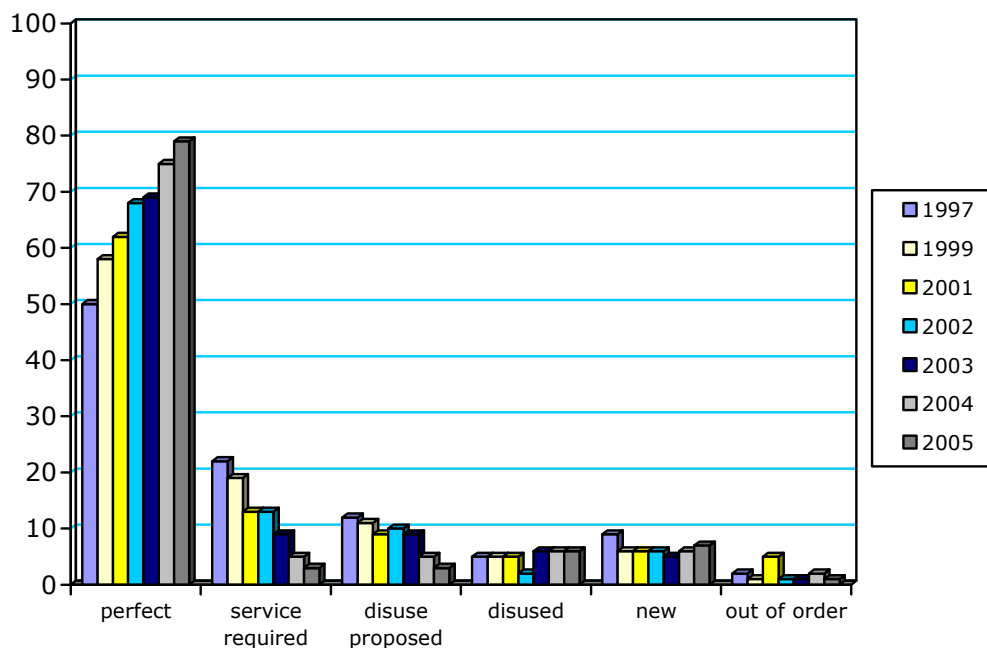
From the total of 758 X-ray devices, 349 were used in private dispensaries and 409 in public hospitals and institutions. The average age of devices in the public sector was 9.9 years and in the private sector 7.2 years. A detailed classification of X-ray devices according to their ownership is given 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	281 (82%)	10.3	106 (28%)	9	9	7.3	13 (45%)	9.2	409 (54%)	9.9
Private	63 (18%)	6	270 (72%)	7.6	0		16 (52%)	5.9	349 (46%)	7.2
Total	344	9.6	376	8	9	7.3	29	7.3	758	8.7

All X-ray devices are examined by approved experts in radiation protection at least once a year. The devices are classified with regard to their quality to one of the following 6 groups: "perfect", "service required", "disuse proposed", "disused in current year", "new" or "out of order". The analysis of data for the time period from 1997 to 2005 shows an increased number of perfect devices and a noticeably reduced number of devices that need repair or are proposed for disuse (figure 16).

Figure 16: Percentage of diagnostic X-ray devices according to their quality for the period 1997-2005



In 2005 four inspections of the use of X-ray devices were performed. Based on the findings, two provisions requiring implementation of legally prescribed conditions for radiation practices and the use of ionizing radiation sources were issued and prohibition of further use for one X-ray device was ordered.

Based on reports of technical checks of medical X-ray devices issued by approved experts in radiation protection, 21 requests for submission of proofs of service were issued.

2.2.2.2. 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 Medical Centre Ljubljana - the Department of Nuclear Medicine, the Institute of Oncology, and general hospitals in Maribor, Celje, Izola, Slovenj Gradec and Šempeter near Gorica. In 2005, nuclear medicine departments applied 6215 GBq of isotope ^{99m}Tc , 1318 GBq of isotope ^{131}I , 217 GBq of isotope ^{133}Xe and minor activities of isotopes ^{67}Ga , ^{111}In , ^{18}F , ^{90}Y , ^{186}Re , ^{51}Cr , ^{125}I , ^{123}I , ^{153}Sm and ^{89}Sr for diagnostics and therapy.

In the scope of inspection surveillance, a minor irregularity was found at the Institute of Oncology. Between 24.5.2005 and 10.8.2005, the radioactive sewage container was filling up too rapidly, with a rate of 1.35 m³/week instead of the allowed average value of 1 m³/week.

In the Maribor General Hospital, the results of regular semiannual measurements done by the Institute of Occupational Safety, combined with other findings of the institute's experts during the last two and a half years, indicate a deterioration of radiation protection practice in the hospital. Particularly, the limits for contamination of the working environment and for contamination of the worker's skin were frequently exceeded. A request to make a form for tracking contamination measurements was issued to the radiation protection officer.

No emergency events (except for the almost full radioactive sewage container at the Institute of Oncology) were reported to the SRPA in 2005. The nuclear medicine departments are checked semiannually by the Jožef Stefan Institute or the Institute of Occupational Safety, and apart from the Maribor General Hospital no major deficiencies have been found.

Sealed therapeutic sources are used at the Institute of Oncology and at the Medical Centre Ljubljana - the Eye Clinic. At the Institute of Oncology two ^{60}Co sources with initial activities of 407 TBq and 290 TBq are used in the radiotherapy department, and one ^{192}Ir source of initial activity of 37 GBq, three ^{90}Sr sources with initial activity up to 740 MBq and 25 sources with ^{137}Cs with initial activities up to 6 GBq are used in the brachytherapy department. At the Eye Clinic seven ^{106}Ru sources with initial activities up to 26 MBq are in use for eye tumor treatment.

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

3. RADIOACTIVITY IN THE ENVIRONMENT

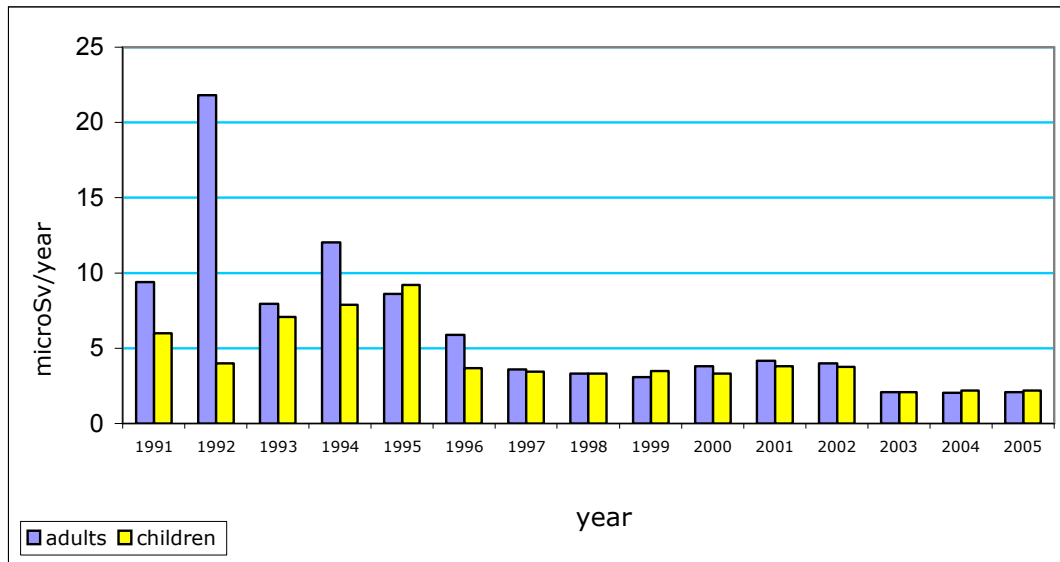
3.1. Monitoring of environmental radioactivity

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, foodstuffs and feeding stuffs. A part of the monitoring programme comprises also river water contamination with ^{131}I due to medical use of this radionuclide. In all samples, other gamma emitters are measured too, and additionally tritium ^3H in drinking water and precipitation.

The results for 2005 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 slowly to decrease 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/m²) 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 and this feature directly contributes to the enhancement of contents of this radionuclide in forest fruits, mushrooms and game, and in Alpine milk and cheese. In 2005 no radioactive contamination of the environment was detected related to any nuclear or radiation event.

The biggest contribution to 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 2005 the effective dose for an adult from external radiation of ^{137}Cs was estimated at about 5 μSv , which is similar to previous years. The annual dose from the ingestion pathway (food and drinking water consumption) was 2.1 μSv , just like in previous years; radionuclide ^{90}Sr accounts for three quarters of the dose, while ^{137}Cs contributed the remaining quarter. 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 2005, the total effective dose to an adult individual of Slovenia arising from the global contamination of the environment with fission products was estimated at 7 μSv , as shown in Table 5. This is approximately a three hundred times lower dose compared to the annual exposure from natural radiation in the environment (2500–2800 μSv). The effective dose for drinking water, taking into account natural and artificial radionuclides, was 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.

Figure 17: Annual exposure of members of the public in Slovenia to global radioactive contamination of the environment, taking into account radionuclides ^{137}Cs and ^{90}Sr .



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 $10 \mu\text{Sv}$.

Table 5: Radiation exposure of population in Slovenia due to global contamination of the environment in 2005

Transfer pathway	Effective dose [$\mu\text{Sv}/\text{year}$]	
	Adults	Children (up to 12 years)
Inhalation (^{137}Cs , ^{90}Sr)	0.001	0.001
Ingestion:		
- drinking water (^{137}Cs , ^{90}Sr)	0.04	0.05
- food (^{137}Cs , ^{90}Sr)	2.1	2.2
External radiation	4.8	4.8
Total in 2005 (rounded)	6.9	7.0

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 derived limits and also if the population exposures are lower than the prescribed dose constraints or limits. The performed radioactivity measurements follow the monitoring programmes approved by the competent authorities according to the operational conditions.

3.2.1. The Krško Nuclear Power Plant

The radiological situation in the surroundings of the nuclear power plant is monitored by means of continuous measurements of gaseous and liquid radioactive discharges and by carrying out radioactivity measurements of environmental samples. The measured values of analyzed radionuclides in environmental samples (in air, soil, surface and underground water, precipitation, drinking water, agriculture products, 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 data on gaseous and liquid discharges. The data are used as input data for the modeling 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 a case of emergency, the established monitoring network enables immediate sampling and analysis of contaminated samples.

Radioactive discharges

Atmospheric discharges from the nuclear power plant differ with regard to how specific groups of radionuclides contribute to the exposure of population. Radioisotopes of noble gases of argon (Ar), krypton (Kr) and xenon (Xe) are monitored, as well as radionuclides tritium ^3H and carbon ^{14}C , beta- and gamma-emitting aerosols (isotopes of cobalt (Co), cesium (Cs), strontium (Sr), etc.) and iodine isotopes in different chemical forms. In 2005 the total released activity of noble gases to the atmosphere was 0.36 TBq, which is less than 0.3 % of the limit, while the released activities of iodine isotopes and aerosols were even lower (less than 0.001 % of the limit). Discharges of tritium into the atmosphere were similar as the year before, while the ^{14}C discharges were reduced by almost ten times.

In 2005, in liquid discharges from the plant to the Sava river the activity of tritium (^3H , abbreviated as T) in the form of water (HTO) prevailed with 18 TBq. This represents the highest annual release up till now (90 % of the limit). The reason for this is operational change (the fuel cycle was extended to 18 months). Tritium has a relatively small contribution to the exposure of population, so there are realistic considerations of the possibility that in the future the annual discharge limit could be increased. The discharged activity of fission and activation products was more than a thousand times lower, i.e. 0.058 GBq, which is 0.03 % of the limit value, while the activity of alpha emitters was under the detection limit.

Environmental radioactivity

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

- in air (aerosols and iodine filters),
- in dry and wet deposition (dry and wet precipitation),
- in 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 in water samples, precipitation, soil, sediments and foodstuffs is a consequence of global contamination and is 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 ^3H in the Sava river downstream the plant. Concentration of tritium of 1.5 kBq/m³ was measured at Krško, upstream the plant, while at Brežice downstream the plant, the value of 6.3 kBq/m³ was obtained. The

limit value prescribed with a government decree is 7400 kBq/m³ (as the derived concentration for drinking water). Concentrations of other artificial radionuclides discharged to the Sava river (⁵⁸Co, ⁶⁰Co, and others) were measured below the detection limits in all samples. The concentrations of radioisotope ¹³¹I in the Sava river downstream the plant were caused by discharges from the clinics of nuclear medicine in Ljubljana and Celje, not by the operation of the nuclear power plant. The annual average concentration upstream, at Krško, was 17 Bq/m³, and downstream, at Brežice, 10 Bq/m³. Iodine isotope ¹³¹I was detected also in fish, at levels between 0.1 and 0.8 Bq/kg, and in sediments, upstream and downstream of the plant. In tap waters and water captures no impacts due to the nuclear power plant were detected.

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 the cloud and deposition, inhalation of tritium and ¹⁴C, and ingestion of food with ¹⁴C. The highest annual dose (less than 1 μSv, in 2005 only some tenths of μSv) was received by individuals due to ¹⁴C intake with milk ingestion (children) and cereals (other age groups), and a lower dose was received due to inhalation of tritium (HTO) and ¹⁴C. The dose assessment due to liquid discharges in 2005 showed their very low contribution to the population exposure: it was less than 0.05 μSv. The levels of external radiation in the vicinity of the structures (on-site) are higher than in the natural surroundings, but they are 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 less conservative 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 2005

Type of exposure	Transfer pathway	Most important radionuclides	Effective dose [μSv/year]
External radiation	Cloud immersion	(⁴¹ Ar, ¹³³ Xe, ^{131m} Xe) Particulates	0.1
	Deposition	(⁵⁸ Co, ⁶⁰ Co, ¹³⁷ Cs...)	< 0.1
Inhalation	Cloud	³ H, ¹⁴ C	< 0.2
Ingestion (atmospheric discharges)	Milk, cereals	¹⁴ C	< 0.5
Ingestion (liquid discharges)	Drinking water (Sava river)	¹³⁷ Cs, ⁸⁹ Sr, ⁹⁰ Sr, ¹³¹ I	< 0.1
Total in 2005			< 1*

*(single dose contributions from particular exposures are not additive)

From Table 6 it is clear that the total effective dose for an individual who lives in the surroundings of the Krško nuclear power plant is less than 1 μSv per year. This value is an order of magnitude lower than those obtained in previous years; it represents about 2 percent of the authorized dose limit (50 μSv) and equals less than a half of a thousandth of the dose received by an average Slovenian from natural background radiation (2500–2800 μSv).

