REPUBLIC OF SLOVENIA
MINISTRY OF AGRICULTURE AND THE ENVIRONMENT
SLOVENIAN NUCLEAR SAFETY ADMINISTRATION

Annual Report 2013 on Radiation and Nuclear Safety in the Republic of Slovenia

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June 2014

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

The Slovenian Radiation Protection Administration;
The Administration of the Republic of Slovenia for Civil Protection and Disaster Relief
The Ministry of Infrastructure and Spatial Planning;
The Administration of the Republic of Slovenia for Food Safety, Veterinary and Plant Protection;
The Ministry of the Interior;
The Agency for Radwaste Management;
The Nuclear Insurance and Reinsurance Pool;
The Fund for Financing the Decommissioning of the Krško Nuclear Power Plant;
The Krško Nuclear Power Plant;
Žirovski Vrh Mine Llc;
Jožef Stefan Institute; and
The Institute of Occupational Safety.

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Editors: Andrej Stritar and Katarina Kašnar
Slovenian Nuclear Safety Administration
Litostrojska cesta 54
1000 Ljubljana, Slovenia
Telephone: +386-1/472 11 00
Fax: +386-1/472 11 99
gp.ursjv@gov.si
http://www.ursjv.gov.si/

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SUMMARY

In 2013, there were no events that posed a serious radiological threat to the population in Slovenia. Unforeseen problems during an outage of the Krško Nuclear Power Plant aroused significant public interest. Slovenia also experienced a significant unfortunate event in which two workers were irradiated above the legal limits during the implementation of on-site radiography at a fossil power plant.

At the Krško Nuclear Power Plant two additional systems to control hydrogen in the containment and for filtered discharging of containment pressure during severe accidents were installed during the autumn outage. These were the first major improvements based on lessons from the accident in Fukushima in 2011. During the outage, the system for measuring the temperature of the primary water was also modernized.

At the beginning of the year, the Krško NPP automatically shut down due to the collapse of a valve in the main steam line. Fuel damage, which turned out to be more extensive than expected, generated a great deal of public attention. Due to the complex search for the causes and the elimination of the consequences, the outage was extended by two weeks. A few days after the outage the NPP shut down again due to incorrect functioning of the new electronic system for measuring the temperature of the water.

Implementation of the programme of safety upgrades after Fukushima was delayed during the year. It was deemed that the programme of safety upgrades is too extensive and it will not be possible to implement the programme by the end of the originally planned outage in 2016. It has been rescheduled for the year 2018.

During the verification of the quality of the welds using industrial radiography in the construction of the new Thermal Power Plant 6 in Šoštanj, two workers received excessive doses of radiation. The company that carried out the measurements did not adequately follow the requirements determined by legislation and the licence to carry out radiation practice, and was therefore fined.

There were no complications in the field of radioactive waste management in Slovenia. Unfortunately, there was no visible progress in the process of planning and obtaining permits for the construction of the final repository for low- and intermediate-level waste (LILW). In 2013, the investment plan was still not approved by the Government of the Republic of Slovenia, the investor of the project, which would allow the continuation of the funding of the LILW repository project, conducted on behalf and for the account of the state by the ARAO. The ARAO was required to revise the project, which was carried out in December 2013.

At the former Žirovski Vrh uranium mine, the final remediation of the mine was also stopped due to a lack of funds. At the Boršt mill tailings site, the activities to prevent long-term landslide movement were not carried out. The processes of closing the Jazbec disposal site was not completed in 2013, even though the technical works on remediation were finished a few years ago. Consequently, the ARAO was not able to institute long-term surveillance and maintenance of it. Monitoring and maintenance have been conducted by the Žirovski Vrh Mine Llc.

The Intergovernmental Slovenian-Croatian commission, which should monitor the implementation of the Agreement on the Co-ownership of the Krško NPP, has not

met since 2010. This is already having an impact on the delays in making important decisions.

National Assembly adopted a Resolution on Radiation and Nuclear Safety as a fundamental strategic and political document of Slovenia.

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1. INTRODUCTION

This report is prepared annually in accordance with the provisions of the Ionizing Radiation Protection and Nuclear Safety Act. It summarizes all developments related to nuclear and radiation safety. The report is endorsed by the Slovenian Government and is thereafter sent to the National Assembly of Republic of Slovenia. It is also the main method of communicating recent developments in the area of ionizing radiation protection and nuclear safety to the general public. It has been issued since 1985. This English version is the essential publication for the presentation of these activities in Slovenia to the international public.

In creating the report, the Slovenian Nuclear Safety Administration (SNSA) performs the role of editor, while the report's content is also provided by other state bodies whose competences include ionizing radiation protection and nuclear safety, as well as other institutions in this area. Of these, the most important are the Slovenian Radiation Protection Administration (SRPA), the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief (ACPRD), the Ministry of Infrastructure and Spatial Planning, the Administration of the Republic of Slovenia for Food Safety, Veterinary and Plant Protection, the Ministry of the Interior, the Agency for Radwaste Management (ARAO), the Nuclear Insurance and Reinsurance Pool, the Krško Nuclear Power Plant (Krško NPP), the Žirovski Vrh Mine Llc, Jožef Stefan Institute (JSI), the Institute of Occupational Safety (IOS), and the Fund for Financing the Decommissioning of the Krško Nuclear Power Plant and Disposal of Radioactive Waste from the Krško NPP, and others.

In 2013, the economic crisis continued, and therefore the budgetary funds for the operation of the ministries and regulatory bodies were reduced. Conditions in the field of research and education activities have become more severe, state institutions have been forced to reduce material expenses, less resources are earmarked for wages and participation in international conferences and meetings, and staff promotions have been limited. Despite the fact that the reduction in funds for the work of state bodies was not a direct cause of the problems during the outage in 2013, we can conclude that the work of state bodies would be more effective if the flow of funds were normalized. The SNSA would like to draw attention to the problems that will be more noticeable in the future due to a lack of financial and human resources, and to the risks believed to be increasing.

In 2013 the National Assembly adopted the Resolution on Nuclear Safety for the Period 2013-2023, which, *inter alia*, requires annual reporting to the National Assembly on the achievement of the set goals. Therefore, for the first time, this report includes comments on the achievement of these goals in the relevant chapters. As follows, here we can summarize that the fundamental objective of nuclear and radiation safety was definitely achieved.

The protection of people and the environment from unnecessary harmful effects of ionizing radiation.

Together with this report, which is aimed at the wider interested public, an extended version in Slovenian has been prepared. The extended report includes all details and data that might be of interest to the narrower group of professionals. It is available on the SNSA website at http://www.ursjv.gov.si.

2. OPERATIONAL SAFETY

2.1. Operation of Nuclear and Radiation Facilities

2.1.1. Krško Nuclear Power Plant

2.1.1.1. Operation and Performance Indicators

In 2013, the Krško NPP produced 5,299,615.1 MWh (5.3 TWh) gross electrical energy from the output of the generator, which corresponds to 5,036,473.4 MWh (5.0 TWh) net electrical energy delivered to the grid.

In 2013, SNSA inspectors performed 54 inspections of the Krško NPP; 52 inspections were planned, whereas two were carried out following two unusual events:

- automatic plant shutdown due to inadvertent closure of a main steam isolation valve; and
- automatic plant shutdown due to improper functioning of the new system for measuring the temperature of the reactor coolant.

One unannounced inspection review also took place within the regular planned inspections.

In 2013, the SNSA inspection did not identify significant deviations of NPP operation from the applicable laws and regulations. The inspection of the status and testing of safety related equipment did not show major deficiencies or failures, except for increased fuel leaking. The identified problems related to the equipment were analysed and solved in due time within the implementation of the Krško NPP corrective program.

Between 1 October and 19 November 2013, during the regular outage at the end of cycle 26, regular inspection was carried out, in which, in addition to the SNSA inspectors, also the SNSA's division for nuclear safety and representatives of technical support organisations participated. Due to the identified increase in the number of leaking fuel elements, the SNSA inspectorate reinforced supervision activities related to the root cause of the leaks and corrective measures by means of which the Krško NPP intended to prevent further fuel leaks in the next fuel cycle. The inspections demonstrated that activities were carried out in full accordance with high standards of radiation and nuclear safety. Unforeseen events, which increased the volume of work, were resolved promptly and professionally by the NPP, as a consequence of the high level of skill of the NPP staff and external contractors.

The performed inspections support the conclusion that in 2013 the Krško NPP operated safely and with no adverse effects on the population and environment. The SNSA inspectorate deems the job performed by most of Krško NPP's organizational units to be well done. Inspection reviews have shown a high level of safety culture, which is reflected in the quality of activities carried out, where safety always has the highest priority, as well as in identifying potential problems based on experience-based feedback and the tendency towards the implementation of appropriate corrective measures.

In the field of the radiation protection of exposed workers, the Krško NPP is also supervised by the Slovenian Radiation Protection Administration (SRPA). In 2013, the SRPA performed three inspections in this regard, two of them together with the SNSA inspectorate. No major irregularities were found, even though the dose rates and contamination levels of isotopes that emit alpha particles increased radically in some areas of the reactor coolant system due to damaged fuel rods.

The most important performance indicators of the Krško NPP are shown in Tables 1, 2 and 3, while changes over the years are described in the following parts of this report. The performance indicators confirm that the plant's operation is stable and safe.

Table 1: The most important performance indicators in 2013

Safety and performance indicators	Year 2013	Average (1983-2013)
Availability [%]	84.40	86.4
Capacity factor [%]	86.33	84.3
Forced outage factor [%]	2.14	1.10
Gross production [GWh]	5,299.62	5,057.58
Fast shutdowns – automatic [number of shutdowns]	2	2.42
Fast shutdowns – manual [number of shutdowns]	0	0.16
Unplanned normal shutdowns [number of shutdowns]	0	0.77
Planned normal shutdowns [number of shutdowns]	1	0.81
Event reports [number of reports]	5	4.32
Duration of the refuelling outage [days]	49.1	44.1
Fuel reliability indicator (FRI) [GBq/m^3]	1.52×10^{-1}	7.12×10^{-2}

Table 2: Time analysis of Krško NPP operations in 2013

Time analysis of production	Hours	Percentage [%]
Number of hours in a year	8,760	100
Duration of plant operation (on grid)	7,395	84.4
Duration of shutdowns	1,365	15.6
Duration of the refuelling outage	1,178	13.45
Duration of planned shutdowns	1,178	13.45
Duration of unplanned shutdowns	187	2.14

Table 3: Krško NPP shutdowns in 2013

Date	Hours	Type	Actuation	Cause
Feb 25	142	fast	automatic	automatic plant shutdown due to inadvertent closure of a main steam isolation valve
Oct 1	1178	normal	manual	shutdown of the plant in order to carry out the regular refuelling outage
Nov 23	45	fast	automatic	automatic plant shutdown due to improper functioning of the new system for measuring the temperature of the reactor coolant

The operation of the Krško NPP in 2013 is shown in Figure 2, which shows that the power plant was shutdown three times. The 2013 shutdowns of the Krško NPP are briefly described in Table 3 above, while more descriptions are given in Chapter 2.1.1.3. The plant also operated at reduced power in November and December due to testing of the sensitivity of the new reactor coolant temperature measuring system to electromagnetic interference. In the summer months, net energy production was lower due to the use of cooling towers.

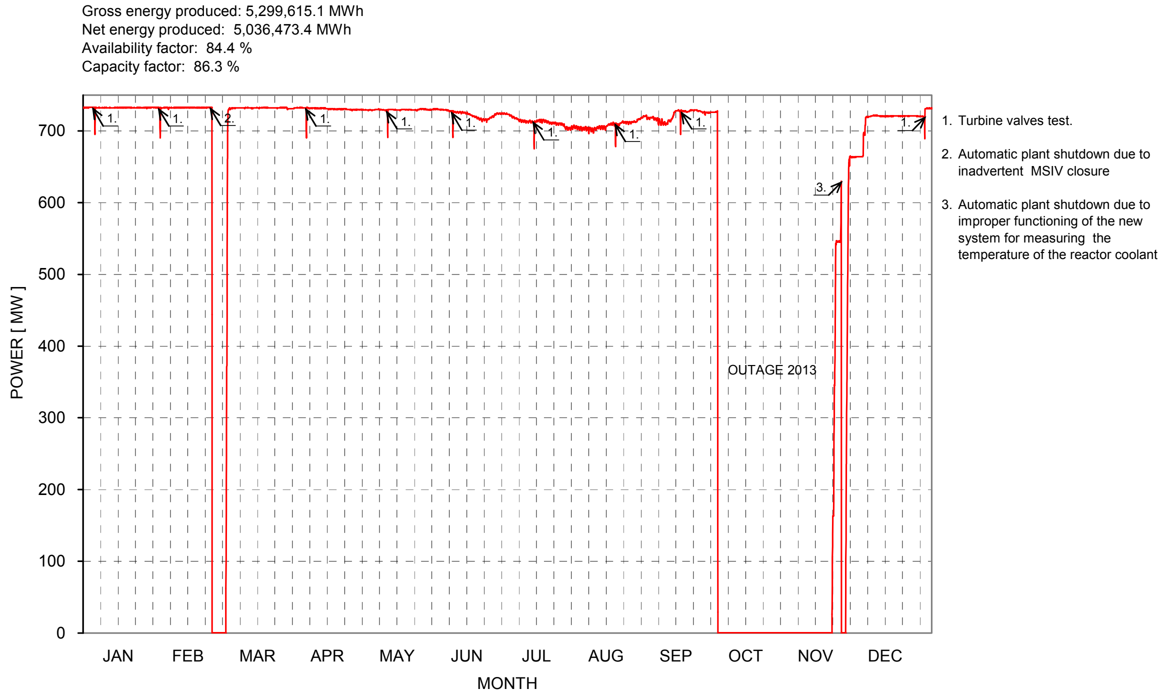

Figure 1: Operating power diagram of Krško NPP in 2013

There are two types of reactor shutdowns, fast and normal. Fast reactor shutdowns are caused by the actuation of the reactor protection system, which can be activated manually or automatically. During normal reactor shutdowns, the reactor power decreases gradually. Normal shutdowns can be planned or unplanned. An outage is a special type of normal, planned gradual shutdown of a reactor.

Figure 2 and 3 show the number of the plant shutdowns. Figure 2 shows that the number of fast reactor shutdowns has stabilized over the years (less then one fast shutdown per year in the last 20 years). There were two automatic shutdowns in 2013.

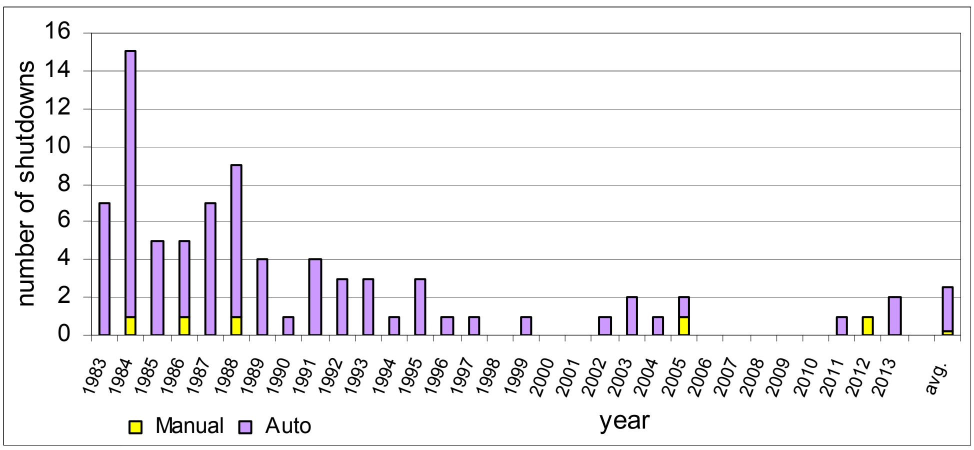

Figure 2: Fast reactor shutdowns – manual and automatic

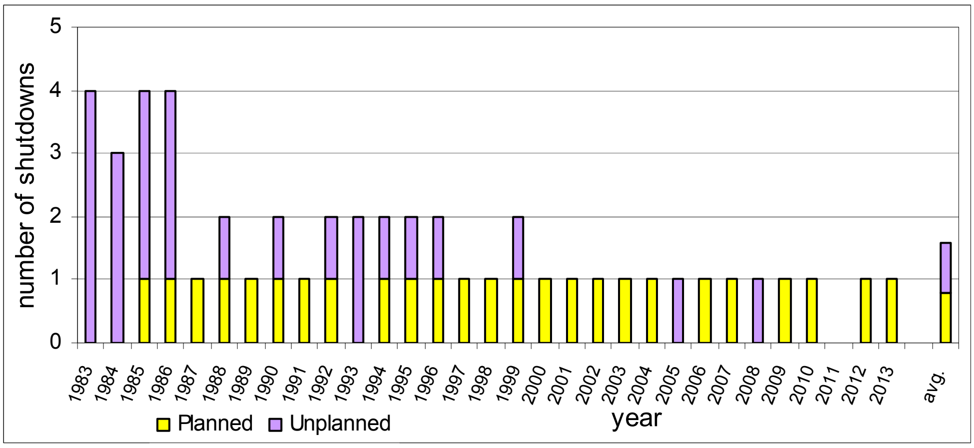

Figure 3: Normal reactor shutdowns – planned and unplanned

Figure 4 shows the number of unplanned actuations of the high-pressure injection system, which can be actuated manually or automatically if the pressure of the primary or secondary cooling system is low and when the pressure in the containment is high. In February 2013 a failure of a main steam isolation system valve caused a pressure drop in the secondary cooling system, which triggered the actuation of the high-pressure injection system. There have been 12 actuations since the Krško NPP started commercial operation.

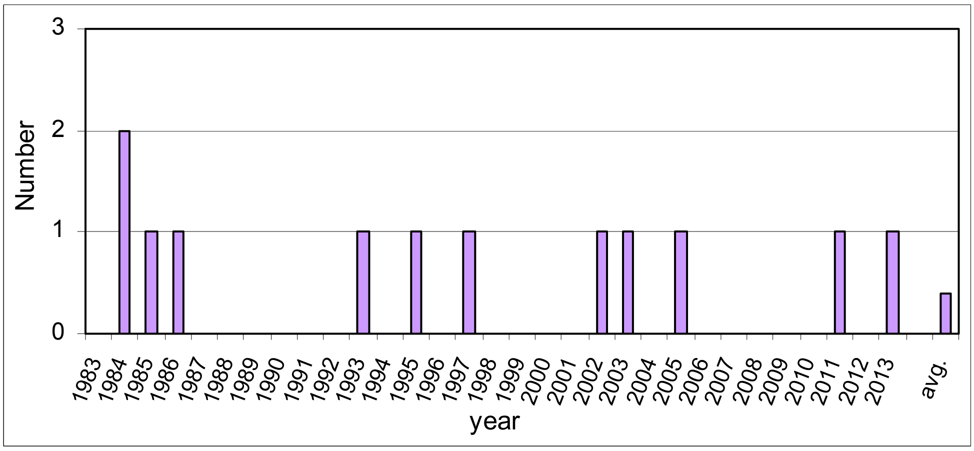

Figure 4: Number of unplanned safety injection system actuations

In Figure 5, the forced outage factor is shown. The factor is calculated in terms of the ratio between the hours of duration of unplanned shutdowns and the number of hours in a year. In 2013, the total duration of the plant's unplanned shutdowns was 187 hours, thus the value of this factor is 2.14%.

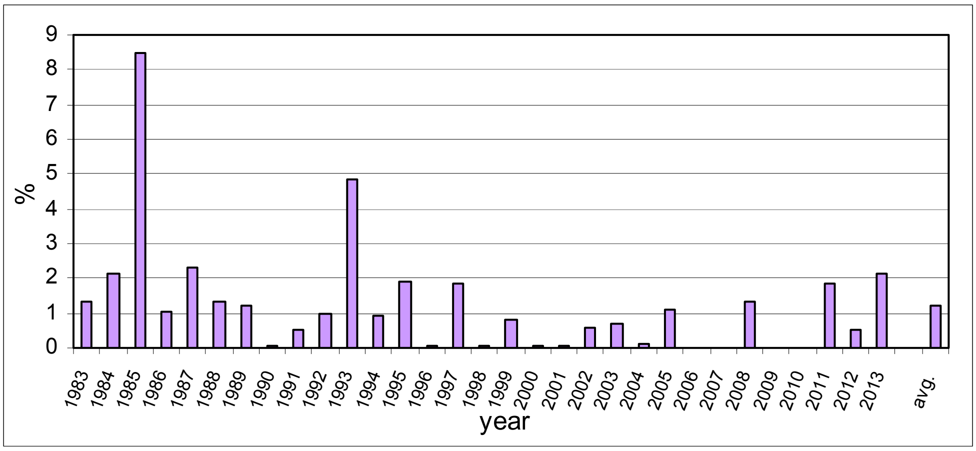

Figure 5: Forced outage factor

Figure 6 shows the number of abnormal events. In 2013 there were five abnormal events. The Krško NPP is obliged to report all events that could reduce the level of nuclear safety to the regulatory body. See Chapter 2.1.1.3 for more details about abnormal events.