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, soil and the Sava river sediments.

Measurements of radioactive aerosol discharges into the atmosphere showed results below the detection limit, while in liquid discharges – from the laboratory of the Jožef Stefan Institute – two radioisotopes ^{131}I and ^{137}Cs were identified, with the total discharged activity of 0.18 MBq per year. This is the minimum value in the whole period of radioactivity control to date. No radioactive contamination due to reactor operation was detected by environmental measurements. Taking into account the average continuous power of the reactor operation and the annual decreasing trends of radioactive discharges from the waste tank used by the laboratories of the Jožef Stefan Institute, the exposure of population in 2005 was estimated to be similar to the previous year. The external immersion dose due to ^{41}Ar discharges to the atmosphere was estimated by a model calculation at approximately 0.24 μSv per year. A conservative assumption was used for dose assessment to individuals of the population for liquid discharges: if river water is ingested directly from the recipient river (Sava), the annual exposure is less than 0.001 μSv , or an order of magnitude lower than in the previous year. The total annual dose (0.24 μSv) to an individual from the public equals to previous levels and reaches only 0.024 % of the general dose limit (1000 μSv) or one ten thousandth of natural background radiation in Slovenia (about 2500–2800 μSv).

The Central storage of low and intermediate radioactive waste at Brinje was reconstructed in 2004, which led to a decrease of radioactive releases to the environment, i.e. also to the atmosphere and to the surface and underground water. The monitoring programme of environmental radioactivity of the storage 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 outside walls of the storage). Environmental concentrations of radionuclides were measured in the same scope as in previous years (in underground water from the well, in soil near the storage, external radiation at several distances from the storage, and dry deposition).

After the reconstruction of the storage, radon releases to the environment decreased from the former annual average value of 75 Bq/s to 52 Bq/s or 1.65 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 equals to 7.6 Bq/m³ at the distance of 30 m and to about 3 Bq/m³ at the distance at 50 m, i.e. at the fence of the reactor centre. In waste water from the drainage collector radionuclides ^{241}Am , ^{137}Cs , ^{60}Co , $^{108\text{m}}\text{Ag}$ and ^{152}Eu were measured as a consequence of cleaning the storage after the reconstruction. These radionuclides originated from keeping and handling radioactive waste in the storage in the past. No radionuclides due to storage operation were detected in underground 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 in 2005 an effective dose of 8 μSv (annual effective dose from natural background in the country is 2500–2800 μSv). The security officer receives about 5 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 0.2 μSv . These values are lower than in previous years, mostly due to lower radon releases, lower dose conversion coefficients in accordance with the new regulations, and taking into account the actual prevailing wind directions.

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 closing 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 villages 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 been partially decreased after cessation of mine operation. The differences are the 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 Brebovščica, the main recipient stream: they are close to the natural background level. Only uranium ^{238}U concentrations in the Brebovščica stream (155 Bq/m^3) is still increased, because all liquid discharges from the mine and from disposal sites flow into it. Radioactivity of sediments in the Brebovščica and Todražica streams is still 2 to 4 times higher than in the Sora, the recipient river. The average concentrations of radon ^{222}Rn in the surroundings of the mine (at Gorenja Dobrava) were still higher than a long-term average value concentration at the reference point, outside the mine influence (about 20 Bq/m^3). In the last years the mine's contribution of radon was estimated to have decreased to about 5 Bq/m^3 (2005: 5.0 Bq/m^3 , 2004: 5.8 Bq/m^3 , 2003: 8.4 Bq/m^3 , 2002: 5.4 Bq/m^3 , 2001 5.1 Bq/m^3). The enhanced concentrations have been very rarely measured in food products, but it is reported that grass from the farmland around the mine contains more radioactivity, especially the grass from the pile slopes. The contents of radionuclides ^{226}Ra and ^{210}Pb in grass almost reach the level of 100 Bq/kg , while the normal values are scattered around 1 and 10 Bq/kg respectively.

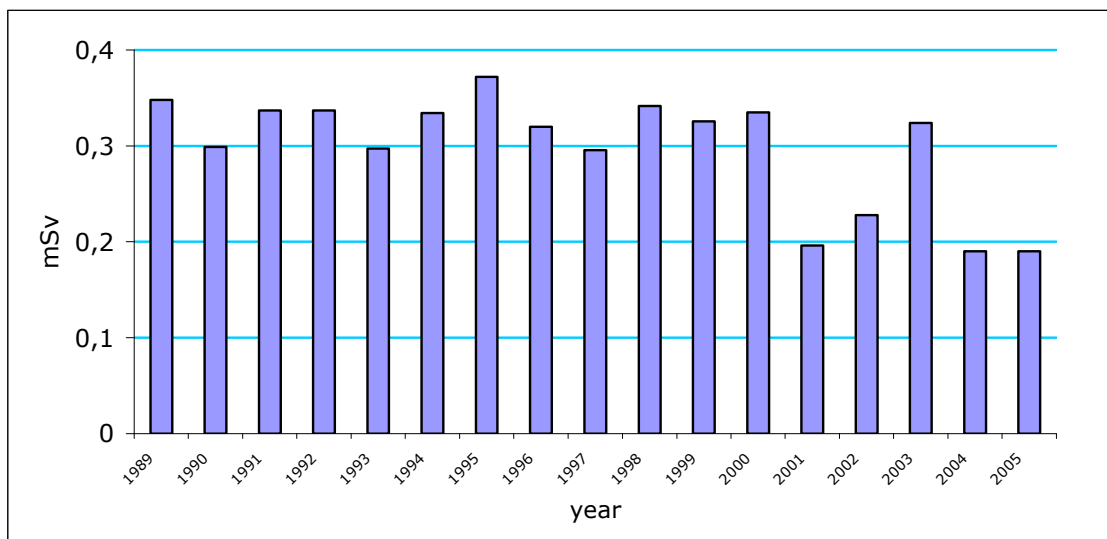
Calculation of the effective dose for population takes into account the following exposure pathways: inhalation of long-lived radionuclides, radon and its short-lived progeny, ingestion (intake with food and water) and external gamma radiation. Radiation exposure of the population living in the vicinity of the mine was estimated to be 0.19 mSv in 2005. This value equals to the one from 2004 and is somewhat lower than the ones calculated in previous years. This is partly attributed to lower releases of radon and partly to the dose conversion factor for radon short-lived progeny according to the Regulations on conditions and methodology for dose assessment (OJ RS No. 115/03). The most important radioactive contaminant in the mine environment still remains radon with its short-lived progeny, which contribute almost three quarters of additional exposure (Table 7).

Table 7: Effective dose of population in the surroundings of the former uranium mine at Žirovski Vrh in 2005

Transfer pathway	Important radionuclides	Effective dose [mSv/year]
Inhalation	- aerosols with long-lived radionuclides (U, ²²⁶ Ra, ²¹⁰ Pb)	0.007
	- only ²²² Rn	0.005
	- Rn – short-lived progeny	0.130
Ingestion	- drinking water (U, ²²⁶ Ra, ²¹⁰ Pb, ²³⁰ Th in Brebovščica)	(0.0114)*
	- fish (²²⁶ Ra, ²¹⁰ Pb)	0.003
	- local food (²²⁶ Ra in ²¹⁰ Pb)	< 0.042
External radiation	- immersion and deposition of radon progeny	0.001
	- deposition of long-lived radionuclides	-
	- direct gamma radiation from disposal sites	0.002
Total effective dose for 2005 (rounded): 0.19 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 in 2005 due to contribution of the former uranium mine reached one fifth of the general limit value for the population. This figure represents about 8 percent of the annual dose due to natural radiation background in Slovenia (2500–2800 μ Sv) and less than 4 percent of the natural background dose in the Žirovski Vrh environment (5500 μ Sv). Annual changes of effective doses due to the mine contribution are shown in Figure 18.

Figure 18: Annual contributions to the effective dose of population due to the Žirovski Vrh Mine

Measurements and dose estimations for the period of the last several years clearly show that cessation of uranium mining and the restoration works carried out till now, have decreased the environmental impacts and exposure to population. The annual effective dose for 2003 (see the diagram) is not a result of increased radioactive discharges to the environment but is due to the selected methodology for the evaluation of results.

The license for the execution of the final close-out activities for the Jazbec disposal site with mine waste pile was issued in 2005.

3.3. Early warning system for radiation in the environment

The Slovenian early warning system 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 and ground are contaminated by the fallout. The network consists of 42 on-line automatic gamma dose rate probes that are located over the territory of Slovenia. They are managed by the SNSA, the Krško NPP, the EARS and the Slovenian thermal power plants. The SNSA collects, analyzes and archives data which are also presented on-line on the SNSA web pages. In the year 2005 there were no events which would have triggered the alarms due to elevated values of radioactivity in the environment.

Since 1997 the SNSA has been sending data to the European system EURDEP with its center 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 center in Vienna, the Croatian in Zagreb and the Hungarian in Budapest.

The SNSA and the EARS have started a common project of upgrading and modernization of the early warning system. The project was approved by the European Commission and is co-financed from the PHARE programme. It will enhance the existing network with 35 additional stations for gamma dose rate measurements. These stations are equipped with precipitation meters, and some of them are capable of even more complex meteorological measurements, which is essential for decision making in case of emergency. The data transfer is also improved, as well as the visualization and analysis of the incoming data. Special care was dedicated to the alarming mode, which automatically starts in case of elevated dose rate values. It is expected that the project will be finished in spring 2006.

3.4. Radiation exposures of 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. Humans are exposed to external and internal radiation. 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 population of Slovenia receives various radiation doses from different sources. The data on population exposure are presented in following subchapters, while the occupational and medical exposures are presented in Chapter 4.

3.4.1. Exposure to natural radiation

Exposure to natural radiation is caused by the radioactivity of rocks on the Earth and by radiation coming from space (cosmic rays). 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. In Slovenia the average annual dose from natural radiation sources 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. 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.

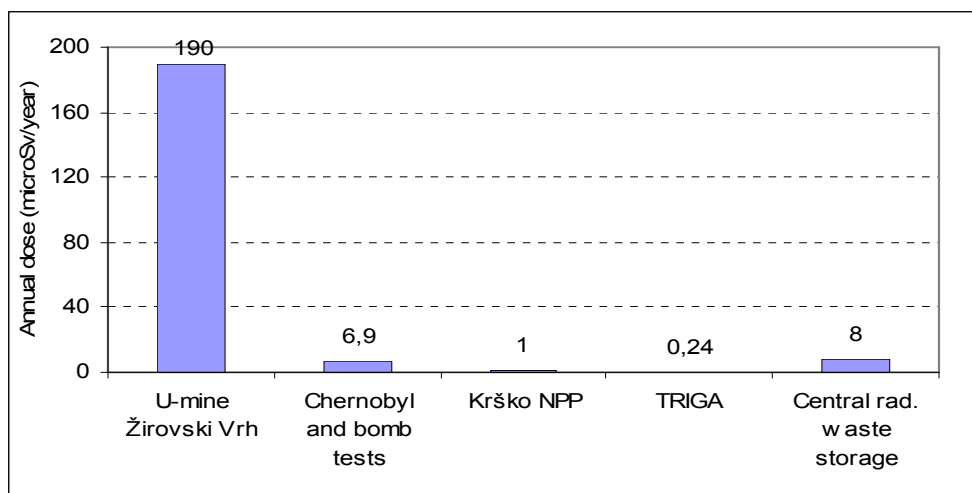
3.4.2. Population dose due to global contamination

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 2005 the average individual dose to the population from this source in our country was near 7 μ Sv. The biggest contribution comes from external radiation, while the exposure due to intake of food and water was estimated at only 2 μ Sv. Due to lower contamination of the ground with ^{137}Cs the population in urban areas is less exposed than the one in rural environment.

3.4.3. 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 Figure 19 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 Chernobyl accident) is shown. The highest exposures of the population are received by 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.

Figure 19: Population exposures due to the installations discharging radioactivity to the environment, and due to global contamination in 2005 (annual dose limit for the population is 1000 μ Sv, natural background radiation is 2500-2800 μ Sv)



The population is exposed to radiation also due to some other human activities. These exposures come from deposited materials with enhanced natural radioactivity and originates from past industrial or mine activities, related mostly to mining and processing of raw materials containing uranium and thorium (in Slovenia: mining and processing of mercury ore, processing of bauxite, phosphates, coal combustion). Certain data are available on various types of materials, on their amounts, and their higher contents of

natural radionuclides. The dose assessment has not been systematically carried out due to the lack of data needed. The only exception is the operation of the Šoštanj thermal plant: environmental radioactivity monitoring of the coal ash disposal provided the information that in the year 2005 individuals from the surrounding population received about 6 μSv .

3.5. Research studies

3.5.1. Outdoor radon concentration in Slovenia

Radon concentrations outdoors are usually at least by 10 to 100 times lower than indoors and equal on average to about 10 Bq/m^3 over the continental areas. The aim of the study, conducted by the Jožef Stefan Institute, was to acquire the reference levels of outdoor radon on the territory of Slovenia. Measurements of radon concentration were performed with nuclear track detectors at 50 measurement locations in a grid of 20x20 km^2 and were uniformly distributed across the whole country. In 2005, outdoor radon was measured in two series, each lasting about three months (March-June, July-September).