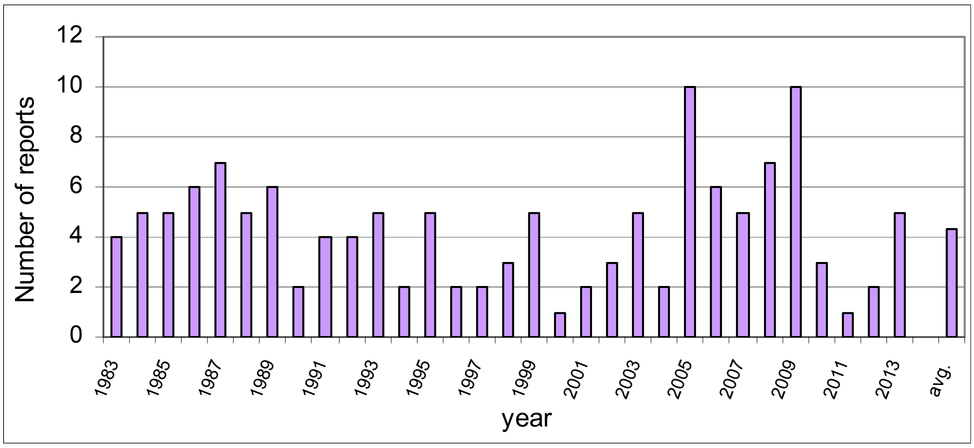

Figure 6: Number of abnormal events

Figure 7 presents data on different means of electrical energy production in Slovenia, specifically electricity production in nuclear, hydro, thermal, and solar power plants. In 2013, the production of electrical energy reached a record value of 15.0 TWh, mostly due to the higher production of hydro power plants, but also due to increased production in thermal power plants.

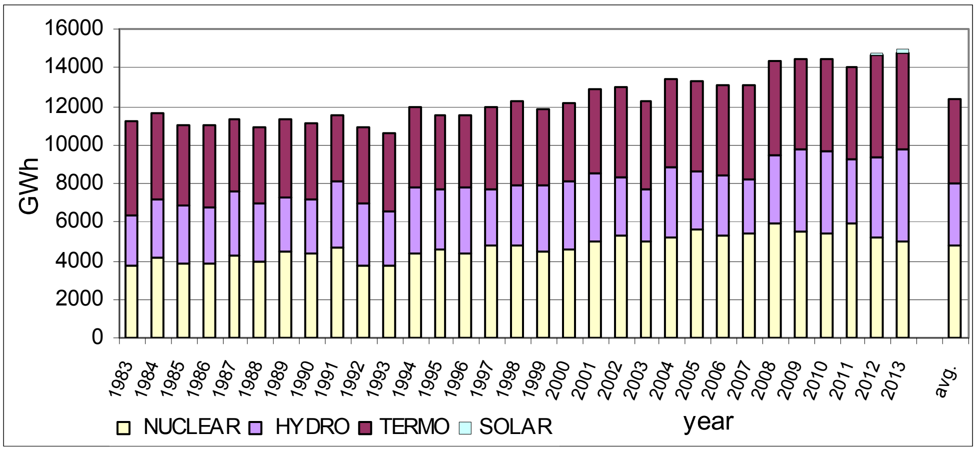

Figure 7: Production of electrical energy in Slovenia

The collective exposure to radiation is shown in Figure 8. The value of this factor in 2013 was 1351 man mSv and was higher than in previous years, mainly due to higher fuel leakage, but also due to the extensive workload for the modification of the reactor coolant temperature measurement system.

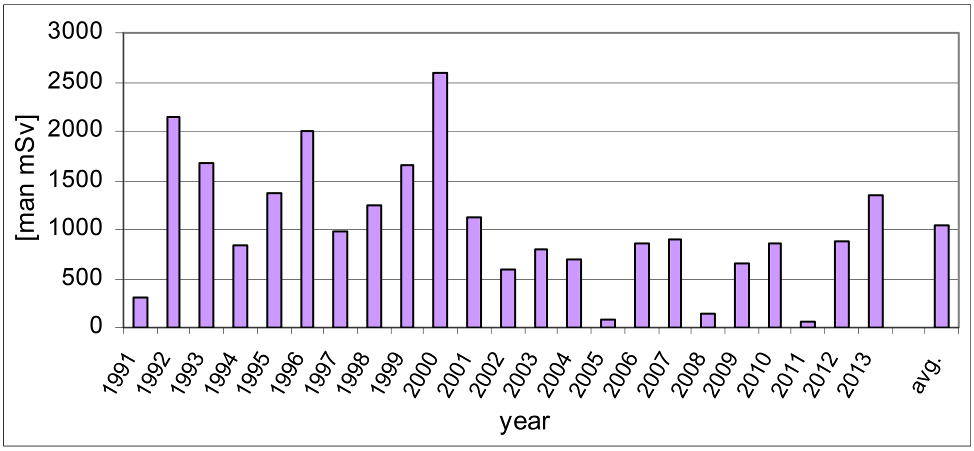

Figure 8: Collective exposure to radiation in the Krško NPP

The purpose of the inoperability factors given in Figures 9, 10 and 11 is to show whether important safety systems can ensure their function during normal operation, as well as in the event of an accident.

Figure 9 shows the unavailability factor of the safety injection system. In 2013, the value of this factor was 0.0018, which is less than the Krško NPP's goal value of 0.02. In 2013, this system was inoperable only during the planned on-line maintenance.

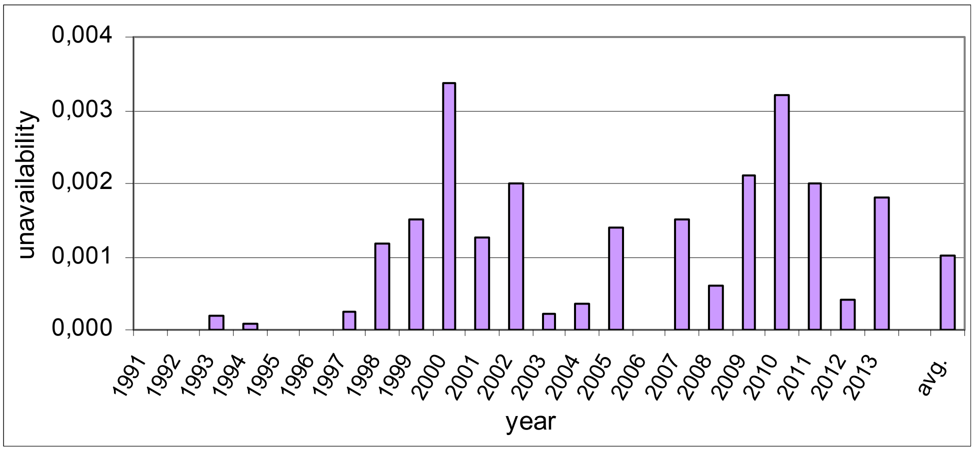

Figure 9: The unavailability of the safety injection system

The unavailability factor of the emergency power supply, namely emergency diesel generators, is shown in Figure 10. This system is important when the normal off-site and on-site power supplies are not functioning. The operability of the diesel generators in 2013 was lower than usual due to the unsuccessful testing of emergency diesel generator No. 2 in April, when the excitation of the diesel generator failed. Thus the value of this factor in 2013 was 0.02, which is equal to the Krško NPP's goal value of 0.02.

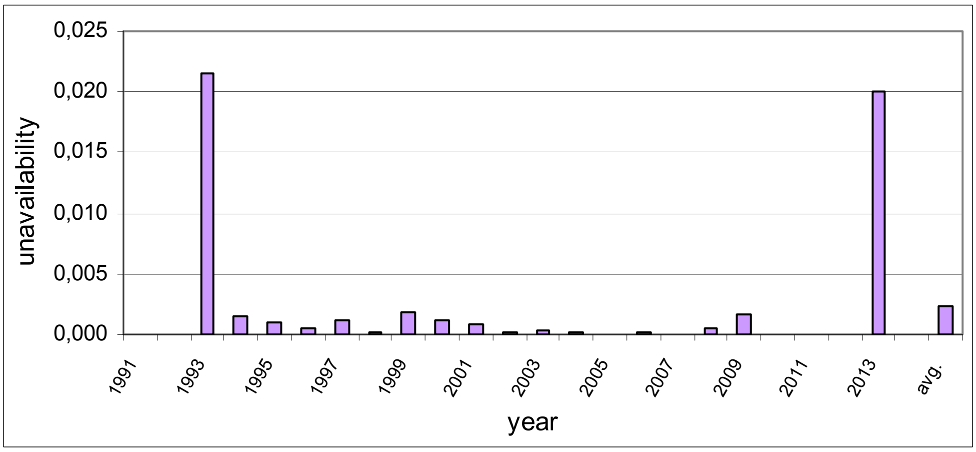

Figure 10: The unavailability of the emergency power supply

In Figure 11, the unavailability factor of the auxiliary feedwater system is shown. This system is used to supply water to steam generators when the main feedwater system is unavailable. In 2013, the value of this indicator was 0.002, which is below the goal value of the Krško NPP of 0.02. In 2013, the system was not available only during the planned on-line maintenance.

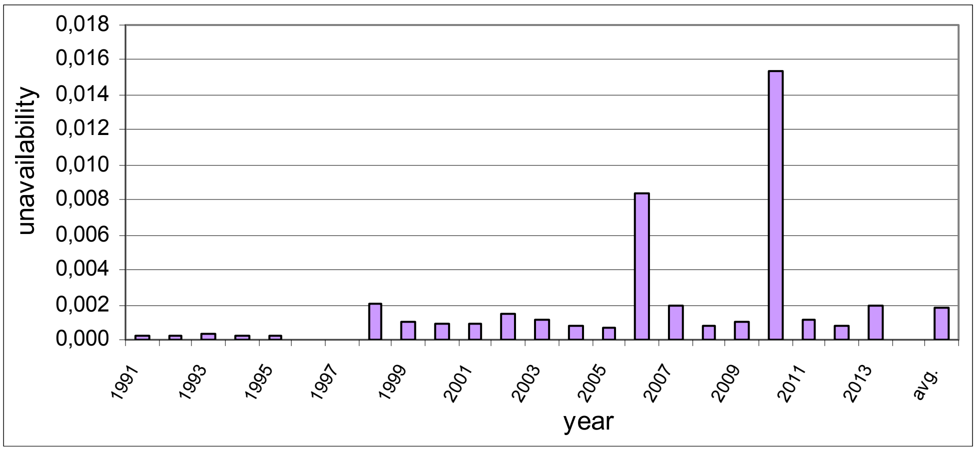

Figure 11: The unavailability of the auxiliary feedwater system

2.1.1.2. SNSA's Oversight of the Krško NPP by Means of Safety and Performance Indicators

In 2013, the SNSA monitored a set of 37 safety and performance indicators (hereinafter SPIs). The SPIs help to identify possible problems that can have an influence on nuclear safety very early. As an example, the indicator that shows the activity of the primary cooling system is presented in Figure 12; the trend in the leak from the fuel elements at the Krško NPP is shown before the outage in 2013. During this outage, it was also confirmed that within the three fuel assemblies comprehensive damage to the fuel rods occurred. One included a broken fuel rod, while within two fuel elements leakage was discovered. The event is described in detail in Chapter 2.1.1.3.