The results show that the arithmetic mean of radon outdoor concentrations in Slovenia is 15 Bq/m^3 and this value was expected. The highest concentrations were measured at Kočevska Reka - 47 Bq/m^3 , at Nova vas (Bloke tableland) - 37 Bq/m^3 , at Vrhnika - 36 Bq/m^3 , and at Zdenska vas, Goričko and Dvor pri Žužemberku (25 Bq/m^3 each). In the region of the Dinara plateau and in the Karst region of Primorje the values are still above the average, while low values were obtained in sub-Panonian Slovenia, Ljubljana basin (10.5 and 12.5 Bq/m^3 respectively) and at the coast (8.2 Bq/m^3). An expected low value was measured in windy higher elevations, such as Lisca and Golica (6-10 Bq/m^3).

The institute additionally made measurements at locations with technologically enhanced natural radioactivity and in places where high radon concentrations indoors had already been identified. Above-average concentrations of outdoor radon were measured in the vicinity of the uranium mine at Žirovski Vrh (27 Bq/m^3), in Kočevje (24 Bq/m^3), and in Idrija (21 Bq/m^3). But all of these values are below the levels that would require measures for population protection. For comparison: the arithmetic mean of radon in 900 dwellings was 86 Bq/m^3 .

3.5.2. Radioactivity of the forest eco-system in Slovenia

The highest radioactive contamination in the environment due to the past atmospheric nuclear tests and the Chernobyl accident was found in the forest ecosystem. The reason for that is the permanent cycling of radionuclides inside the system and the feature that contamination of the upper layer of soil is not reduced due to soil cultivation. Radionuclides are mostly retained in the upper (organic) soil layer because migration to the deeper layers is much lower.

In the pilot study performed by the Institute of Occupational Safety three years ago (in 2003) some measurements of Cs-137 and ^{90}Sr contents were done for the region of northern Carinthia (Dravograd). The results showed one order of magnitude higher surface activities of both long-lived radionuclides compared to the uncultivated grassy areas elsewhere in Slovenia. In the most frequently picked mushrooms (boletus, chanterelles) the content of ^{137}Cs was up to 5 times higher and in one mushroom species even a decade and a half after the Chernobyl accident it still exceeded the limit set by the European Commission for import of food from third countries (600 Bq/kg). In deer meat almost 20 times more ^{137}Cs was found than in other types of meat.

The research study in 2005 was continuation of the initial work and comprised all other large forest regions in Slovenia, such as the Trnovo forest, forests between Bloke and Snežnik, forests between Krim and Kočevje, the Rog forest, and the forest slope of

Pohorje, which all together covered almost a half of the territory of Slovenia. The second part of the research was of the same content as the first one but focused on the forest samples that had already shown typically enhanced contents of ^{137}Cs (forest soil, wild fruits, mushrooms); they were analyzed only for this radionuclide.

Table 8: Contents of ^{137}Cs in the upper layer of forest soil in Slovenia

Forest regions	Surface contamination with ^{137}Cs [kBq/m ²]		Content of ^{137}Cs in soil [Bq/kg]	
	0-5 cm	0-20 cm	0-5 cm	0-20 cm
Carinthia (Libeliče) ⁽¹⁾	7.7-9.7	13.5	410-490	207
Trnovo forest (Čaven)	12	16.7	710	275
Inner Carniola (Sviščaki)	1.8	4.2	210	80
Kočevje forest (Rog)	5.1	7.7	110	44
Pohorje slope forest	20	30	510	180
Lower Carniola (Trebnje)	3.3	4.4	75	46
Ljubljana (reference point)	2.7	6.8	110	110

⁽¹⁾ measurements performed in 2003

The most contaminated is the upper layer of the ground (0-20 cm) in the forest of Pohorje, Trnovo forest and forest in Carinthia (10-20 kBq/m²), while the forests in Lower and Inner Carniola are less contaminated (2-5 kBq/m²).

With regard to this finding, the contents of wild fruits are relevant: blackberries in Pohorje forest contain 29-36 Bq/kg, and in the Carinthia forests 50-65 Bq/kg. Among the edible picked mushrooms the boletus from Carinthia contains the highest activity of ^{137}Cs (140 Bq/kg) followed by the boletus from the forest of Lower Carniola (46 Bq/kg). In the Libeliče forest (Carinthia) considerably higher activity was found in chanterelles and honey agarics (100 Bq/kg), and especially in the species *Xerocomus badius* (980 Bq/kg). Similar contamination distribution of ^{137}Cs can be found in bioindicators (lichens, mosses, pine needles).

Both research studies on radioactivity of the forest ecosystem showed that the contents of ^{137}Cs in forest soil, wild fruits (mushrooms, wild berries), and in bioindicators (lichens, mosses) are up to one hundred times higher than in vegetable food samples from cultivated areas elsewhere in Slovenia.

Ingestion of forest wild fruits may sometimes cause – for some groups of population – higher radiation exposure due to global radioactive contamination than usual. But this exposure contribution is still much lower than the total dose of natural radiation received by an average member of the public. Therefore there is no need to require any restriction for ingestion of any kind of forest fruit in Slovenia.

3.5.3. Radioactivity of the Atmosphere in Slovenia

The Earth's atmosphere consists of gases (N₂, O₂, Ar, CO₂, water vapor, and to a lesser extent also SO₂, CO, NO_x, CH₄, H₂S, etc.) and aerosol particles. Much less is known that in the atmosphere also radioactive substances are continuously present and that they are mostly aerosols and radioactive gases by their structure.

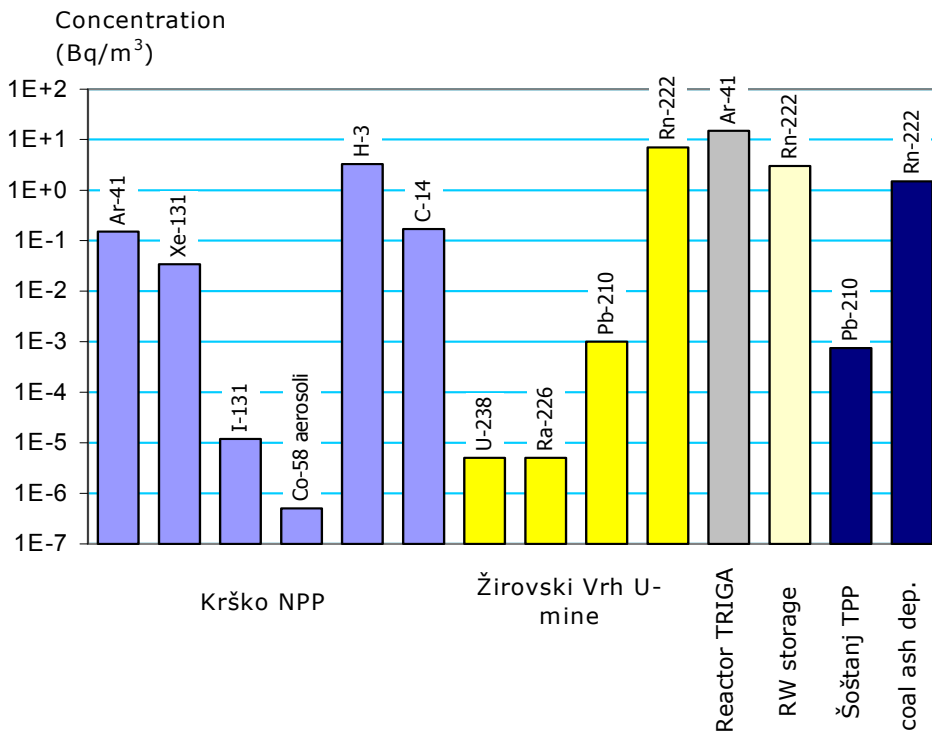
A study was conducted in the form of a diploma work entitled "Atmospheric Radioactivity in Slovenia" (candidate Natalija Leskovar, College of Health Studies, University of Ljubljana) in close collaboration with the SNSA. It was the first attempt to present in one document the entire inventory of radionuclides that can be found in the outdoor

atmosphere, their origin and their typical concentrations on the territory of Slovenia. Monitoring of near-ground air radioactivity has been continuously running elsewhere in the country for decades but it has by no means covered all existing radionuclides in the atmosphere. Mostly, the concentration levels of radionuclides regularly exceeding the value of $1 \mu\text{Bq}/\text{m}^3$ are presented here (with some exceptions).

In our atmosphere 36 natural radionuclides can be found that originate from the radioactivity of the Earth's crust and from interactions of cosmic radiation with the atmosphere. These radionuclides belong to the uranium-radium, thorium and uranium-actinium decay series, ^{40}K and ^{87}Rb , and to cosmogenic radionuclides such as ^3H , ^7Be , ^{14}C in ^{22}Na .

Some radioactive isotopes in the atmosphere are of artificial origin and are the consequence of the past and present human activities. The atmospheric bomb tests in 1950-1980 and the Chernobyl accident (1986) contributed to the global contamination with long-lived radionuclides (^{90}Sr , ^{137}Cs). On the other hand, regular operation of nuclear reactors also results in emissions of ^3H and ^{14}C , as well as fuel processing plants in the production of ^{85}Kr and ^{129}I . Radioactive gaseous discharges from a particular nuclear or radiation facility give rise to local contamination of the atmosphere, limited to the nearby vicinity of the installation. Altogether there are about 40 radionuclides in the air in Slovenia (natural and globally distributed). In the surroundings of the nuclear power plant Krško – taking into account the reported potential inventory of radionuclides in gaseous effluents – 25 other radionuclides can be detected.

Figure 20: Average annual concentrations of radionuclides in the air in the vicinity of the installations



Concentrations of natural and artificial radionuclides in the outdoor atmosphere are relatively low and in no case exceed the prescribed limits.

4. RADIATION PROTECTION OF WORKERS AND MEDICAL EXPOSURES

4.1. Occupational exposure to ionizing radiation

Due to occupational exposure, individuals can receive a substantial dose of radiation. Therefore, 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 highest contribution to the annual radiation dose from natural sources of radiation is due to radon and its progeny. Workers exposed to radon in tourist caves are one of the most occupationally exposed groups of workers. The Slovenian Radiation Protection Administration (SRPA) carried out a project to assess the exposure of individuals in the tourist caves. The dose rates assessed by different models were determined to be in the range from 0.012 to 0.113 mSv/h.

According to the International Commission on Radiation Protection exposure of the air crews to cosmic radiation should be considered as occupational exposure. In addition, the requirement for assessment of individual doses of the members of air crews is given in the Council Directive 96/29/EURATOM, laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation. Therefore in 2005 the SRPA started a project to assess the individual doses due to natural radiation during flights. Preliminary results show that pilots of smaller planes, flying at lower altitudes and shorter distances, receive about 1 mSv/year on average, while pilots of larger aircrafts, flying at higher altitudes and longer distances, receive about 3 mSv/year on average. Cabin crews are evenly distributed during the year to both types of flights and receive on average about 2 mSv.

4.1.1. Individual exposures

The SRPA manages a central register of individual exposures to radiation. All approved dosimetry services regularly report to this register 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 are 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 the Žirovski Vrh Mine (internal dosimetry for workplaces in mines). Currently 7,100 persons have their records in the central register, including those who stopped using sources of ionizing radiation in previous years. In 2005, the dosimetric service at the IOS performed measurements of individual exposures for 3,200 workers employed at around 700 enterprises. The JSI monitored the exposures of 479 radiation workers. The average annual effective dose due to external radiation was the highest for workers with industrial radiography, namely 1 mSv, while the employees in medicine received on average 0.38 mSv. The highest values for these, 0.79 mSv, were recorded for brachytherapy workers. The Krško NPP performed dosimetric control only for their staff and for outside workers, with 519 workers in total, and the average annual effective dose was 0.25 mSv.

The highest collective dose was received by radiation workers employed in medical institutions and amounted to 442 man mSv. As outage in the Krško NPP was not carried out in 2005, the collective dose was several times lower than in previous years (72.4 man mSv in 2005 in comparison to 668 man mSv in 2004 and 799 man mSv in 2003). Exposures in industry and in education, research and other activities were

49 man mSv and 30 man mSv, respectively.

An individual external dose of 22.3 mSv was measured for an outside worker at the Žirovski Vrh Mine. However, during an inspection procedure it was established that most likely only the dosimeter was exposed to ionizing radiation.

The highest doses are received by workers exposed to radon and its progeny.

At the Žirovski Vrh Mine the highest annual individual dose was 4.59 mSv, and the average for a group of 87 workers was 0.99 mSv. The collective dose was 86.2 man mSv. The unusually high dose due to external radiation (22.3 mSv) was not taken into account.

In the other two mines (Mežica Lead and Zinc Mine in closure and Idria Mercury Mine in closure) a total of 68 workers were exposed in 2005. On average they received 0.49 mSv and the collective dose was 33.1 man mSv.

Out of 145 tourist workers in the Karst caves 33 received an effective dose above 5 mSv. The collective dose was 399 man mSv, with an average dose of 2.94 mSv.

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

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

	0-ND	ND≤E<1	1≤E<5	5≤E<10	10≤E<15	15≤E<20	20≤E<30	E≥ 30	skupaj
Krško NPP	240	267	11	1	0	0	0	0	519
industry	298	75	13	1	0	0	0	0	387
medicine and veterinary	1622	1058	111	3	0	0	0	0	2794
radon	10	162	92	33	2	0	1*	0	300
education, research and other activities	286	219	5	0	0	0	0	0	510
TOTAL	2456	1781	232	38	2	0	1*	0	4510

MDL - minimum detection level

E- effective dose in mSv received by an exposed worker

*Unusually high dose due to external radiation which usually contributes up to a few percent to the collective dose. In an inspection procedure it was established that most likely only the dosimeter was exposed to ionizing radiation.

4.1.2. Training

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 are carried out by the approved technical support organizations, namely the Institute of Occupational Safety and the Jožef Stefan Institute. In 2005 a total of 1688 participants attended courses on ionizing radiation protection.

The training of exposed workers was inspected by the Slovenian Radiation Protection Administration. Three inspections related to training in radiation protection at use of X-ray devices in medicine and veterinary medicine were performed in 2005.

4.1.3. Medical surveillance

In 2005, medical surveillance of radiation workers was performed by five approved occupational health institutions:

- Clinical Institute of Occupational, Traffic and Sports Medicine, Ljubljana,

- Institute of Occupational Safety, Ljubljana,
- Aristotel Llc., Krško,
- Health Centre Krško,
- Health Centre Škofja Loka.

Altogether 2,283 medical examinations were carried out.

4.2. Medical exposures

About 15% of the total dose received by an average European is due to medical use of ionizing radiation. Leaving aside the natural sources, diagnostic radiology contributes almost 90% to the collective dose of the public. Therefore in 2005 the SRPA continued the project of establishing diagnostic reference levels with the aim of optimizing the quality system in radiological procedures. According to the preliminary results of the project that started in 2003, the diagnostic reference levels in Slovenia are comparable to developed European countries.

5. RADIOACTIVE WASTE MANAGEMENT AND MANAGEMENT OF NUCLEAR AND RADIOACTIVE MATERIALS

In Slovenia high level radioactive waste (HLW) consists of the spent nuclear fuel (SNF) at the Krško NPP and at the research reactor TRIGA. 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. The National Programme on Radioactive Waste and Spent Nuclear Fuel Management

In October 2005 the Government of the Republic of Slovenia approved the proposal of the Resolution on the National Programme on Radioactive Waste and Spent Nuclear Fuel Management, which was sent for ratification to the National Assembly of the Republic of Slovenia².

The tasks needed to assure permanent and safe solutions for the management of radioactive waste and SNF are addressed in the Programme, regardless of whether Slovenia will remain a nuclear country or not after the end of the operation time of the Krško NPP in 2023. The main focus of the Resolution is on low and intermediate level waste management of waste coming from the Krško NPP, to decommissioning of the Krško NPP and to disposal of SNF from the Krško NPP.

The Programme defines the deadline for site selection of the LILW repository as 2008, while the repository shall have the license for operation until 2013. The repository must operate at least until 2038, when the main phase of Krško NPP decommissioning will be finished.

The chosen scenario for decommissioning of the Krško NPP foresees a dry storage of SNF. The storage is to be constructed between 2024 and 2037 and to operate until 2070, when SNF will be disposed in the final repository or permanently exported to another country.

Because disposal of HLW and SNF from a single nuclear power plant in its own repository is, based on preliminary analysis, an irrational solution, searching for international cooperation is a logical option. If no joint solution is found, then construction of our own repository will be necessary. The Programme foresees the beginning of operation of the final repository for HLW and spent nuclear fuel in 2065. The locations suitable for site investigations must be selected by 2035, while the locations which are appropriate and publicly acceptable for construction must be chosen by 2055.

The designed life time of the Krško NPP ends in 2023, but it can be extended for up to 20 years, which is possible only after extensive technical examinations and a safety analysis. The possibility for life time extension of the Krško NPP shall be addressed and the decision taken by 2012.

With the assumption that the Krško NPP will cease to operate in 2023, its decommissioning will start before the end of operation in the years 2021-2023 with a preparation of projects and required documentation. Most of the dismantled components will be disposed of in the LILW repository that will operate during the decommissioning process; the control rods and the reactor vessel that are contaminated with long-lived radionuclides will be disposed together with SNF. SNF will be transferred into the cooling

² ratified and published in Off. Gaz. RS in February 2006.

pool and in 2030 moved into a dry storage.

The Programme also defines that the operator of the TRIGA research reactor shall bring the decision about the expected operation time of the reactor by 2007, taking into account the fact that Slovenia has an offer for shipping spent nuclear fuel from the research reactor to the USA by May 2019. In this case the reactor must stop operating by 2016. If the operator decides to extend the operational time beyond 2016, it shall propose a solution for HLW and SNF management and prepare the decommissioning programme.

The Central Interim Storage for radioactive waste at Brinje (CISRW) shall operate at least until the beginning of the operation of the LILW repository. The inventory from the CISRW will be partly disposed in the LILW repository and partly in an infrastructure center next to the repository. The CISRW will then be decontaminated and used for other purposes or decommissioned.

Radioactive waste arising from various nuclear facilities as well as that from use of radioactive sources in industry and research shall be managed as it has been so far. When an appropriate final repository is in operation, the waste will be permanently disposed of.

The Hospital centre Ljubljana uses open sources in medical treatment. Hence, collecting tanks for faeces contaminated with radionuclides shall be constructed by 2007. To store solid waste contaminated with short-lived radionuclides, special pantries shall be constructed.

The Programme also includes works for remediation of consequences of mining at the Žirovski Vrh uranium mine. Remediation of the Žirovski Vrh uranium mine will be finished when the shafts are closed, processing facilities decommissioned, and Jazbec and Boršt waste piles closed. Most of the land will be returned to unlimited use, with limitations foreseen only for waste piles of mine and hydrometallurgical tailings. The works will be finished in 2009, after which the public enterprise Žirovski Vrh Mine will be abolished and institutional control over the facilities with limited use shall be carried out by the ARAO.

The Resolution foresees operational programmes for management of radioactive waste and spent nuclear fuel for the periods 2005-2008 and 2008-2014.

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 and incineration, so that the total volume of waste accumulated at the end of 2005 amounted to 2255 m³. The total gamma and alpha activity stored were $1.80 \cdot 10^{13}$ Bq and $1.88 \cdot 10^{10}$ Bq, respectively. In 2005 112 standard drums containing solid waste were stored with total gamma and alpha activity $1.80 \cdot 10^{13}$ Bq and $1.88 \cdot 10^{10}$ Bq, respectively.

Figure 21 shows the accumulation of low and intermediate level radioactive waste in the storage at the Krško NPP. Periodical volume reductions with compression, super-compaction and incineration 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.

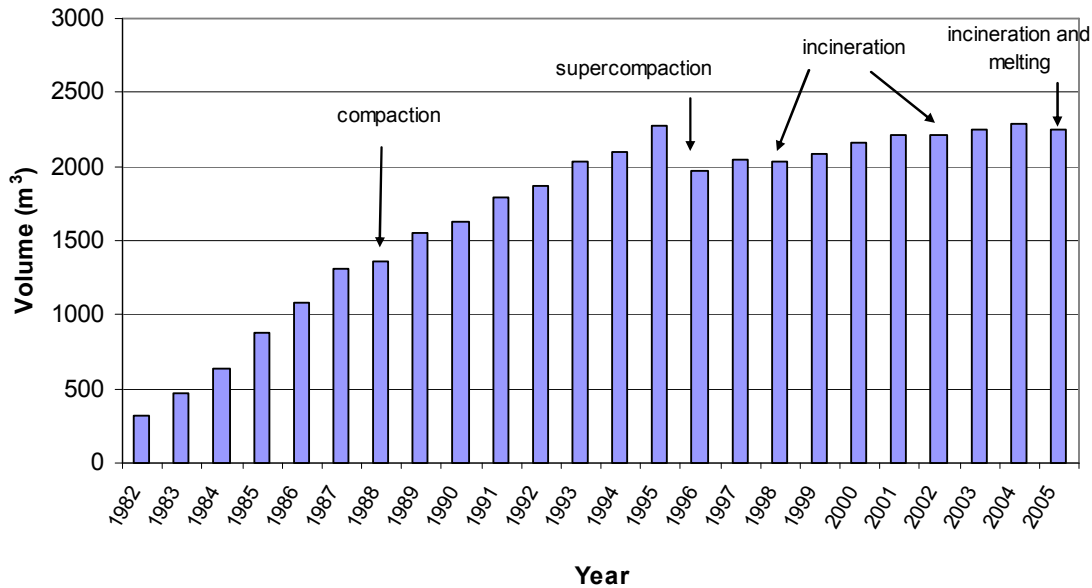
On 4th November 2005 the SNSA issued a provision to install a supercompactor HFC 1500 into the LILW storage at the Krško NPP.

In October 2005 283 drums of radioactive waste, among which 146 drums of compressible and 137 drums of other waste, were sent to Studsvik RadWaste Sweden for incineration and melting. At the end of 2005 the treated waste still hadn't been returned to Krško, hence the total volume of waste was 33.8 m³ smaller and the total activity was lower than the year before.

Because the working capacity of the existing IDDS is insufficient for drying the backlog

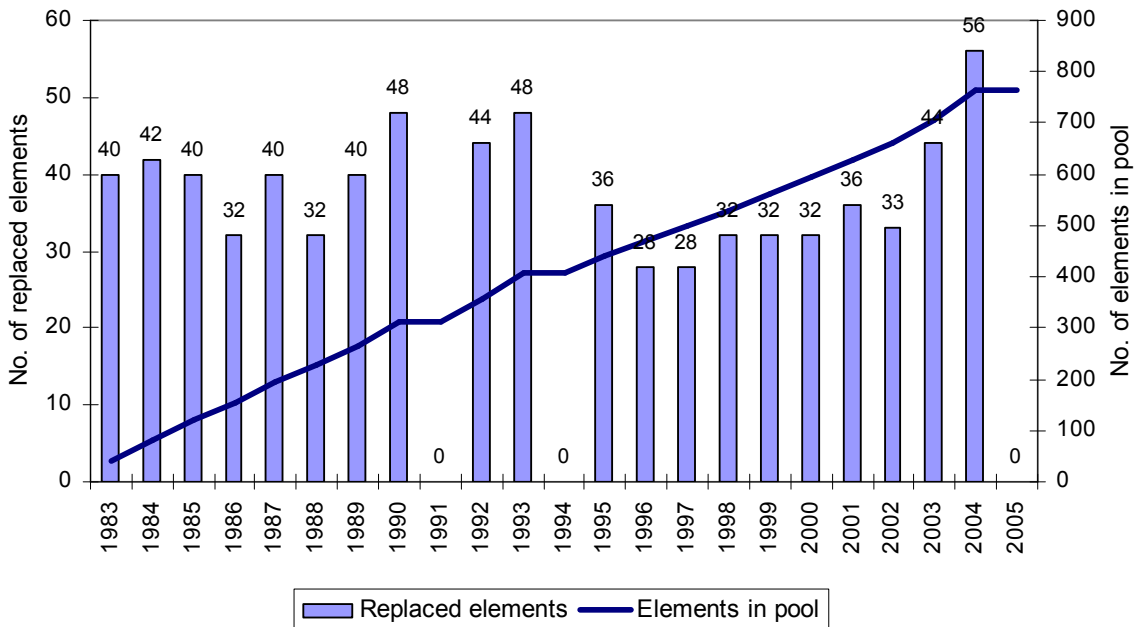
sludges and sediments, the Krško NPP hired an external service GNS Gesellschaft für Nuclear-Service mbH from Germany to perform the drying using a mobile IDDS unit.

Figure 21: Accumulation of low and intermediate level radioactive waste at the storage in the Krško NPP



As the Krško NPP started the 18-months fuel cycle in 2004, there was no outage of nuclear fuel in 2005. At the end of 2005 there were 763 fuel elements stored in the spent fuel pool. Figure 22 shows accumulation of spent fuel at the Krško NPP.

Figure 22: 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

In 2005 approximately 0.05 m³ of low and intermediate level waste was produced at the Reactor infrastructure centre of the Jožef Stefan Institute, and was handed over to the Central Interim Storage Facility at Brinje.

5.4. Radioactive Waste in Medicine

The Oncological Institute Ljubljana, as the biggest user of radioactive iodine ¹³¹I, has appropriate hold-up tanks to facilitate decrease of activity waste liquids through decay. The tanks are emptied every four or more months. Before the discharge, measurements of specific activity are performed by the authorized organizations. Discharge is carried out if the limit values are not exceeded. The Clinic for Nuclear Medicine of the Clinical centre of Ljubljana has not built the system for holding-up of liquid waste yet. The Clinic for Nuclear Medicine intends to build new premises that will have an appropriate system for holding-up of liquid waste, in accordance with the issued written order which requires this.

5.5. Activities of the Agency for Radwaste Management

The ARAO is responsible for carrying out the public service of radioactive waste management. Among other things, it also covers the operation of the Central Interim Storage for Radioactive Waste at Brinje, receipt of radioactive waste from small producers, siting and construction of a repository for low and intermediate level radioactive waste, and preparation of planning documents for radioactive waste management.

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

In 2005 the Agency for RadWaste Management prepared the basis for implementation of the Detailed Plan of National Importance (DPNI) for the LILW repository and announced a call for tenders for site selection. Eight municipalities applied, three of which later resigned.

In the remaining five municipalities 12 potential locations were identified, for which a preliminary study was performed by the ARAO. The aim of the study was to compare the natural (geological and hydro-geological), functional, economic, environmental, spatial and sociological (public acceptance) preferences and to identify the three most appropriate locations. At the end of October 2005 the study was delivered to the Ministry of Environment and Spatial Planning and in November 2005 the Government of the Republic of Slovenia decided that the LILW repository siting process should continue at the location Vrbina in the Krško municipality, the location Čagoš in the Sevnica municipality and the location Globoko in the Brežice municipality.

Projects for field investigations on these sites were prepared and delivered to the local communities for information and discussion. The ARAO prepared abundant documentation and project bases for the Detailed Plan of National Importance, and taking into account international experience it also prepared a methodology for the evaluation of research findings. Assistance from foreign professional organizations and experts has been assured through the PHARE programme.