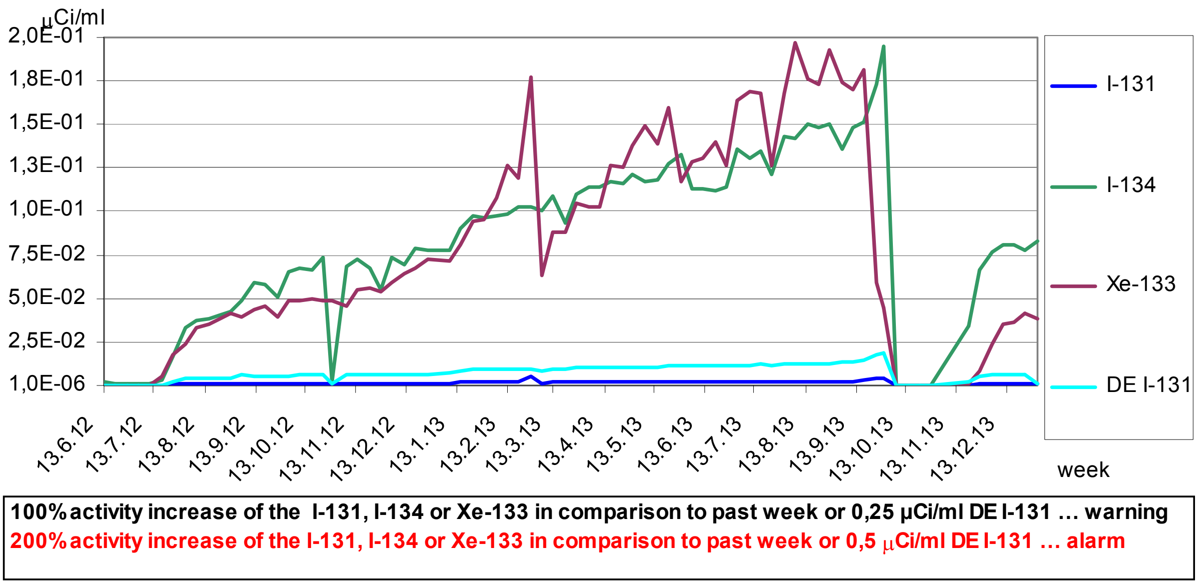

Figure 12: Activity of the primary cooling system – fuel cycle 26 and part of fuel cycle 27.

* The largest value represents about 3% of the limit value.

2.1.1.3. Abnormal Events in the Krško NPP

Event reporting is defined by the Rules on the Operational Safety of Radiation or Nuclear Facilities, which in Appendix Six lists events that have to be specially reported by nuclear power plant operators. In 2013, the Krško NPP, in accordance with the above-mentioned Rules, reported three events that did not require stopping plant operation, and two events due to which automatic shutdowns occurred. The two automatic shutdowns were classified as “reactor trip due to sudden main steam line valve closure” on 25 February 2013 and “reactor trip due to a spurious actuation reactor protection signal over power delta temperature” on 23 November 2013. None of these events jeopardized nuclear and radiation safety. All events were reviewed and analysed by the SNSA.

Reactor trip due to sudden main steam line valve closure

On 25 February 2013 an automatic shutdown of the Krško Nuclear Power Plant occurred. The sequence of events started with the sudden closure of a main steam isolation valve (MSIV) on steam line No. 2. Due to the MSIV closure the steam flow increased in steam line No. 1, which resulted in a pressure drop actuating the safety injection system (SI), causing the reactor trip. During the event all safety systems functioned as intended.

The event was analysed and it was concluded that an MSIV stem break was the direct cause of the event. The root causes were deficiencies in the design of the MSIV (construction, material, etc.), unimplemented valve modification, and deficient surveillance and testing procedures (manufacturer instructions). There was also inadequate attention paid to operating experience, because a similar event occurred in 1997. Furthermore, vibrations due to turbulence in the main steam line and MSIV were a contributing cause.

The broken stem was replaced with a new one. In the 2013 outage a new modification of the MSIV was implemented. The modification should resolve the design problems in the main steam line and MSIV.

Loss of generator excitation during the regular monthly test on diesel generator No. 2

On 18 April 2013, a regular monthly test was performed at 7:25 on diesel generator No. 2 (DG2). The test started with a slow start-up in IDLE mode (450 min^{-1}). After IDLE was released, DG2 accelerated to 750 min^{-1}, but the voltage was not re-established on DG2 because the generator’s excitation did not work.

DG2 was stopped normally and was declared inoperable at 7:27. The cause of the event was a nonconductive contact on the “Latching Relay”. The relay was fixed and reinstalled. The repeated test was successful.

Damaged fuel assemblies and the discovery of a fuel rod segment on the transfer channel bottom

During fuel cycle 26 core unloading on 8 October 2013 at 12:27, an approximately half-meter-long fuel rod segment was found in the transfer channel. After visual inspection of the fuel assemblies it was determined that the broken rod was a part of fuel assembly AD11. During the inspection of all fuel assemblies, the Krško NPP discovered visible defects in two other fuel assemblies from the same region (AD12 and AD13).

Due to the fuel rod break there were no radioactive releases that would result in additional exposure of workers performing the transportation of fuel assemblies from the core to the spent fuel pool. The inventory of noble gases and volatile iodine isotopes was transferred from the rod with open cladding defects to the reactor coolant already during plant operation and was appropriately extracted through a chemical composition control system.

The broken rod segment of fuel assembly AD11 is temporarily being stored in a strainer basket in the spent fuel pool.

Figure 13: Damaged fuel assembly AD11 (Source: Kanal A)

Determining the cause of the damage to the fuel assemblies

The root cause of the damage to the fuel assemblies are to be determined by an analysis carried out by Westinghouse and Krško NPP at the start of 2014. Based on the results of fuel inspections of the cycle 26 core and Krško NPP reports as well as the findings of two meetings in the Krško NPP on 18 October 2013 and 6 November 2013, a conclusion can be reached with regard to several types of failed fuel assemblies:

- Fuel assemblies with extensive visible damage

Fuel assemblies AD11, AD 12 and AD 13 contain a total of 8 fuel rods with open cladding damage. All these fuel assemblies were located at the baffle plate in cycle 26. The damaged fuel rods dropped to the bottom nozzle. Open defects were caused by the ingression of primary coolant into a fuel rod and the formation of zirconium hydride. Primary fuel rod defects were probably caused by strong vibrations from baffle jetting. Other possible causes of the primary defects that enabled the ingression of coolant into a fuel rod could result from different causes, such as grid to rod fretting or debris-induced defects.

- The fuel assembly with a broken internal rod

Fuel assembly AC29 had a broken internal rod, B-11 in the second row, which could not have been caused by baffle jetting. The probable cause of the primary defect is attributed to grid to rod fretting or debris induced fretting and the subsequent ingression of coolant into the fuel rod and the formation of zirconium hydride.

- Fuel assembly – an instance of tight leakage

Fuel assemblies AD17 and AC35 had a single leaking fuel rod with a tight defect. According to experience from previous fuel cycles, the cause of tight fuel cladding leakage is grid to rod fretting.

Corrective actions performed

Short-term corrective actions prior to the restart of the plant at the end of the outage were the following:

- Armouring of the fuel assemblies at the location where baffle jetting defects are possible. In each of four fuel assemblies, AE50, AE51, AE52 and AE55, seven fuel rods were replaced with stainless steel dummy rods. Extracted fuel rods were stored in a dedicated container in the spent fuel pool.
- During the reconstitution of fuel assembly AE51 damage to the guide tubes occurred. It was possible to repair some guide tubes but it was impossible to repair one of them. This fuel assembly is therefore not allowed in core locations with control rods and in-core instrumentation.
- The reactor vessel, reactor vessel internals, reactor cavity and transfer channel were inspected with an underwater robot “submarine” and all debris found was collected.
- Visual inspection was performed for all fuel assemblies to be reused in cycle 27 and found debris was removed from the bottom nozzle, the top nozzle and the grids. In two fuel assemblies the debris could not be removed but both fuel assemblies are acceptable for use.
- Based on inspection results by three methods, the integrity of all fuel assemblies was confirmed and they were accepted for reuse in the cycle 27 core. All damaged or leaking fuel assemblies from the cycle 26 core were excluded from further use.
- Inspections of the fuel assemblies and reactor vessel components were reviewed by four authorized organizations (EIMV, IJS, FER and IMT), which reported on the evaluation of the fuel conditions, the possible causes of fuel damage and proposals for corrective measures.

The following are the long tem corrective actions:

- An upgrade of the failed fuel action plan with additional criteria that consider an earlier outage in the event of open fuel defects. The criteria are determined by ^{134}iodine activity in the primary coolant, which is an indicator of open fuel defects.
- Root cause analysis of damage to fuel assemblies prepared by Westinghouse and subsequent analysis by the Krško NPP. Both analyses will be reviewed by an independent expert organization. Based on these analyses, additional corrective actions could be prepared.
- Plant modification with reactor vessel upflow conversion, which would decrease or eliminate the effect of vibrations due to baffle jetting.

Fuel conditions are also described in Chapter 2.1.1.5.

Loss of diesel generator No. 1 excitation during testing of the blackout signal

A test of diesel generator No. 1 (DG1) was started at 20:35 on 10 November 2013. A blackout signal was activated at 21:00 on bus MD-1, which had been successfully unloaded. DG1 started and reached nominal parameters for loading (49 Hz, 5.67 kV). Afterward, DG1 connected to the MD-1 bus, which had been loading according to the blackout sequence. A few seconds later, the voltage on MD-1 dropped. 22 seconds after establishing a connection, the voltage dropped to 1.4 kV. Some pumps had been connected to the bus MD-1 before. The charging pump tripped due to voltage protection. The other pumps stopped when operators disconnected DG1 from MD-1. 26 second after the disconnection DG1 tripped. Operators connected MD-1 to the transformer. They switched off the control switches of the pumps to prevent them from starting. DG1 was declared inoperable and DG3 was put into operation instead of DG1. The review revealed that the A and B engines of DG1 had tripped due to overspeed. The cause was a shortened diode in the excitation circuit. Operators also reviewed the motors of the pumps, which had been working under low voltage, and measured the parameters of the excitation wiring on the generator rotor. There was no indication of deviations. The destroyed diode was replaced and the test was successfully repeated. Due to a potential common cause failure, also DG2 was tested, and the diode on DG2 circuits was checked. All parameters were acceptable.

Reactor trip due to spurious actuation reactor protection signal over power delta temperature (OPΔT)

On 23 November 2013, just a few days after the end of the refuelling outage, an automatic shutdown of the Krško nuclear power plant occurred. A reactor trip occurred due to spurious actuation of the OPΔT (Over Power Delta Temperature) reactor protection signal. During the event all safety systems performed their functions as designed.

An analysis of the event identified electromagnetic (EM) interference as the trigger for the actuation of the OPΔT signal. The EM interference was caused by switching the auxiliary relays of the reactor makeup water system, which dilutes the primary system during plant startup. This EM interference was reflected as a drop in the voltage measurement on some reactor coolant system (RCS) temperature measuring cards (performing the conversion of resistance from resistance temperature detectors (RTDs) to voltage) resulting in spurious actuation of the OPΔT reactor protection signal and consequently in a reactor trip.

A detailed analysis of the event showed that a modification performed on the RCS temperature measuring cards during the regular outage introduced a small difference in the processing of the hot and cold leg temperatures of the RCS, which caused the EM interference to be reflected in the output of the cards. The analysis concluded that spurious actuation of the OPΔT reactor protection signal was the direct cause of the event. The root causes of the event were inadequate preparation and implementation of the “RTD Bypass Elimination” modification (i.e. possible electromagnetic interference was not considered).

The problem with the EM interference was temporarily solved by the installation of AC suppressors on auxiliary relays. The Krško power plant is planning to implement additional long-term improvements ensuring a more robust RTD measuring system.

2.1.1.4. Periodic Safety Review (PSR)

A Periodic Safety Review (PSR) is an intense systematic review of all operational and safety aspects of the NPP and must take place once every ten years. The SNSA approved the programme of the second PSR (PSR2) in the first half of 2010.

The Krško NPP carried out inspections of safety factors and delivered the corresponding reports to the SNSA. The SNSA conducted a review of the reports, paying special attention to:

- an assessment of the compliance of the reports with the approved programme;
- an assessment of the compliance of the performed inspections with the requirements of Slovenian legislation and applicable standards;
- an assessment of the compliance of the reports with the actual state of the Krško NPP;
- an assessment of the relevance of the actions from the first PSR (PSR1) review.

During reviews of the safety factor reports meetings were held where ambiguities and missing information from the reports were cleared up.

The Krško NPP submitted an application for approval of the PSR2 inspection and action plan on 16 December 2013.

The PSR2 final report determined that there are no substantial irregularities at the Krško NPP. Furthermore, the plant is as safe as was designed and its operation is safe. The list of the possible improvements from the PSR2 final report encompasses the improvement of various procedures, the control of environmental qualifications, control of aging, accident management, safety analyses, as well as improvement of the design basis of the Krško NPP. The plan of activities and the deadlines for their realization are given in the action plan.

The attached evaluation report of a technical support organization also determines that there are no problems at the Krško NPP that could jeopardize the safety of operations and concludes that the plant is as safe as it was designed. Also, the Krško NPP is capable of operating for the next 10 years.

The SNSA expects that the PSR2 report will be reviewed by mid 2014.

2.1.1.5. Nuclear Fuel Integrity

The year 2013 comprised a part of fuel cycle 26, which started on 26 May 2012 and ended on 1 October 2013 with the refuelling outage, and a part of cycle 27, which started on 18 November 2013. Cycle 27 will last 18 months, until the refuelling outage in April 2015. Of the 56 new fuel assemblies in the cycle 27 core, 20 are 4.4% enriched and 36 are 4.8% enriched.

The condition of fuel assemblies in the reactor (fuel cladding integrity) is monitored indirectly through measurements of specific activities of the reactor coolant in conditions of stable operation and during transient events. Isotopes of xenon, krypton and iodine show fuel defects; from measurements of specific activities of iodine isotopes the defect size and coolant contamination can be estimated. From specific activities of caesium isotopes the burn-up of damaged fuel can be estimated. In the event of fuel rod cladding degradation, solid particles can be detected in the coolant, such as Neptunium (^{239}Np) or Barium (^{140}Ba).

With the start of cycle 27, the failed fuel action plan was upgraded to comprise five action levels based on the estimated number of damaged fuel assemblies and the specific activities of isotopes ^{131}I and ^{134}I. The estimate also takes into account the correction due to the specific activity of isotope ^{134}I that is derived from contamination of the primary circuit as a consequence of open fuel defects in fuel cycle 26. Every action level includes corrective and preventive actions in the event of the degradation of fuel assembly conditions and in the event of open defects in the fuel rods, as observed in fuel cycle 26.

In fuel cycle 26 the first indications of fuel leakage were observed on 18 July 2012, which was reflected in a large and sudden rise in specific activities of isotopes ^{133}Xe and ^{131}I. The activities of iodine and xenon isotopes increased by an order of magnitude. This simultaneous rise in activities indicated the presence of open fuel defects in the core. In 2013 and within cycle 26, the specific activities of isotopes continuously increased and reached values an order of magnitude higher than for the specific activities of isotopes xenon (^{133}Xe) and iodine (^{131}I). An analysis of the measured values showed that there were several fuel rods with open defects in the core at the end of cycle 26.

Resolving the issue of leaking fuel is also described in Chapter 2.1.1.3.

In fuel cycle 27, high specific activities of xenon and iodine isotopes were measured until the end of the year 2013, which is a consequence of tramp fission material remaining in the primary circuit due to open defects in fuel rods in the previous cycle. At the end of December 2013, analyses showed that there were no leaking fuel rods in the core of cycle 27.

The reactor coolant contamination with uranium determined on the basis of the activities of isotope ^{134}I in cycle 27 reached a value of 6.3 g uranium, which is about 40% of the values from the previous fuel cycle.

Specific coolant activities in cycle 26 reached 2.95% of the dose equivalent ^{131}I limit and 2.7% of the 47/Ē reactor coolant gross activity limit (mean energy Ē = 0.27 MeV) from the Operational Limits and Conditions. In cycle 27 these values have reached 1.22% of the dose equivalent ^{131}I limit and 1.35% of the 47/Ē reactor coolant gross activity limit (mean energy Ē = 0.27 MeV).

The Fuel Reliability Indicator (FRI) is an indicator of fuel damage and is used for comparison with nuclear power plants around the world. FRI values are determined from specific activities of ^{131}I corrected by the contribution of ^{134}I from tramp Uranium (^{134}I activities) in the reactor coolant system and normalized to a constant value of the reactor coolant clean-up rate and reactor operating power. An FRI value equal to or below 5•10-4 μCi/g (1.85•10-2 GBq/m^3) represents fuel with no damage according to internationally adopted criteria. Exceeding this limit is not a criterion for deeming there to exist open defects of fuel rods.

Figure 14 shows the FRI values for individual fuel cycles. In fuel cycle 26, the FRI values exceeded the limit for leaking fuel. In the first part of cycle 27, the FRI value with a correction for the primary circuit contamination reached values that are below the limit for leaking fuel.

The FRI indicator that is calculated according the WANO methodology was increased from December 2012 because a new calculation mode for the coolant contamination correction was introduced. In cycle 27 the FRI values are small because they reflect the core without damaged fuel.

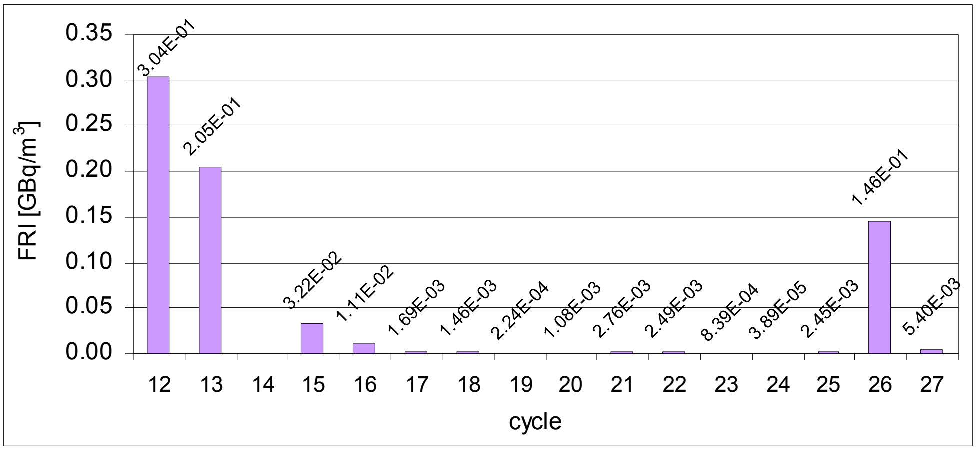

Figure 14: Fuel Reliability Indicator (FRI) for the last 16 fuel cycles

2.1.1.6. Modifications in the Krško NPP

The SNSA devotes a great deal of attention to reviewing modifications and improvements in the Krško NPP. The modifications and improvements result from international practice, operational experience and the newest insights in nuclear technology. Modifications can strongly influence the safety of nuclear objects and therefore must be rigorously controlled and appropriately documented.

In 2013, the SNSA approved 7 modifications and agreed to 22 modifications. During the preliminary safety evaluation, the Krško NPP found no open safety issues for 14 modifications. Therefore, the NPP only informed the SNSA of those 14 changes. As of 31 December 2013, there were 18 active temporary modifications. 53 active temporary modifications were opened and 54 were closed in 2013. Among active modifications, 4 temporary modifications were approved in 2011 or earlier.

In 2013, the Krško NPP issued the 20th revision of the "Updated Safety Analysis Report", which took into account the changes approved up to 1 November 2013.

A list of modifications since 2000 approved by the SNSA or those of which the SNSA was informed can be found on the SNSA website at:

http://www.ursjv.gov.si/si/jedrski_in_sevalni_objekti/nuklearna_elektrarna/spremembe_v_nek/.