Outline schemes for the LILW repository have been prepared in order to elaborate the documentation required for the Ministry of Environment and Spatial Planning when contacting other involved administrative parties to submit their design guidelines for projecting and planning of the repository. In the next step design bases will be prepared for a comparative study of various options.

The Agency pays considerable attention to public involvement in the decision-making on site selection, giving the local communities the basic right to actively participate in the siting process. When communicating with the public a series of activities have been performed and reports on public acceptance for each municipality have been prepared. The communications include phone interviews, interviews with decision-makers, broadcasting on local radio and TV stations, distribution of information materials, presentations and round tables for target groups, workshops, collecting public opinion etc. In May 2005 the ARAO prepared résumés for forming local partnerships and sent them for reviewing and completion to the municipalities entering the tender. The résumés define the purpose of formation of local partnerships, their legal status, structures, costs, funding and abolishment.

The site selection for a nuclear facility shall be based on the Special Safety Analysis, which evaluates all factors potentially affecting nuclear safety of the facility during its operation and the effects of the facility to the population and environment. The SNSA, in compliance with the 2002 Act, defined the contents and scope of the safety analysis.

5.6. Remediation of the Žirovski Vrh Uranium Mine

The remediation of the Žirovski Vrh uranium mine has been in progress since the foundation of the public enterprise Rudnik Žirovski Vrh in 1992. Since then, the uranium processing plant, together with the accompanying objects, has been successfully decommissioned and deconstructed. In 2005 activities were mainly performed in the mineshaft and consisted of removal of temporary mill tailings depository, preparation of project documentation and regular maintenance of facilities and both depositories, Jazbec and Boršt respectively.

Works in the shaft and on the surface were carried out without any special technical complications. In July 2005 all works in the shaft were finished, the ventilation station P-36 was removed and the saps were filled-up. Entry into the mine is no longer possible.

RŽV applied for consent to the mining works for closure of the Jazbec mine tailings. The project documentation was attached to the application and completed upon request by the SNSA. The analysis of potential emergency events (earthquake, storm, airplane crash, landslide, drought, fire, heavy rain and flooding of the Brebovščica River) showed that the consequences of such events would be localized, affecting only a few percent of the surface of the piles.

The dose to members of the public is expected to be below the annual limit of 0.3 mSv, which was set in the Planning license issued in May 2003 by the MESP. Therefore the SNSA issued a consent for closure of the Jazbec mine tailings. Following the issue of the consent the Ministry of Economy (Directorate for Energy, Sector for Mining) issued a license for the execution of mining works. When the works are finished a license for closure will be applied for and issued by the SNSA. The license for closure is a condition for the final provision on cessation of rights and obligations according to mining regulations.

For the Boršt depository of uranium mill tailings, project documentation and the Safety Analysis Report are in preparation. In 2005 regular maintenance of objects and surface was carried out.

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. Import, Export, Transport and Transit of Radioactive and Nuclear Materials

SNSA issues permits for 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). The SNSA issued a permit for import of 56 fresh fuel assemblies for the Krško NPP, which will be imported in February 2006.

On 1st May 2004 Slovenia became a member of the European Union. Therefore import and export of radioactive materials from the EU became subject to Council Directive (EURATOM) No. 1493/93 of 8 June 1993 on the shipments of radioactive substances between Member States. In accordance with the Directive both regulatory bodies have validated 44 declarations of consignees, where each isotope at the same consignee from one holder is counted separately. This standard document of declaration shall be valid for a period of not more than three years.

Besides imports and exports from Member States, in 2005 the SNSA and the SRPA issued 21 permits, 19 permits for import and 2 for export, respectively. The biggest importers were Biomedis Llc., Karanta Ljubljana Llc., Genos Llc., Krško NPP, Temat Llc., Kemofarmacija Inc., IMP Promont kontrolor NDT Črnuče, Premogovnik Velenje Llc. and Nafta-Geoterm Llc. Other companies only have occasional imports of radiation sources.

In 2005 one permit was issued for the transit of spent nuclear fuel from the research reactor Siemens-Argonout, Graz, Austria via Slovenia to the Port of Koper. The cargo was loaded on a ship and transported to the USA.

5.8. The Programme of Decommissioning of the Krško NPP

Obligations relating to the decommissioning of the Krško NPP are defined by the treaty between the Slovenian and Croatian Governments on solving statutory and other legal relations related to the investment into the Krško NPP, its exploitation and decommissioning. The treaty determines, *inter alia*, that the decommissioning of the Krško NPP and the disposal of radioactive waste are joint responsibilities of both contractors. A Programme of Decommissioning was prepared, which is to be revised at least every five years. The purpose of The Programme was to estimate the costs of decommissioning and to determine the corresponding amount of regular levy liable for payment for every kWh of electric power delivered from the NPP. The programme was confirmed in March 2005 by the Interstate Commission. According to the interstate treaty, Croatia should start collecting financial resources for the decommissioning of the Krško NPP in its own fund, which has not yet been established.

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

In 2005 the Slovenian national report on fulfillment of the obligations as a Contracting Party of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management was prepared. At the end of 2005 the Convention was obligatory for 36 countries.

This report was prepared by the Slovenian Nuclear Safety Administration. Contributions to the report were made by the Krško NPP, the Jožef Stefan Institute, the Agency for Radwaste Management, the Žirovski Vrh Mine Llc, the Isotope Laboratory of the Institute of Oncology, the Department for Nuclear Medicine of the Ljubljana University Medical Centre, the Slovenian Protection Administration and the body of delegates for the review meeting. The report was confirmed by the Government of the Republic of Slovenia and it will be presented at the second meeting of the Contracting Parties, which will be held in May 2006 in Vienna.

6. CONTROL OVER RADIATION AND NUCLEAR SAFETY

6.1. 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, last revised in 2004, Off. Gaz. RS, 102/2004).

The ZVISJV provides in its final clauses that a number of governmental and ministerial implementing regulations should be adopted. Until such regulations are adopted the regulations based on the acts which were valid in the year 2002 are still in force (Act on Radiation Protection and the Safe Use of Nuclear Energy, Off. Gaz. SFRY, 62/1984; Act on Implementing Protection against Ionizing Radiation and Measures on the Safety of Nuclear Facilities, Off. Gaz. SRS, 82/1980).

Based on the ZVISJV, fifteen implementing regulations were adopted by the end of 2004, namely four governmental decrees, two regulations issued by the minister of environment and nine regulations issued by the minister of health.

In 2005 the adoption of implementing regulations expedited and the following regulations and decrees were issued:

- Regulation on physical protection of nuclear substances, nuclear facilities and radiation facilities (Off. Gaz. RS, 31/05),
- Regulation on working conditions for workers carrying out physical protection of nuclear substances, nuclear facilities and radiation facilities and on requirements for workers having access to nuclear substances and on other conditions relating to physical protection (Off. Gaz. RS, 36/05 and 64/05),
- Regulation on conditions which must be fulfilled by workers carrying out safety significant works in the nuclear facilities or radiation facilities (Off. Gaz. RS, 74/05),
- Amendments of the regulation on shipment of radioactive waste into and out of the EU (Off. Gaz. RS, 80/05).

Several other decrees and regulations were in the process of preparation and reconciliation in 2005 and will be adopted and published in 2006.

6.2. Slovenian Nuclear Safety Administration

The Regulation on Organizations within the Ministries (Off. Gaz. RS, 58/03, 45/04, 86/04, 138/04, 52/05 and 82/05) provides that 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.

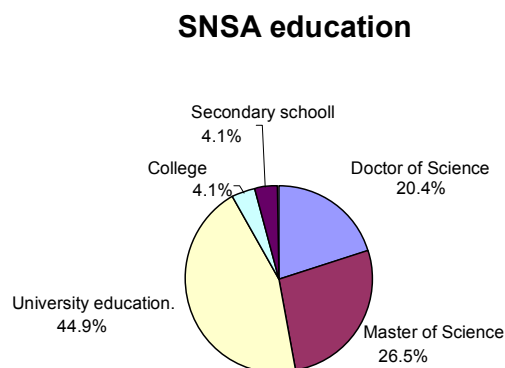
The legal basis for the administrative and professional tasks in the field of nuclear and radiation safety as well as inspection in this field are the Act on Protection against Ionizing Radiation and Nuclear Safety (Off. Gaz. RS, 102/2004, OCT-2) with the implementing decrees and regulations, the Act on Third Party Liability for Nuclear Damage (Off. Gaz. SFRY, 22/78 and 34/79), the Act on Transport of Dangerous Goods

(Off. Gaz. RS,79/99, 96/02, 2/04 and 101/05) and other regulations in the field of radiation protection and nuclear safety. The legal basis are also the acts and decrees for the ratification of international agreements in the field of nuclear energy and nuclear and radiation safety.

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.

The structure of SNSA's employees was at the end of 2005 as follows:

	No.	%
All employees	49	100
Women	15	30.6
Men	34	69.4
Doctor of Science	10	20.4
Master of Science	13	26.5
University education	22	44.9
College	2	4.1
Secondary school	2	4.1



The average age of employees was 41.4 years, while the average employment period at the SNSA was 7,1 years.

6.2.1. The Expert Council for Radiation and Nuclear Safety

The Expert Council for Radiation and Nuclear Safety provides expert assistance to the Ministry of the Environment and Spatial Planning and to the SNSA 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.

The Expert Council convened four times in 2005. In addition to the regular report of the SNSA director on the radiation and nuclear safety for the period in between meetings, the Expert Council considered and adopted four draft regulations (on authorized expert of radiation and nuclear safety, on radiation monitoring, on radioactive waste management and spent nuclear fuel management and on radioactive contamination). In 2005, the Expert Council also adopted:

- a position and proposals for long-term sustainability of supporting activities in the field of radiation and nuclear safety,
- an annual report on radiation and nuclear safety in Slovenia for 2004,
- a Krško NPP report on periodical safety report review,
- a national report according to the Joint Convention on Spent Fuel Management and Radioactive Waste management,
- a report on the status review in the field of physical protection of nuclear facilities and nuclear materials after Slovenia's accession to the EU.

Due to the expiry of the mandates the Minister of the Environment and Spatial Planning relieved two members of the Expert Council and appointed two new members with six-

year mandates. The first four-year mandates of the other three members are due to expire in the middle of 2007.

6.2.2. Expert Commission for the Examination of the Krško NPP Operators Qualifications

In 2005, the Expert Commission for the Examination of the Krško NPP Operators Qualifications, nominated by the SNSA, held seven sessions. The first session was devoted to the organizational problems in the preparation for carrying out the examinations of the Krško NPP operators' qualifications.

The remaining six sessions were related to the performance of the examinations for the extension of the licenses for the Senior Reactor Operator and the Reactor Operator.

In November and December 2005 the Commission organized six examinations for altogether 15 candidates. Nine candidates successfully acquired extension of the Senior Reactor Operator license and six candidates acquired the extension of the Reactor Operator license.

Upon the proposal of the Commission, the candidates who successfully passed the extension examination for the Senior Reactor Operator or the Reactor Operator obtained the relevant licenses from the SNSA, with a validity of four years.

6.3. The Slovenian Radiation Protection Administration

The Slovenian Radiation Protection Administration (SRPA), an agency within the Ministry of Health, performs specialized technical and developmental administrative tasks and tasks of inspection related to carrying out practices involving radiation and use of radiation sources in medicine and veterinary medicine, protection of people against ionizing radiation, systematic survey of exposure of both living and working environments to natural 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.

An expert council for radiation protection 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 responsible for surveillance of sources of ionizing radiation used in medicine and veterinary medicine and for the execution of regulations in the field of protection of workers and general population against ionizing radiation. In 2005, the SRPA had five employees, four of them holding the Ph.D. degree in science.

The activities of the administration focused on establishing an integral institutionalized system required for performing duties in the field of radiation protection. Within this framework, the activities of the SRPA comprised issuing of permits and certificates as prescribed by the Act, transfer of EU legislation, performing of inspections, informing and bringing awareness to the public about procedures of health protection against effects of radiation, and co-operation with international institutions involved in radiation protection.

The SRPA continued with monitoring of foodstuff and drinking water and with determination of radon concentrations and gamma radiation levels at workplaces in Karst caves. A project of assessing the exposure of air crews was started and the project of preparation of diagnostic reference levels was continued.

The SRPA surveyed radiation practices in medicine and veterinary medicine and use of radiation sources in those activities. 48 permits to carry out a practice involving radiation, 98 permits to use radiation sources in medicine and veterinary medicine and

46 confirmations of programmes of radiological procedures were granted. Seven inspections were performed in medicine and veterinary medicine. In three cases provisions requiring implementation of legally prescribed conditions for radiation practices and the use of ionizing radiation sources were issued and prohibition of further use for one X-ray device was ordered.

Within its competencies the SRPA also supervised the radiation protection of exposed workers in the Krško NPP, the Agency for Radioactive Waste Management, the Jožef Stefan Institute (JSI) – the Reactor Centre Brinje, and the Žirovski Vrh Uranium mine. One inspection was performed in each institution. Deficiencies were found in the Krško NPP regarding exceeding the authorized dose constraint and at the JSI - Reactor Centre Brinje with regard to the content of the document "Evaluation of protection of exposed workers against radiation".

With regard to radon, in 2005 SRPA supervised the Mežica Lead and Zinc Mine in closure, the Idria Mercury Mine in closure, the Postojna Cave, the Škocjan Caves and primary schools, kindergartens, hospitals and other public buildings with increased radon concentrations.

The inspection surveillance doubled in number (82 inspection procedures in 2005) and the number of granted permits increased by 20 %. Appropriate protection was assured in carrying out radiation activities and the use of sources of radiation in medicine and veterinary medicine. The SRPA carried out supervision together with the professional organizations that regularly inspect 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 register of personal doses of exposed workers were also performed.