2.1.2. Outage 2013

2.1.2.1 Description of the events

The outage at the end of fuel cycle 26, which took place between 1 October and 19 November 2013, was carried out successfully. The following major activities were carried out during this years outage: the replacement of 56 fuel elements, preventive inspections and associated maintenance work, the implementation of proposed modifications and the modernization of systems and equipment, the replacement of reactor in-core instrumentation, modernization of the system measuring reactor coolant temperature, modernization of the main steam isolation valves, partial replacement of emergency power supply batteries, an outage of the high-pressure turbine, inspection and restoration of the essential service water system underground canals, outage work on the main electrical transformer and reconstruction work in the 400 kV switchyard. In addition to all of the mentioned activities, the NPP also extended its Fire Protection System to the technological part of the NPP. During the outage the following modifications were implemented: 17 modifications whose purpose had to be reported to the Slovenian Nuclear Safety Administration, and 8 modifications regarding which the SNSA only had to be notified of their implementation.

One of the most extensive modifications implemented in the 2013 outage was the modernization of the system measuring the temperature of the reactor coolant. With this modernized system measurements are performed by sensors inserted directly in the primary loop.

As a part of the Safety Upgrade Program based on the lessons learned from Fukushima, Krško NPP installed a passive containment filtered venting system (PCFVS) that is capable of reducing hydrogen values during possible severe accident conditions in the containment building.

With the PCFVS system in place, the likelihood of a large release of radioactive material into the environment during a severe accident is minimized.

A major part of SNSA outage activities were focused on ensuring a high level of nuclear safety.

The technical basis prepared by authorized organisations evaluated the outage work. The reports did not cite any critical issues regarding the quality of the work carried out. At the end of the outage the SNSA evaluated the facts and concluded that the NPP is capable of performing safely until the next outage.

Some events occurred during the outage in 2013. In addition to the events described in detail in Chapter 2.1.1.3, the following are considered to be outage events:

- an unsuccessful test of islanding with regard to the Brestanica thermal power plant; the test was successful on the third attempt;
- suspected damage to steam generator U-tubes; the possibility of damage was later rejected after several verifications were carried out;
- deviations when implementing a modernized system for measuring the temperature of the reactor coolant;
- the overflight of a small aircraft over the NPP area; the event was investigated by the Civil Aviation Agency.

2.1.3. The TRIGA Mark II Research Reactor in Brinje

The operator of the TRIGA Mark II Research Reactor is the Jožef Stefan Institute (JSI) and operation is carried out by the personnel of the Reactor Infrastructure Center (RIC).

Operation

In 2013, the reactor operated for 136 days and it released 104 MWh of heat during operation. The operation was carried out according to the programme that is approved for each week by the head of the RIC and the JSI radiation protection service. The reactor operated in stationary mode and was mostly used as a neutron source for neutron activation analysis, for irradiation of electronic components and for educational purposes. A total of 825 samples were irradiated in the carrousel and the channels, as well as 16 in the pneumatic post. The operational parameters are shown in the Figure 15.

In the Hot Cell Facility (OVC) of the Department of Environmental Sciences, the JSI radiation protection service and the ARAO regularly perform radioactive waste treatment and preparation for the purpose of radioactive waste storage.

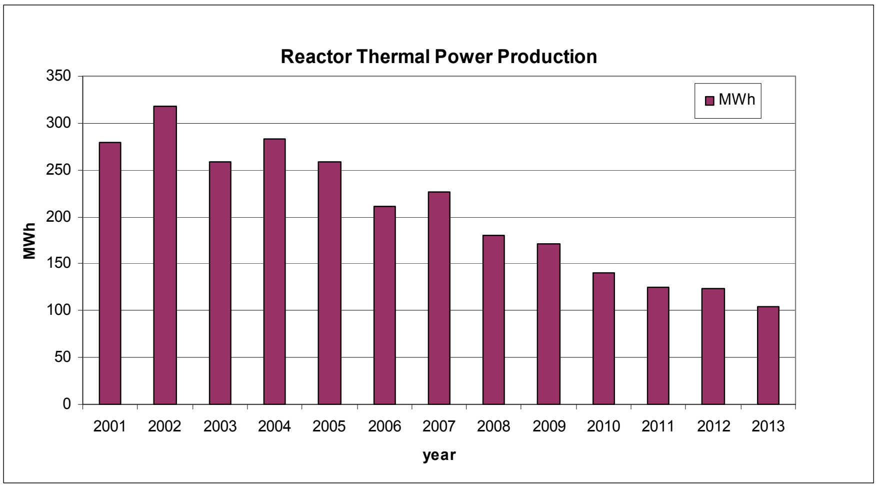

Figure 15: The operational parameters of the TRIGA Mark II Research Reactor in Brinje

In 2013, there were ten automatic reactor shutdowns, three of which were caused by operator error, six by disturbances of the linear channel switch, and one by primary water activity detector disturbances. The nominal reactor power was not exceeded during the shutdowns caused by operator errors or disturbances of the linear channel switch. In order to prevent shutdowns caused by disturbances in the linear channel switch, an additional guidance for reactor operation will be prepared. Disturbances of the primary water activity detector were confirmed by measurements with a LaBr probe. The primary water activity detector will be replaced when additional financial resources are provided.

There were no violations of the operational limits and conditions from the Safety Analysis Report in 2013. There were also no events that required reporting to the SNSA in 2013.

Operational indicators for acquired doses of the operating staff and experimenters show values far below the regulatory limits. The collective dose in 2013 was 123 man µSv for operating staff and 521 man µSv for personnel carrying out the research work at the reactor (operating staff, members of the JSI radiation protection service, experimenters).

In 2013, the SRPA approved one assessment of exposed workers radiation protection for the RIC. The SRPA did not perform any inspections in 2013.

Nuclear Fuel

In 2013, a total of 84 fuel elements were located on the reactor site. There were no spent fuel elements. All fuel elements were standard elements with 12% uranium content and 20% enrichment. Control measurements of radioactivity in the reactor building and in the reactor coolant showed that no fuel elements were damaged. An inspection of 17 fuel elements from the reactor core was carried out and no visible damage was observed. The JSI reported on the fuel balance monthly to EURATOM and the SNSA.

Staff training

An RIC employee completed a NPP technology course in April 2013 and obtained a TRIGA reactor operator license on 6 June 2013 that is valid for a period of 18 months. A new RIC employee attended a radiation protection course for exposed workers and he is continuing his training according to the *Programme of expert training of workers that perform relevant safety work at the TRIGA nuclear reactor*, IJS-DP-9296, rev. 2.

Modifications, inspections of the systems, structures and components of the nuclear facility, fire safety and physical security

In 2013, nine reactor core modifications were made for the experimental purposes of the nuclear physics department.

In 2013, an active fire protection system was installed in all facilities of the Podgorica Reactor Center. Appropriate changes in the Safety Analysis Report were approved by the SNSA.

A refurbishment of the access control system of the RIC controlled area was performed. In October 2013 the reactor was inspected by EURATOM and IAEA inspectors.

In 2012 a temporary modification of the bubbles formation system in the core was started, which was also extended into 2013. The system was used for practical exercises at the reactor.

The RIC personnel, the JSI technical services, the JSI radiation protection service and the authorized external organizations conduct periodic inspections and supervisions of the safety relevant structures, systems and components (SSC). The inspection did not find any deficiencies.

Periodic safety review

In 2013, the periodic safety review of the TRIGA research reactor and the hot cell facility continued. The operator issued two reports on the pace of progress regarding the periodic safety review and issued seven topical reports on the review. In 2014 all the other seven topical reports will be issued. The periodic safety review will conclude with the preparation of a report on the review and a plan for implementing modifications and improvements. The report on the periodic safety review needs to be approved by the SNSA.

Upgrade of the Safety Analysis Report

In 2012, an administrative procedure was conducted with regard to upgrading the Safety Analysis Report of the TRIGA Mark II Research Reactor and the administrative procedure will continue in 2013.

2.1.4. The Central Storage for Radioactive Waste in Brinje

Central Storage for Radioactive Waste (CSRW) in Brinje is managed by the Agency for Radwaste Management (ARAO).

The CSRW operated safely; there were no recorded incidents or accidents. All periodic preventive maintenance inspections and testing of CSRW structures, systems and components as well as of functioning measuring equipment and utilities were carried out as planed.

As the operator of the nuclear facility, in 2013 the ARAO prepared new programme of the professional training of workers engaged in work relevant to safety in the CSRW, the programme for the management of radioactive waste by the commercial public service for radioactive waste from small producers and a physical protection plan for the CSRW.

In 2013, one employee at the ARAO received a licence to work as head of a storage facility, while two employees carried out initial training for work in the Radiation Protection Unit. This training will be completed in early 2014. Both workers have been employed by ARAO for many years.

The acceptance of radioactive waste in CSRW in 2013 and the inventory of the waste stored at the end of 2013 is described in more detail in Chapter 5.4.1.

In 2013, SRPA did not carry out an inspection of the ARAO or the CSRW, but it confirmed one of the assessments of the protection of workers exposed to radiation.

2.1.5. The Former Žirovski Vrh Uranium Mine

In the area around Žirovski Vrh, the extraction of uranium ore took place between 1982 and 1990 and uranium concentrate was processed there from. Mill tailings were disposed of on the Jazbec mine waste pile and hydrometallurgical tailings were disposed of at the Boršt site. In 1990, after the extraction of uranium ore was temporarily halted and a subsequent decision on permanent cessation was made, the process of remediating the mining and its consequences began. More information on remediation activities due to former mining activities at Žirovski Vrh can be found in Chapter 5.5. An amendment of the assessment of the radiation protection of the exposed workers was approved by the SNSA in 2013. On the basis of a decision of the SNSA, the Jazbec mine waste pile became part of the country's infrastructure in 2013.

2.2. Radiation Practices and the Use of Radiation Sources

The Ionizing Radiation Protection and Nuclear Safety Act stipulates advanced notification of the intention to carry out radiation practice or intended use of a radiation source, the evaluation of the radiation exposure of workers, a mandatory licence to carry out a radiation practice and a licence for the use of a radiation source or certificates of registration of radiation sources and the programme of radiological procedures for use in medicine. The competent authority for licensing in the fields of industry and research is the SNSA, while the competent authority in the field of medicine and veterinary medicine is the Slovenian Radiation Protection Administration (SRPA).

One of the licensing documents is an evaluation of the protection of workers exposed to radiation, which has to be approved by the SRPA. In the document, the nature and extent of the radiation risk of exposed workers, apprentices and students are assessed in advance. In addition, based on this assessment, a programme for the optimization of radiation protection measures in all working conditions is drawn up. The document must be prepared by the applicant, who is obliged to consult an authorized radiation protection expert. The evaluation can also be prepared by an authorized expert in this field. In 2013, the SRPA approved 155 such evaluations.