6.4. Authorized Organizations

The Act on protection against ionizing radiation and nuclear safety stipulates the functioning of several types of authorized organizations and experts.

The regulation on authorizations for special tasks in the area of protection against ionizing radiation was adopted in early 2004 (Off. Gaz. RS, št. 18/04). It sets the conditions for obtaining such authorizations. The mandatory accreditation of laboratories is the new requirement, introduced by that regulation. All the authorized persons from these areas have to obtain new authorization by 13 March 2007, when their previous authorizations will expire.

6.4.1. Authorized radiation protection experts

cooperate with the employers in drawing up an 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, the 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 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. Presently the authorizations for radiation protection experts are granted by the Jožef Stefan Institute and the Institute of Occupational Health, which acquired the status of an authorized organization with the legislation of 1980.

6.4.2. Authorized dosimetric service

performs tasks related to monitoring of the exposure of persons to ionizing radiation. The authorization for measuring personal doses with the thermoluminescent dosimeters is held by the Institute of Occupational health, the Jožef Stefan Institute and the Nuclear Power Plant Krško (for its own and for the contractor's workers). Of the above mentioned

institutions the Institute of Occupational Health has already acquired an accreditation according to the SIST EN ISO/IEC 17025 standard, while the other two are in the process of accreditation. Authorization for monitoring of exposure to radon and its progeny is held by the Institute of Occupational Health, the Jožef Stefan Institute and the Žirovski Vrh mine.

6.4.3. 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. The institution of authorized medical physics experts is a novelty in our legislation, and no experts have been authorized so far in this field.

At the beginning of 2004 a Regulation on authorization of providers of professional tasks in the field of ionizing radiation (Off. Gaz. RS, 18/04) was passed. The regulation sets conditions for acquiring the authorizations. A novelty introduced by this regulation is the requirement for accreditation of laboratories in compliance with the standards SIST EN ISO/IEC 17025 or SIST EN 45004. The regulation also sets the requirement that the authorization in accordance with this regulation should be acquired by the present authorized organizations in 3 years from its coming into force i.e. by 13 March, 2007. Until that date the authorizations issued on the basis of the legislation of 1980 are valid.

6.4.4. Authorized providers of the health surveillance of exposed workers

carry out health surveillance of exposed workers within the framework of the public health service. At present five organizations are authorized: the Clinical Institute for Medicine of Work, Traffic and Sport, the Institute of Occupational Safety, 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. The extent of medical surveillance, the functioning of the authorized institutions and the conditions which must be fulfilled for acquiring the authorization are set in the Regulation on Medical Surveillance of Exposed Workers (Off. Gaz. RS, 2/2004).

Authorized providers of the health surveillance of exposed workers have to get appropriate refreshment training every three years. In 2005 the Slovenian Radiation Protection Administration in co-operation with Clinical Institute of Occupational, Traffic and Sports Medicine initiated the preparation of training programmes.

6.4.5. Authorised experts for radiation and nuclear safety

perform certain tasks in the fields of nuclear safety and radiation protection within the Republic of Slovenia. They were authorized on the basis of Article 14 of the Act on Implementing Protection Against Ionizing Radiation and Measures for the Safety of Nuclear Facilities of 1980. These authorizations will expire six months after the introduction of the new regulation based on the Act on Protection against Ionizing Radiation and Nuclear Safety from 2002.

In 2005 the following 13 organizations held the authorization:

- Milan Vidmar Electric Institute (EIMV), Ljubljana,
- ENCONET Consulting, Vienna, Austria,
- Faculty of Electrical Engineering and Computing, University of Zagreb, Croatia,
- Faculty of Mechanical Engineering, University of Ljubljana,
- IBE Consulting Engineers (IBE), Ljubljana,
- Jožef Stefan Institute (IJS), Ljubljana,
- Energy Institute (IE), Zagreb, Croatia,
- Institute for Energy and Environment Protection (EKONERG), Zagreb, Croatia,
- Institute of Metals and Technologies (IMT), Ljubljana,

- Institute of Metal Constructions (IMK), Ljubljana,
- Welding Institute (ZAVAR), Ljubljana,
- Izolirka, Fire Engineering, Radovljica,
- Slovenian National Building and Civil Engineering Institute (ZAG), Ljubljana.

Based on the yearly reports of the authorized organizations, the main conclusion was that there were no major changes in their performance in comparison with previous years. In the field of staffing the authorized organizations maintain their competence; however, there is no noticeable recruitment of new young engineers. The equipment used in their professional work has been well maintained and updated. The organizations have established the Quality Management Programmes, and some of them even obtained or renewed the Quality Certificate in compliance with ISO 9001:2000. As in 2005 there was no regular refueling outage of the Krško NPP, the independent surveillance of the activities related to nuclear and radiation safety during its refueling outage, and the provision of the Joint Expert Assessment Report on the Outage Activities to the SNSA were not carried out.

The authorized organizations kept providing professional support to the Krško NPP by preparation of expertises, safety analyses and design work; they also trained the plant's personnel in various professional areas. An important part of their work focused on 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 participated very successfully in the 6th framework programme of the EU research.

The authorized organizations also cooperated with two international organizations: the International Atomic Energy Agency and the OECD Nuclear Energy Agency.

The Act on ionizing radiation protection and nuclear safety of 2002, in Articles 58 and 59, regulates the functioning of the authorized experts for radiation and nuclear safety. A particular regulation, required by Article 59, shall set the procedure for acquiring the authorization for carrying out the work of an authorized expert for radiation and nuclear safety, the requirement for keeping the records of authorized experts, the format and extent of regular and exceptional reports, and other conditions which authorized experts for individual fields of radiation and nuclear safety must fulfill in relation to assessing radiation and nuclear safety. According to the Act the authorized organizations shall acquire new authorizations for authorized experts. The validity of the old authorizations will expire in six months after the promulgation of the new regulation.

6.5. The Fund for decommissioning of the Krško NPP

The fund for Decommissioning of the Krško NPP is collecting financial resources from the Slovenian owner of the plant. In 2005 the Krško NPP delivered half of electric power to Slovenian and Croatian economy respectively. ELES GEN, Llc. was liable for the payment of the regular levy to the Fund until May 2005 in the amount of 0.462 SIT and from May 2005, due to the adoption of the decommissioning plan, 0.3 eurocent (0.719 SIT) for every kWh of electric power received from the NPP. By the end of the year ELES GEN contributed in due time the total amount of 1,783 million SIT, which is 48 % more than in 2004.

In 2005 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 Republic of Slovenia.

On 31 December 2005, the Fund managed 29,116 million SIT of financial investments, 25 % of which was invested in banks in the form of deposits and CDs, 47 % in state securities, 21 % in other bonds and 7 % in mutual funds and stock of Slovenian

companies. Investments in deposits are dispersed in six business banks and one savings bank, while investments in state securities are dispersed at sixteen national and fourteen foreign editions.

Considering the stock market exchange rates of the Fund's portfolio on 31 December 2005, the selling of all securities would have resulted in 1,294 million SIT of capital profit. The yield of entire portfolio of the Fund for the 2005 amounted to 4.82 % per Euro.

The entire income of 3,052 million SIT from the funding in 2005 exceeded the income of 2004 by 4.6 %, but was 6.5 % lower than initially planned, which is the result of smaller than planned contribution. The expenses in 2005 were 4 % lower than planned and amounted to 1,132 million SIT.

Construction of LILW repository is expected to take place between 2006 and 2013. Because of 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 90.6 million EUR or 21.7 billion SIT 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.

6.6. 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 eight members.

The Insurance Company Triglav, Ltd., and the Reinsurance Company Sava, 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 (special drawing rights) 150 million or approximately USD 227 million, which is in accordance with the Decree on Establishment of the Amount of Operator's Limited Liability and the Corresponding Amount of Insurance for Nuclear Damage. The share retained by the Slovenian Pool is 1.30%, while the rest of the risk is reinsured by 16 foreign pools, the most important being British, Japanese, German, French and Swedish.

In 2005 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 Slovenian tolar, which equals to the amount of SDR (special drawing rights) 5 million.

6.7. Nuclear and Radiation Emergency Preparedness

The emergency response, which would be activated in the case of a substantial release of radioactivity to the environment, is very important part of the national comprehensive system of nuclear and radiation safety. Therefore, for ensuring national nuclear and radiation safety it is essential constantly to work on nuclear and radiation emergency preparedness.

6.7.1. The Administration of RS for Civil Protection and Disaster Relief

The Administration of RS for Civil Protection and Disaster Relief (ACPDR) is responsible for updating the Annexes and for the review of Appendices of the National Nuclear Emergency Plan. These Annexes and Appendices are written and sent to the ACPDR by the responsible ministries and governmental institutions. In 2005 the focus of ACPDR

activities was mainly on these Annexes and Appendices, with the intention of bringing them up to date.

To increase the effectiveness of the national emergency plans and to update the Annexes and Appendices to these plans, as well as to assure faster access to the data in case of various exercises and disasters, the project was finalized in 2005 and a computer code was produced for preparation and use of plans for on-line access to emergency data bases. The labeling of Annexes and Appendices was unified, the Annexes and Appendices were transferred to digital form and the data bases were cross-connected. Most of the regional emergency plans were harmonized with the National Emergency Plan, while the municipal plans are still in the phase of changing and harmonization with other plans.

The National Nuclear Emergency Plan is published on the website of the ACPDR along with the English version. There are also instructions for the population in case of nuclear emergency.

In the Training Centre for Protection and Rescue at Ig, 279 members of Civil Protection, capable of intervening in radiation and nuclear emergencies, were trained.

Under the provisions of the Agreement between the Governments of Croatia and Slovenia on Co-operation in the Protection against Natural and Civilization Disasters, one meeting was organized in 2005.

6.7.2. The Slovenian Nuclear Safety Administration

By continuous activity on emergency preparedness, the SNSA has maintained an efficient emergency response system which would be activated in case of a nuclear and/or radiation emergency and release of radioactivity to the environment. During an emergency the SNSA completely transforms its operation structure, follows its own emergency plan and provides professional support to the National Civil Protection Headquarters (Administration for Civil Protection and Disaster Relief - ACPDR, the leading agency for decision making during an emergency in Slovenia). During nuclear or radiological emergencies the SNSA prepares expert and competent suggestions for the civil protection administration in the form of recommendations about protective actions, response and counter-measures (especially in early and intermediate phases of the accident). The emergency plan contains specific procedures for maintenance the SNSA preparedness to emergency and for staff activation. Some new procedures were prepared in 2005 on the basis of domestic exercises, international experience and new knowledge, and they were included in the SNSA emergency plan. The SNSA emergency plan is regularly revised, verified and updated by new procedures. At the moment it is composed of 34 procedures, instructions and guidelines for procedures revision.

The SNSA regularly trains its staff for the response in case of a nuclear and/or radiological emergency. The emergency personnel had general and also more specific regular drills during the whole year. The SNSA also actively worked with other institutions (in particular with the Jožef Stefan Institute) in preparing drills and exercises for its staff.

The SNSA actively and periodically co-operates with domestic and international organizations and emergency agencies on maintaining and updating the national emergency plan. It was also actively involved in the Krško NPP emergency plan examination.

In 2005 the "NEK-2005" exercise took place. Besides the Krško NPP, also the SNSA emergency team actively participated in this exercise.

6.7.3. The Krško NPP

The activities of the Krško NPP in 2005 concerning emergency planning were directed to the maintenance of the existing preparedness, especially to increasing the training and skills of the Krško NPP emergency personnel and to implementing the tasks and recommendations assigned within the frame of the annual emergency preparedness

action plan. In this context, priority was given to the staff's professional training and evaluation of the emergency plan, and on the tasks preparation and implementation of the past Krško NPP exercises.

In 2005 emergency preparedness was enhanced by preparation and implementation of the IAEA OSART 2003 mission recommendations. All IAEA recommendations were successfully realized, which was confirmed by the IAEA's review in November 2005.

Throughout the year, the Krško NPP maintained the operability of emergency centers and equipment, updated emergency documentation and performed systematic monthly communication testing and checking of emergency personnel response. In 2005 14 Krško NPP emergency implementation procedures were revised. One new procedure for application of potassium iodide was issued. Three groups visited the plant and informatively examined the Krško NPP's emergency preparedness and response system.

The Krško NPP alerting system was also updated. The modification of the Technical Support Centre (TSC) ventilation and reorganization of the Operative Support Centre (OSC) continued successfully in 2005, and are expected to be completed in 2006. The computer code for dose calculation was prepared and used for training and exercises. The code was successfully tested in October 2005. As a consequence of past trainings the radio system ZARE+ was installed in the Krško NPP external support center in December 2005. The same radio system will be installed in the Krško NPP TSC in 2006.

Throughout the year, the Krško NPP actively co-operated with the ACPDR, the SNSA and other local and national domestic organizations and emergency agencies.

6.7.3.1. The "NEK-2005" Exercise

The announced annual internal exercise, called "NEK-2005", took place on 14 December 2005 between 15:00 and 19:30. Besides the plant's personnel, the Krško professional fire unit, the Krško police station and the SNSA participated. The National Notification Centre and the Regional Krško Notification Centre were also involved.

The exercise had the following objects:

- An integrity test of the plant's emergency preparedness by trying out specific elements of the whole system.
- A reconciliation test of the Krško NPP's emergency plan with procedures for physical protection and fire-defense plan.

The exercise has shown that all participants are well prepared for this type of event. The Krško NPP procedures and emergency plan are reconciled with and follow international recommendations and practice. The need for some specific equipment, the revision of some procedures and of specifying some measures was established

7. NUCLEAR NON-PROLIFERATION AND SECURITY OF RADIOACTIVE MATERIALS

Nuclear non-proliferation is an activity preventing the development and production of nuclear weapons in countries which are formally non-nuclear-weapon states. Nuclear-weapon states are the USA, the Russian Federation, the United Kingdom, France and China. Since the Gulf crisis, the discovery of clandestine activities in North Korea, nuclear weapon tests in India and Pakistan and the terrorist attacks on 11 September 2001, the international community has been devoting a lot of attention to this issue. Slovenia completely fulfils its obligations which derive from the adopted international agreements and treaties. Slovenia supports all efforts of the International Atomic Energy Agency (IAEA), which inter alia issued a Code of Conduct on the Safety and Security of Radioactive Sources. Particular attention is paid to high-activity sources with the biggest potential risk and consequences. In 2003, the Council of the European Union issued Council Directive 2003/122/EURATOM on the control of high-activity sealed radioactive sources and orphan sources. Slovenia took into consideration this directive during the preparation of 2nd level legislation in 2005. In May 2005, a Review Conference regarding Non-Proliferation of Nuclear Weapons was held in New York. The results of the conference are worrying, as substantial differences emerged among the Member States.

7.1. The Safeguards agreement

In Slovenia, all nuclear material (fresh and spent fuel) at the Krško NPP and at the Research reactor TRIGA (which is operated by the Jožef Stefan Institute) is under the International Atomic Energy Agency supervision. There were five IAEA inspections during 2005 and no anomalies were found. The SNSA reported to the IAEA in due time and in accordance with the Safeguards agreement. In September 2005, the IAEA informed the SNSA (the Republic of Slovenia) on the beginning of application of integrated safeguards, which will be an upgrading of the current system of safeguards. On 1 May 2004 Slovenia became a member of the European Union; hence the organizations that possess nuclear materials are liable to the regulations within the EURATOM legislation. There were two EURATOM inspections in 2004. When the safeguards agreement between the European Union and the IAEA enters into force also for Slovenia, it will not report to the IAEA. Until then, Slovenia will have to apply the Safeguards agreement with the IAEA.

7.2. The Additional protocol to the Safeguards agreement

The Additional protocol to the safeguards agreement was signed in 1998, then ratified, and it entered into force in 2000. The SNSA prepared the initial report and sent it to the IAEA in 2001. Since then annual updates have been prepared. The last one was sent to the IAEA in May 2005. The update mainly referred to Article 2.a (iii) of the Additional protocol, which addresses the description of changes of the Krško NPP site. The changes concerned the facility modifications carried out at the Krško NPP site. IAEA inspectors carried out two inspections under the Additional protocol and no anomalies were discovered.

7.3. 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. In September 2005 there was a conference in New York on the facilitation of application of the CTBT. Its purpose was to look for means and ways to animate the states which have not yet signed or ratified the treaty. Representatives of the Slovenian Ministry of Foreign

Affairs attended the conference.

7.4. 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. In accordance with the established rules and procedures, the SNSA reported regularly to both organizations also in 2005. Since 1 May 2004 a new Act on Export Controls of Dual-Use Goods is in use. A special Commission for Export Controls of Dual-Use Goods was established. 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 2004 the Commission had 15 regular and 35 correspondence sessions, and 69 applications of Slovenian companies were assessed. Most of the goods were either chemicals or machine tools. Some machine tools were indeed from the list of nuclear dual-use goods.

7.5. Physical Protection of Nuclear Material and Facilities

Physical protection of nuclear facilities and material at the Krško NPP, at the research reactor TRIGA, and at the Central Interim Storage for Low and Intermediate Waste at Brinje is supervised by the Ministry of the Interior and the SNSA. At the Ministry of the Interior a Commission has been established for tasks related to physical protection of nuclear material and facilities. On the basis of information provided by the police, intelligence services, the SNSA and nuclear facility operators, the commission reviewed the design basis threat for each nuclear facility in Slovenia.

In 2005, activities related to the harmonization with 2nd level legislation were performed, both by regulatory bodies and nuclear operators, as well as activities related to the ratification of changes of the Convention on Physical Protection of Nuclear Material, which was adopted at a diplomatic conference in Vienna in July 2005.

7.6. Illicit Trafficking of Nuclear and Radioactive Materials

In order to prevent illicit trafficking of nuclear and radioactive material a great number of actions have been organized primarily through international organizations such as the International Atomic Energy Agency and the European Commission. Besides this there are also bilateral activities, mainly with the USA. Mainly between 2002 and 2004, Slovenia received substantial support in detection equipment, and Slovenian experts attended a number of special workshops or trainings.

To enable assistance and consultation, the SNSA gave other state offices and private organizations (scrap recyclers, melting facilities) a phone number of a 24-hour on-duty officer. There were 10 calls in 2005, most of them by the customs and the Slovenian railways.

The Customs Administration informed the SNSA about rejections of train shipments of scrap metal by Italian border officers. The shipments were rejected due to elevated levels of radioactivity. Most of the shipments were returned to the senders, while some were inspected. The sources found were separated and sent to the Central Interim Storage of Radioactive Waste at Brinje. Unfortunately, some contaminated shipments were not detected and were sold to Slovenian metal producers, where they were reprocessed. So far no larger contamination of metallurgic products or the environment has occurred, but a latent risk exists nevertheless. For this reason the SNSA actively co-operates with other state offices and with the Slovenian railways.

In order to find a permanent solution for preventing illicit trafficking of radioactive material, the Slovenian Government in September 2005 appointed a Joint working group for prevention of unauthorized shipments and transit of nuclear and other radioactive materials in Slovenia. Its members are representatives from the Ministry of the Interior, the Ministry of Finance – the Customs Administration, the Ministry of Economy, the Ministry of Transport, the Ministry of Health – the Slovenian Radiation Protection Administration and the SNSA. Until the end of 2005 the working group prepared a programme of preventive measures, among which the most important one is adoption of specific subsidiary legislation, which will bind importers of scrap metals to have their shipments radiologically measured. The subsidiary legislation shall be adopted in 2006

In 2005, an agreement was signed between the Ministry of Finance and the US Department of Energy, on co-operation in the area of combating illicit trafficking of nuclear and other radioactive materials. Based on this agreement, inter alia fixed portal monitors are going to be installed at the Port of Koper and the international border crossing Obrežje (road).

In 2005, Slovenia did not report to the IAEA Illicit Trafficking Database. From 1993 to the end of 2005, the IAEA received around 700 reports of incidents throughout the world. They were characterized as theft, loss, discovery, unauthorized transfer of radioactive sources, etc.

8. INTERNATIONAL CO-OPERATION

8.1. The International Atomic Energy Agency

In the year 2005, the successful co-operation with the International Atomic Energy Agency continued. The Slovenian delegation attended as usual the regular session of the General Conference (26 – 30 September 2005). During the General Conference Slovenia, as representative of the area of Eastern Europe, elected a member to the Board of Governors for a period of two years (2005 – 2007).

The Board of Governors is composed of 35 Member States, designated and elected by the General Conference. It is the main policy-making body in the period of two regular sessions of the General Conference. The Board of Governors consists of the 10 Member States most advanced in the technology of atomic energy (USA, Russian Federation, Great Britain, France, China, Belgium, Japan, Republic of Korea, India and Germany) and 25 Member States elected according to the regional distribution for a period of two years. Slovenia belongs to the area of Eastern Europe. During the second year of Slovenia's membership in the Board of Governors (from 2006 to 2007) the chair of the Board of Governors will be taken over by a member of the area of Eastern Europe. It is most probable that Slovenia will gain enough support within the area to be elected chair of the Board of Governors.

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

- Within the programme of technical co-operation in 2005 Slovenia received 16 applications for training of foreign experts in our country. 12 applications out of 16 were implemented in the same year, as well as 5 applications from 2003 and 2004. All other applications approved by our country will be implemented in 2006.
- Within technical co-operation in 2005 there were 7 research contracts going on, which had been already signed in previous years. 4 new research contract proposals were approved by the Agency.
- Technical assistance projects are the most extensive form of co-operation between Slovenia and the International Atomic Energy Agency. This is due to the large amount of resources, engagement of experts and also to the fact that projects of this type usually last for several years. In 2005, Slovenia submitted 6 new technical assistance project proposals for the cycle 2007-2008, which will be decided upon in the year 2006. In 2005, the activities within the framework of national projects submitted by Slovenia in 2003, started to be implemented, and 4 other national projects continued.
- In 2005, the International Atomic Energy Agency implemented two missions. From 7 to 11 November, a Follow-up OSART Mission (Operational Safety Assessment Review Team Mission) was carried out at the Krško Nuclear Power Plant. The team members determined the status of actions taken in response to the 2003 OSART Mission findings. In September, an expert visit of an American expert concerning the preparation of the content and guidelines for the review process of the environmental impact assessment took place at the Slovenian Nuclear Safety Administration.
- Slovenia continues with its active politics of hosting activities organized by the IAEA. In 2005, Slovenia hosted 6 regional workshops, training courses and seminars.
- Upon the proposal of the Slovenian Nuclear Safety Administration, the International Atomic Energy Agency appointed three Slovenian experts to the Nuclear Standards Committee, the Waste Standards Committee and the Radiation Standards Committee. The Slovenian experts actively participated in activities of the three committees.
- The International Atomic Energy Agency endeavors to improve and strengthen the technical cooperation with Member States. Therefore, the financial resources are focused in the areas of national importance. In this connection the Agency developed the so-called *CPF – Country Programme Framework* programming tool. During the annual meeting of the General Conference Slovenia signed the CPF document. The

Country Programme Framework provides a concise frame of high priorities for the development of our country. The tool will be considered in the Technical Cooperation project planning and design during a period of 4 to 6 years.

It should be emphasized that Slovenia timely settled all its financial obligations to the International Atomic Energy Agency, i.e. the contribution to the Regular Budget as well as the contribution to the Technical Co-operation Fund. Furthermore in 2005 Slovenia expressed readiness to make a voluntary contribution of 20,000 EUR into the Nuclear Security Fund. The Nuclear Security Fund was established to financially support the Agency's projects and activities in the field of strengthening nuclear security activities and protection against acts of nuclear and radiological terrorism.

In the year 2005, the Director General received a formal initiative to fundamentally change the Convention on the Physical Protection of Nuclear Material. Based on that initiative a diplomatic conference to consider and amend the proposed amendments was convened. The conference was held at the Headquarters of the International Atomic Energy Agency in Vienna from 4 to 8 July 2005. Representatives of 88 States Parties (out of 111 States Parties) and of one organization party to the Convention (EURATOM) participated in the Conference. At the end of the conference the proposed text of the Final Act signed by the heads of delegations was adopted by consensus. On behalf of the Republic of Slovenia, Director of the Slovenian Nuclear Safety Administration, Andrej Stritar, signed the Final Act in accordance with a preliminary approved initiative to adopt the amendments to the Convention on the Physical Protection of Nuclear Material. In September 2005, the Slovenian Nuclear Safety Administration, in agreement with the Ministries of the Interior and Foreign Affairs, prepared a written statement to commence the ratification process for the implementation of the Convention.

8.2. OECD/NEA

In the year 2005, as in previous years, there was close co-operation of Slovenia with the Nuclear Energy Agency (NEA). In 2001, Slovenia was awarded the status of an observer country for a two year cycle, which was extended in 2005 for another two year period. Within the framework of the NEA there are seven standing committees to which Slovenian experts were designated by the Slovenian Government. The committees are:

- Radioactive Waste Management Committee,
- Committee on Radiation Protection and Public Health,
- Committee on the Safety of Nuclear Installations,
- Committee on Nuclear Regulatory Activities,
- Nuclear Law Committee,
- Committee for Technological and Economic Studies on Nuclear Energy Development and the Fuel Cycle,
- Nuclear Science Committee.

8.3. Co-operation with the EU

In January 2005 Luxembourg took over the presidency of the EU, as well as the presidency of the Atomic Questions Working Group (ATO). Luxembourg's presidency programme had two main priorities: to finalize the draft Directive on shipment and control of radioactive waste and spent fuel, and to make progress in the discussion on nuclear safety and radioactive waste management, which was based on the work of the ad hoc Working Party on Nuclear Safety (WPNS). The other priorities were: to reach an agreement between the European Commission and the Member States regarding safeguards measures, to make progress in bilateral negotiations (with Kazakhstan, Japan, China, Russia and KEDO) and to carry out accession of the Euratom to the Joint Convention on Radioactive Waste Management and to the conventions on early notification and on assistance in case of nuclear or radiological emergency.

In the first half of 2005 important activities took place between the European Commission and the IAEA with regard to the new safeguards inspection regime. The IAEA complained that the European Commission had not notified the IAEA about the changes of the safeguards inspection regime. The objection was that the European Commission should have notified the IAEA at least one year before the start of implementation of the new safeguards inspection regime, which would enable a smoother transition from one regime to the other. The IAEA called upon the European Commission to temporarily suspend the new safeguards inspection regime for a one year period. The European Commission in its reply did not agree with the temporary suspension, but the EU Energy Commissioner, Andris Piebalgs, responded that he was willing to co-operate with the Member States to resolve the issue.

In the second half of 2005 the United Kingdom took over the Presidency of the EU and the main items on the ATO agenda were the following:

- A new framework for the Euratom Safeguards: UK Presidency prepared an updated document for the Council, which was adopted by the majority of the Member States,
- Winding up the exit of the EU from the KEDO project in the People's Republic of Korea,
- A document called "Instrument for Assistance", the aim of which was to provide assistance in nuclear safety to the third countries.

In November 2005 the European Atomic Energy Community became a party to the two conventions on early notification and on assistance in case of nuclear or radiological emergency. The Decisions about this fact were published in the Official Journal of the EU.

The SNSA took part in the preparation of two documents, i.e. on the priorities of Slovenia in the EU in 2006 and on the priorities of Slovenian Presidency in 2008.