2.2.1. Use of Ionizing Sources in Industry and Research

At the end of 2013, based upon the registry of radiation sources, 138 organizations in industry, research and the state administration in the Republic of Slovenia were using 257 X-ray devices; 770 sealed sources were being used in 82 organizations. As many as 60 radioactive sources were stored at 21 organizations, which are intended to be handed over to the ARAO in the future.

In 2013, 64 licences to carry out radiation practices, 82 licences for the use of a radiation source, 8 certificates of the registration of radiation sources, 20 approvals for external operators of radiation practices, 8 decisions on the termination of the validity of licences to carry out radiation practices, 2 decisions on sealing an X-ray device and 1 decision on unsealing an X-ray device were issued by the SNSA. The SRPA approved 55 evaluations of the protection of workers exposed to radiation and 6 approvals for operators of radiation practices in nuclear and radiation facilities.

The maintenance and updating of the registers are crucial for efficient control of radioactive sources. Due to the increased number of recorded radioactive sources, the existing system is increasingly ineffective. A thorough overhaul is impossible due to a lack of financial resources.

Ionization smoke detectors, utilizing isotope ^{241}Am, form a special group of radiation sources. According to the registry of radiation sources, there were 25,128 ionization smoke detectors being used at 290 organizations at the end of 2013. 173 ionization smoke detectors were also stored at users' premises.

In the last few years the SNSA has put a great deal of effort into registering all ionization smoke detectors. The success of this effort can be seen in the increasing number of detectors registered and of those transferred to the Central Storage Facility for radioactive waste. A few dozen proposals for inspection control were submitted, in particular for those companies which dealt with or have been dealing with the radiation practice of maintaining (mounting, dismounting) ionization smoke detectors. By the end of 2013, as many as 11 different companies had obtained a licence to carry out such radiation practice.

The distribution of the application of radioactive sources in industry and research according to their purpose and mode of use, excluding X-ray devices and ionization smoke detectors, is shown in Figure 16, while the distribution of the application of X-ray devices is shown in Figure 17.

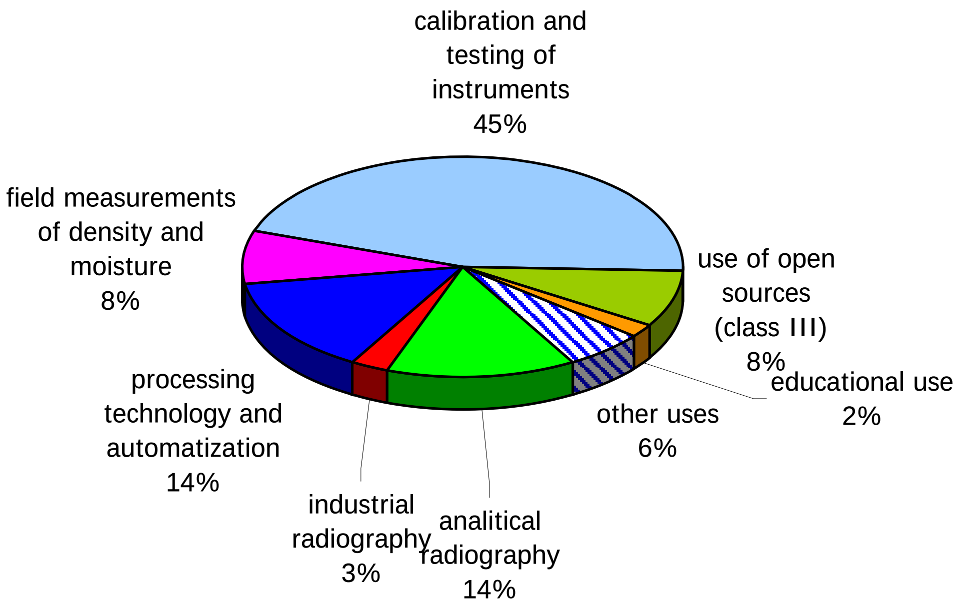

Figure 16: Distribution of the application of radioactive sources according to their purpose and mode of use

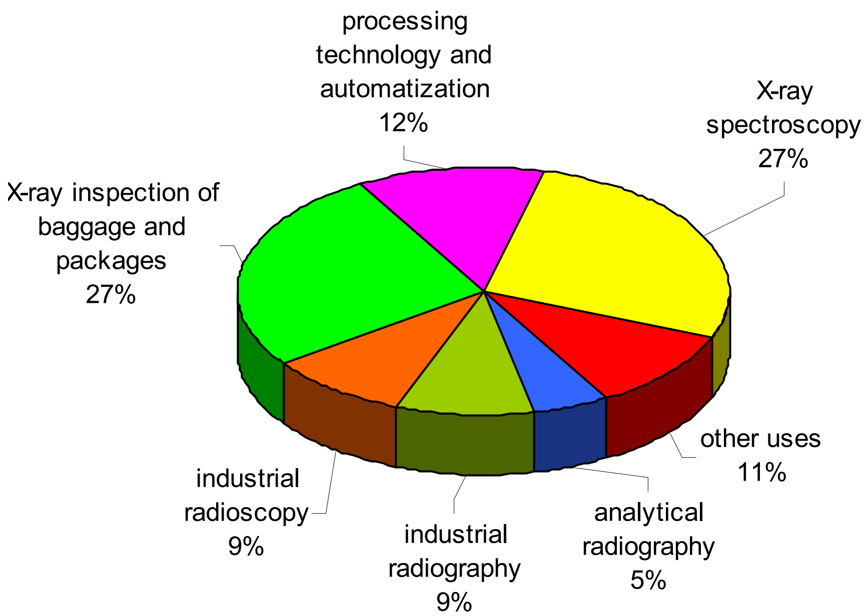

Figure 17: Distribution of the application of X-ray devices according to their purpose and mode of use

2.2.2. Inspections of radiation sources in industry, research and education

In 2013, altogether 48 inspections were conducted, among them ten where urgent intervention was required. In addition, three minor offence proceedings were conducted.

In 2013, inspections analysed three cases related to industrial radiography where the expected doses received by workers were exceeded. Namely, in one company the annual dose limit for occupationally exposed workers was exceeded. In another company the dose measured was a multiple of the monthly dose constraint, i.e. the maximum expected dose received in one month when all safety measures are in place. In addition, inspections also determined that in one company a worker using a radiation source was not categorized as an occupationally exposed worker and his dose was above the dose applicable for a member of the general public. Inspections also observed that the main reason for non-compliance with safety measures is neglect for written procedures where safety measures were already prescribed, e.g. workers did not use equipment for measuring ionizing radiation parameters. Industrial radiography is one of the most risky practices where sources of ionizing radiation are used. Non-compliance with foreseen safety measures is a cause of concern. Figure 18 shows an X-ray machine and defectoscopes used in industrial radiography.

Figure 18: An X-ray machine and defectosopes used in industrial radiography. (Photo: SNSA inspectorate)

The inspectorate also continued the campaign connected to smoke detectors using a source of ionizing radiation. Altogether ten inspections were conducted. As a rule in such smoke detectors, radioisotope ^{241}Am, i.e. one of the most radiotoxic isotopes, is used. Therefore very careful inspection is required when contamination with this radioisotope can be foreseen. Such contamination can be a consequence of inappropriate dismantling or demolition of the smoke detector. The intensive inspection campaign started in 2010, so that altogether 49 inspections were conducted by the end of 2013. Dismantling smoke detectors is an activity requiring a licence. Many companies involved in construction activity in old buildings do not have the knowledge required to handle such smoke detectors. As a result, they do not handle dismantled smoke detectors as radioactive waste. Even today some building managers do not know that smoke detectors with a radioactive source are present in the buildings. Figure 19 shows a smoke detector with ^{241}Am of 74 kBq located on the ceiling of a building in downtown Ljubljana.

Figure 19: A smoke detector with ^{241}Am of 74kBq located on the ceiling of a building in downtown Ljubljana

In 2013, the inspection service conducted ten interventions, slightly fewer than in the previous years. The number of interventions has been decreasing each year. The inspection activities are based on the preparedness of the SNSA, cooperation with the Radioactive Waste Agency, qualified experts, and other institutions in as well as outside the state that are involved in handling sources of ionizing radiation or handling radioactive waste. Interventions where safety measures had to be put in place can be categorized into three groups:

- Interventions related to sources of ionizing radiation in companies. In 2013 only one intervention of this type was carried out.
- Interventions related to the transport of sources of ionizing radiation originating from abroad. In this group, altogether five interventions were carried out.
- Other interventions requiring analysis.

Interventions from the first group are the most demanding, requiring a high level of expertise. The company Odpad Pivka, d.o.o., informed the SNSA that a radiation source was found in scrap. The source was a lightning rod with a radioactive source. The company stored the rod until an authorized expert performed an analysis. The source was also partly shielded. The authorized expert, namely the Institute of Occupational Safety, identified ^{152}Eu and ^{154}Eu. The rod was stored by the Agency for Radioactive Waste in the central radioactive waste storage facility. In addition, the Agency also put into storage contaminated material from this company. This contamination was caused by ^{232}Th. The origin of the lightning rod was not identified.

Transport of radiation sources from abroad requiring the intervention of the SNSA were related to Dinos d.d., Ljubljana, Talum d.d., and Slovenian Railways. Altogether five interventions of this type were carried out. Companies are equipped with measuring instruments so that they can as a general rule promptly identify the presence of an orphan source in a cargo. In addition, in one instance Slovenian Railways received information from a company in Italy that handles transport on the railway. In all five cases the sources were sent back to the state of origin, namely Montenegro, Hungary and Serbia. The SNSA informed the regulatory authorities of these countries of the transport.

The SRPA inspects the radiation protection of workers involved in practices using ionizing radiation. In 2013, the SRPA conducted three inspections in Q Techna due to incidents in that company. One of the inspections was a joint inspection by both authorities, namely the SNSA and SRPA. The first inspection was dedicated to occupational doses received by two workers that were measured in December 2012 and January 2013. Both measurements showed increased doses that were a consequence of an increase of workload. Namely, the workload was ten times higher than foreseen in the assessment of the radiation protection of exposed workers. A written order was issued which required a change in the assessment mentioned due to increased risks. The assessment must be prepared in cooperation with a qualified expert and finally approved by the SRPA. Two other inspections concerned four cases where an increase in doses was identified as well as an incident at the end of October 2013. Two workers received doses of 19.2 mSv and 27.5 mSv. They were conducting industrial radiography. The doses were received when the workers tried to free a source that was stuck. They wanted to put the source in a safe position. The inspector issued a written order containing requirements related to radiation safety, i.e. a prohibition on both workers working, a special health examination, an assessment of the effective doses, as well as equivalent doses received by limbs and eyes, a change in the assessment mentioned that must be prepared in cooperation with a qualified expert, the calibration of electronic dosimeters, the preparation of records of daily doses from January to November 2013 and a written explanation submitted by the third worker receiving an increased dose. This inspection case was not closed in 2013, namely in 2014 it continued in minor offence proceedings.