In January 2005 there was a constitutional meeting of the ad hoc Working Party on Nuclear Safety (WPNS). The WPNS consists of three sub-groups (a) for nuclear safety, (b) for radioactive waste management, and (c) for decommissioning and decommissioning funds. The mandate of the WPNS is to realize the Council Conclusions on Nuclear Safety and Safe Management of Spent Fuel and Radioactive Waste (of June 2004), i.e. to continue activities on the harmonization of nuclear safety in the Member States. The WPNS will try to find common characteristics for all Member States in the concerned area, and special emphasis will be given to the added value of the recommendations, which will be directed to the strengthening and achieving a high level of nuclear safety in the EU.

8.3.1. PHARE Projects in 2005

The contract for the implementation of the project »Support to the SNSA in Upgrading and Modernization of the National Early Warning System« was signed in March 2005. Throughout the year civil engineering works and radiation monitor installations were carried out.

For the project »Characterization of Low and Intermediate Level Radioactive Waste Currently Stored in the Central Facility Brinje« a kick-off meeting was held in January 2005. The first cycle of waste characterization started in April 2005. In May 2005 the action plan for the activities and the working procedures were finalized. A substantial delay was caused by negotiations about renting of the »hot-cell« in the Podgorica research reactor centre and by the establishment of working conditions in it. The characterization was finished in November 2005.

In May 2005 the evaluation of the received bids for the project »Hot-Cells Facility Renovation and Modernization« was carried out. In the tender there were four lots of equipment, but the bidders send only three bids, in which they offered manipulators (mechanical arms), equipment for decontamination and radiation measuring equipment. By the end of 2005 all equipment was supplied except the manipulators, which are planned to be delivered and installed in March 2006.

For the project »Assistance in Development of the Conceptual Design of a Low and Intermediate Radioactive Waste Repository in Slovenia« the tender was published in April 2005, and in August 2005 the bidder short list was produced. By the end of the year the project contractor was selected and the contract was signed.

In November 2005 an independent evaluation of Phare projects was carried out by the Pitija d.o.o. company on behalf of the European Commission in the areas of energy, transport and environment.

8.3.2. WENRA

WENRA is an informal association of European nuclear regulators (the Western European Nuclear Regulators' Association), whose members are regulators of the new EU Member States, the candidate states and Switzerland. The activities of the association encompass reference safety levels and evaluation of how well the requirements of these reference safety levels have been met by a particular member of the association. Two working committees prepare the documents, one committee in the area of reactor safety, and the other one in the area of radioactive waste and decommissioning of nuclear objects.

There were two meetings of the main committee in 2005. Both working committees (for reactor safety and for radioactive waste safety) finalized activities with regard to reference levels, i.e. harmonized the safety requirements. In January 2006 the publishing of reference levels and a presentation of WENRA activities were announced to be held in Paris.

Slovenia will follow the harmonized safety requirements and transpose these requirements to the Slovenian legislation.

8.3.3. Co-operation with other Associations

From 9 to 13 October 2005 the International Law Association (INLA) organized the biennial international conference »Nuclear Inter Jura 2005« in Portorož, Slovenia.

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.

At the INLA Management Committee Meeting in 2003, Professor Peter Grilc (Law Faculty of Ljubljana) was elected President of the INLA Management Committee for a two year term of office (2004 – 2005). Slovenia was unanimously accepted by the Management Committee as the organizer of the 2005 INLA Conference. The venue of the INLA Conference was Portorož and the organization was entrusted to the Nuclear Training Centre »Milan Čopič« at the Jožef Stefan Institute.

More than 120 participants from all over the world attended the Conference. The fact that participants were from all continents proved that this Conference had a "global" character. The countries with extensive peaceful nuclear programmes, such as France, Germany and the UK, had the most numerous delegations. The organizers were pleased to have among the participants also the IAEA, OECD/NEA and the European Commission. With regard to the number of countries and participants this was the biggest international event in the area of legal expertise in Slovenia.

8.3.4. 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.

From 2 to 27 May 2005 a Slovenian delegation participated in the Review Conference of the States Parties to the Non-Proliferation Treaty, held at the UNO headquarters in New York. In the end the Conference adopted a procedural report about the work performed. The report contains the number of meetings and the number of working documents.

Besides co-operation in multilateral agreements, the SNSA continued to co-operate with representatives of related regulatory bodies in the scope of bilateral agreements.

In September 2005 a bilateral meeting of the representatives of the US NRC with representatives of the SNSA was organized. At this occasion Dr Andrej Stritar and Dr Nils Diaz, Chairman of the US NRC, signed a bilateral agreement about bilateral exchange of information between the US NRC and the SNSA for an additional period of five years.

In July 2005 a bilateral agreement was signed between the SNSA and the Austrian Federal Ministry of Agriculture, Environment and Water Management. The scope of the agreement was co-operation in radiation protection and bilateral exchange of data between the two radiation monitoring systems. These data refer mainly to aerosol monitoring stations and the agreement also concerns maintenance of aerosol monitoring stations.

The SNSA hosted a bilateral meeting with Austrian representatives in Maribor in October 2005. The meeting agenda comprised a legal and an administrative framework. It focused on radiation monitoring, emergency preparedness, the Slovenian nuclear programme, radioactive waste management and research reactors. With the Czech Republic, the Slovak Republic and Hungary, the requirements from bilateral agreements to exchange information are met during annual quadrilateral meetings. In 2005 such a meeting was organized in Demanova Dolina, Slovakia. The meeting covered events in nuclear power plants and the regulators' response, the status of nuclear regulations in the respective countries, radioactive waste management, safety indicators and discussion about the conclusions of the last (the third) Convention on Nuclear Safety Review Meeting.

8.3.4.1. The Third Review Meeting of the Contracting Parties of the Convention on Nuclear Safety

The third Review Meeting of the Contracting Parties of the Convention on Nuclear Safety was organized from 11 to 22 April 2005 in Vienna. These meetings are organized every three years.

Slovenia posted 81 questions on the reports of 17 other contracting parties, while the other parties posted 94 questions on the Slovenian report. On the third day of the Review Meeting Slovenia had a presentation of its report. The presentation followed the format which was determined in advance by the IAEA Secretariat. The questions asked by other contracting parties after the presentation were aimed at important modifications, responsibility of the license holder, periodic safety review, radiation protection, quality management, working methods of nuclear safety inspectors and radioactive waste management.

8.4. Use of Nuclear Energy World-wide

At the end of 2005 there were 31 countries operating 443 reactors for electricity production. In 2005 five new nuclear power plants were put in operation, one in Russia, India and Korea and two in Japan. The total installed electric power was 5205 MW. Two nuclear power plants in 2005 were permanently closed down, one in German (340 MW) and one in Sweden (600 MW). Two reactors are under construction, one in Pakistan and one in China.

Data on the number and installed power of reactors by countries at the end of 2005 are shown in Table 10:

Table 10: Number and Installed Power of Reactors by Countries at the end of 2005

Country	Operational		Under construction		Nuclear power share (%)
	No.	Power [MW]	No.	Power [MW]	
Belgium	7	5,824			55.6
Bulgaria	4	2,722	2	1,906	44.1
Czech Republic	6	3,368			30.5
Finland	4	2,676	1	1,600	32.9
France	59	63,363			78.5
Lithuania	1	1,185			69.6
Hungary	4	1,755			37.2
Germany	17	20,339			31.0
Netherlands	1	449			3.9
Romania	1	655	1	655	8.6
Russia	31	21,743	4	3,775	15.8
Slovakia	6	2,442			56.1
Slovenia	1	656			42.4
Spain	9	7,588			19.6
Sweden	10	8,910			46.7
Switzerland	5	3,220			32.1
Ukraine	15	13,107	2	1,900	48.5
Great Britain	23	11,852			19.9
Europe total:	204	171,854	10	9,836	
Argentina	2	935	1	692	6.9
Brazil	2	1,901			2.5
Canada	18	12,599			14.6
Mexico	2	1,310			5.0
USA	104	99,210			19.3
America total:	128	115,955	1	692	
Armenia	1	376			42.7
India	15	3,040	8	3,602	2.8
Iran			1	915	
Japan	56	47,839	1	866	29.3
China	9	6,572	3	3,000	2.0
Korea, Republic of	20	16,810			44.7
Pakistan	2	425	1	300	2.8
Taiwan	6	4,904	2	2,600	
Asia total:	109	79,966	16	11,283	
South Africa	2	1,800			5.5
World total:	443	369,575	27	21,811	

8.5. 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 six years since the Nuclear Events Web Based System (NEWS) went into operation. NEWS is a partially open communication system providing a fast flow of information between regulatory bodies, operators, technical support organizations, media and the public. The system is jointly managed by IAEA, the OECD Nuclear Energy Agency and the World Association of Nuclear Operators. It enables transfer of information on the occurrence of events that could attract interest of the media. The system has different levels of access: for experts from regulatory bodies and nuclear facilities or 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/index.php?id=8891>.

The summary of the reports of 2005 shows the level of radiation protection and nuclear safety world-wide.

Twenty four INES reports were received by the IAEA NEWS in 2005. Seven reports were on events in nuclear power plants, the remaining 17 on exceeded dose levels due to use of radioactive sources (9 reports), on lost radioactive sources (3 reports), inadvertently stolen radioactive sources (2 reports), incidents in the production of nuclear fuel (2 reports) and on transport of radioactive material (1 report).

Six events in a nuclear power plant were rated as level 2 – incident and one as level 1 – anomaly. Three reports were related to minor flaws in design, two to material problems, one to a problem occurring at the management of nuclear fuel and one to overexposure during maintenance works.

Among other events one was level 3 – serious incident, 15 were level 2 - incident and one was not rated.

Slovenia did not report any event to NEWS in 2005 since there were no reports satisfying the criteria for reporting.

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 unsatisfactory in the world, and that often the source is lost during transport, inadvertently stolen or found in scrap metal.

The events which were reported to NEWS in 2005 did not have any strong impacts on the environment, nor did they cause any injuries to workers due to radiation. In seven cases radiation workers received doses higher than the prescribed limit but this did not result in any lasting health effects. In two other cases workers were potentially overexposed but there was no possibility to confirm their doses by measurement.

The event rated as level 3 - serious incident occurred in the UK Thorp Reprocessing Plant at Sellafield. On 20 April 2005 a fractured pipe was discovered in the Feed Clarification Cell. The pipe was a feed pipe to a Head End Accountancy Tank and the fracture led to a significant release of dissolver liquor to the Cell, and to some corrosion in the cell steelwork. The liquor volume was around 83m³ of nitric acid containing dissolved irradiated uranium and associated plutonium and fission products.

There was no exposure of workers and no abnormal discharge of radioactivity to the environment. The cell was designed to contain any spilled liquor and there was no evidence of any leakage from the cell. There was no risk of criticality in the cell and the situation in the cell and in the plant was stable.

9. APPENDIX: 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.sigov.si/mop/
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.p hp
Slovenian National Building and Civil Engineering Institute	http://www.zag.si/
Institute for Occupational Safety	http://www.zvd.si/

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5. Posebno poročilo št. 1/2005 o sproženju varnostnega vbrizgavanja na signal nizkega tlaka glavnega parovoda in samodejna zaustavitev reaktorja, NEK dopis št. ING.DOV-073.05/BG/3575 z dne 15.4.2005.
6. Letna poročila pooblaščenih organizacij za leto 2005.
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8. Redna mesečna poročila o skladiščenju trdnih radioaktivnih odpadkov NEK.
9. Letno poročilo o izvajanju varstva pred IO sevanji in o vplivu Rudnika Žirovski vrh na okolje za leto 2005, RŽV.
10. Resolucija o nacionalnem programu ravnanja z radioaktivnimi odpadki in izrabljenim jedrskim gorivom.
11. Drugo nacionalno poročilo po Skupni konvenciji o varnosti ravnanja z izrabljenim gorivom in varnosti ravnanja z radioaktivnimi odpadki.
12. Intranet portal InfoURSJV-Register virov sevanja in register sevalnih dejavnosti.
13. Analiza dveh zaporednih zaustavitev reaktorja pri testiranju turbinskih ventilov in pri poškodbi odzračevalne linije separatorja vlage in pregrevalnika pare, rev. 1, URSJV, december 2005.
14. Posebno poročilo št. 2/2005 o ročnem izklopu reaktorja zaradi izgube vakuuma v kondenzatorju A in zloma cevi na kondenzatorju, NEK dopis št. ING.DOV-089.05/BG/4280 z dne 10.5.2005.
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21. Posebno poročilo št. 6/2005 o nepričakovani zaustavitvi v nuji dizel generatorja, NEK dopis št. ING.DOV-141.05/AL/6551 z dne 22.7.2005.
22. Posebno poročilo št. 7/2005 o neoperabilni dizel protipožarni črpalki, NEK dopis št. ING.DOV-143.05/AL/6571 z dne 22.7.2005.
23. Zaključno poročilo o neoperabilni dizel protipožarni črpalki, URSJV št. 39010-5/2005/18 z dne 9.9.2005.
24. Inšpektorski zapisnik URSJV št. 002/2005 z dne 6.1.2005.
25. Posebno poročilo št. 8/2005 o neoperabilni dizel protipožarni črpalki, NEK dopis št. ING.DOV-155.05/AL/7263 z dne 19.8.2005.
26. Zaključno poročilo o neoperabilni dizel protipožarni črpalki, URSJV št. 39010-5/2005/17 z dne 30.9.2005.
27. Posebno poročilo št. 10/2005 o neoperabilni klimatizaciji glavne kontrolne sobe, NEK dopis št. ING.DOV-211.05/AL/10112 z dne 11.11.2005.
28. URSJV elektronsko sporočilo št. 39010-5/2005/21 z dne 29.9.2005.
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