In January 2013 an enforcement order was issued to Pivovarna Union. The order was related to a written order from 19 October 2012 whereby the SRPA required the company to put in place safety measures. Namely, the assessment of effective and equivalent doses was required as well as a special health examination, an evaluation of the assessment the radiation protection of exposed workers and proposals for improvements. The written order was initiated by the doses received by a maintenance worker whose equivalent doses were in the range 1-10 mSv. The written order requirements were put in place on 13 February 2013.

2.2.3. Use of Radiation Sources in Medicine and Veterinary Medicine

The Slovenian Radiation Protection Administration (SRPA) is responsible for the administration and inspection of practices involving radiation in medicine and veterinary medicine.

X-ray Devices in Medicine and Veterinary Medicine

According to the records of the SRPA, 913 X-ray devices for medicine and veterinary medicine were installed as of the end of 2013; 60 of them were not in use. The categorization of X-ray devices based on their purpose is given in Table 4.

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

Purpose	Status 2012	New	Written off	Status 2013
Dental	462	24	17	469
Diagnostic	265	7	12	260
Therapeutic	10	0	0	10
Simulator	3	1	1	3
Mammography	36	2	0	38
Computer tomography CT	26	1	2	25
Densitometers	46	1	1	46
Veterinary	59	4	1	62
TOTAL	**907**	**40**	**34**	**913**

In the field of the use of X-ray devices in medicine and veterinary medicine in 2013, the SRPA granted 91 licences to carry out a radiation practice and 195 licences to use X-ray devices. Also, 142 confirmations of the programmes of radiological procedures and 94 confirmations of the evaluation of the protection of workers exposed to radiation were issued.

In medicine, 446 X-ray devices were used in private dispensaries and 405 in public hospitals and institutions. The average age of X-ray devices was 9.5 years (9.1 years in 2012) in the public sector and 9.7 years (9.2 years in 2012) in the private sector. In veterinary medicine, 52 devices were used in private dispensaries and 10 in public institutions. The average age of these X-ray devices was 13.5 years (13.8 years in 2012) in the public sector and 9.6 years (8.0 years in 2012) in the private sector. A detailed classification of X-ray devices in medicine and veterinary medicine according to their ownership is given in Table 5.

Table 5: Number of X-ray devices in medicine and veterinary medicine by ownership

Ownership	Diagnostic		Dental		Therapeutic		Veterinary		Total	
	No. (%)	Age (years)	No. (%)	Age (years)	No. (%)	Age (years)	No. (%)	Age (years)	No. (%)	Age (years)
Public	294 (79%)	9.8	100 (21%)	8.9	11 (100%)	7.7	10 (16%)	13.5	415 (45%)	9.6
Private	77 (21%)	10.3	369 (79%)	9.6	0	0	52 (84%)	9.6	498 (55%)	9.7
Total	**371**	**9.9**	**469**	**9.5**	**11**	**7.7**	**62**	**10.2**	**913**	**9.7**

All X-ray devices are examined by approved radiation protection experts at least once a year. The devices are classified, with regard to their quality, into the following groups: fully functional, servicing required, decommissioning proposed, and not functional. The analysis of the data for X-ray devices is presented in Figure 20, which shows that more than 95% of devices were classified as “fully functional” in the last five years.

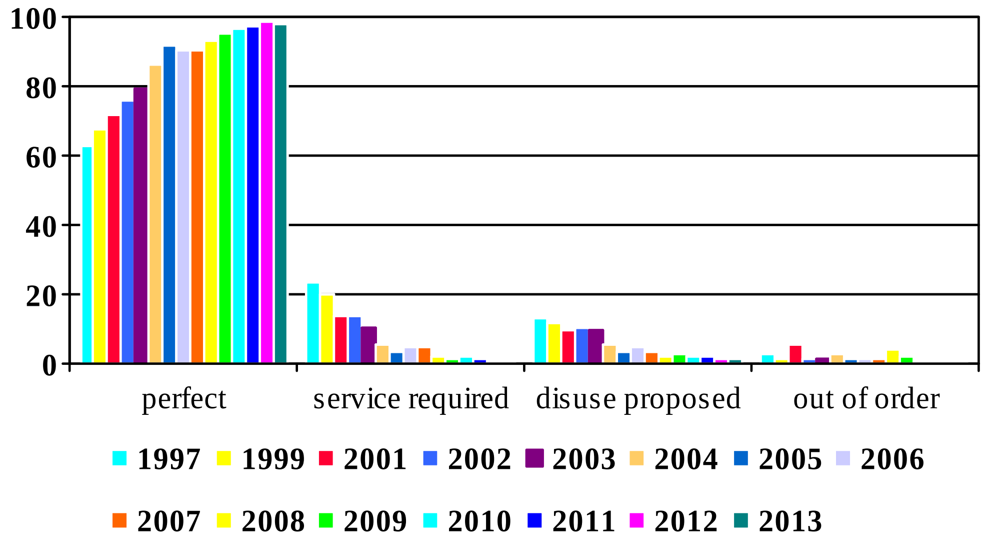

Figure 20: Percentage of diagnostic X-ray devices according to their quality in the period 1997–2013

In 2013, 13 in-depth inspections of the use of X-ray devices in medicine and veterinary medicine were carried out, of which two inspections were in the latter field. In three cases, based on the findings of the inspection, the inspection decision was issued with requirements that needed to be fulfilled in order to comply with the valid regulations. Measures to optimize procedures were ordered in two inspections that were associated with the high exposure of patients during procedures. In three cases, the inspection included the sealing of an X-ray machine in order to prevent any use of the device, which had been maintained as a back-up. In one case, an X-ray machine was sealed because a decision prohibiting its use was issued due to its technical inadequacy.

Based on a review of inspection reports on X-ray devices for medical use sent to the SRPA by approved technical support organisations, 6 inspections were conducted during which the SRPA requested that the user provide evidence that the noted shortcomings had been eliminated. There were 20 cases in which the user was asked to present evidence relating to the termination of the use of an X-ray device and 56 cases involving the requirement to comply with the applicable legislation.

Unsealed and Sealed Radiation Sources in Medicine and Veterinary Medicine

Seven hospitals or clinics in Slovenia, namely the Clinic for Nuclear Medicine of the University Medical Centre Ljubljana, the Institute of Oncology, the University Medical Centre Maribor, and general hospitals in Celje, Izola, Slovenj Gradec and Šempeter near Nova Gorica use unsealed sources (radiopharmaceuticals) for diagnostics and therapy in their nuclear medicine departments.

In nuclear medicine departments, altogether 6,726 GBq of isotope ^{99}Mo, 2,863 GBq of isotope ^{18}F, 1,069 GBq of isotope ^{131}I, and minor activities involving the isotopes ^{123}I, ^{177}Lu, ^{201}Tl, ^{90}Y, ^{111}In and some other isotopes are used for diagnostics and therapy. Isotope ^{99}Mo is used as a generator of the isotope technetium ^{99m}Tc, which is used for diagnostics by nuclear medicine departments. From the initial activity of ^{99}Mo, approximately three times higher activity of ^{99m}Tc can be eluted in one week.

Sealed sources for therapy are used at the Institute of Oncology and the Clinic of Ophthalmology, and for the irradiation of blood components at the Blood Transfusion Centre of Slovenia. At the Institute of Oncology, 3 sources of ^{192}Ir, one of them with initial activity of 440 GBq and two with initial activity of 47 GBq, and 3 sources of ^{90}Sr with initial activities up to 740 MBq were used. At the Clinic of Ophthalmology, 4 sources of ^{106}Ru with initial activities up to 37 MBq were used for treating eye tumours. At the Blood Transfusion Centre of Slovenia, a device with ^{137}Cs with initial activity of 49.2 TBq was used for the irradiation of blood components.

Sealed sources with low activity are used for the operational testing of various devices and measurement equipment in some nuclear medicine departments. The SRPA registry shows that there are still 1,933 ionization smoke detectors with ^{241}Am in 18 medical facilities.

In 2013, the following documents with reference to the use of unsealed and sealed sources in medicine were issued: 3 licences to carry out a radiation practice, 1 licence to use a radiation source in medicine, 2 confirmations of radiological procedure programmes, 3 permits for the import of radioactive material and 72 statements on the shipment of radioactive materials from EU Member States.

Medical departments with unsealed and sealed radiation sources were surveyed (twice or once annually, depending on the source type) by the approved experts for radiation protection and medical physics from the Institute for Occupational Safety (ZVD). No major deficiencies were found in 2013 and no dose constraint or dose limit was exceeded.

In addition to the expert reviews made by the ZVD, the SRPA inspectorate also carried out two inspections, one at the Institute of Oncology and another at the Blood Transfusion Centre. Inspection at the Institute of Oncology deals with the acquisition of appropriate permits and approvals for the implementation of computerized tomography in the Department of Nuclear Medicine. Inspection by ZTM dealt with the renewal of a programme involving radiological procedures. There were no major irregularities.

Neither unsealed nor sealed radioactive sources were used in veterinary medicine in 2013.

In the field of the transport of radioactive materials used in medicine and veterinary medicine, one certificate of eligibility for a foreign contractor carrying out a radiation practice was issued. One inspection was also carried out during the transport of radioactive material, which dealt with the delivery of radioactive material to the Institute of Oncology, the Department of Nuclear Medicine, carried out by the company IBA from Italy. No irregularities were found.

2.2.4. The transport of radioactive and nuclear materials

The transport of radioactive and nuclear materials is regulated by the Act on the transport of dangerous goods. All road transport of such materials has to be carried out in accordance with the provisions of the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR).

In 2013, the SNSA issued one approval for transport under special arrangement to the Agency for Radioactive Waste for transport of spent sealed sources from the producer VIPAP VIDEM Krško, d.d., and MUFLON, d.o.o., to the Central Storage Facility in Brinje.

The Ionizing Radiation Protection and Nuclear Safety Act, which was amended in 2011, now defines the transport of radioactive materials as a radiation practice. Thus, the transport of radioactive materials is allowed only if a licence to carry out a radiation practice has been obtained, which is a similar arrangement to that for the transport of nuclear material. As of the coming into force of the amendments, the SNSA systematically treats such transportation as a radiation practice, as regards prolonging or amending a licence or issuing a new licence for carrying out a radiation practice for carriers of such materials and companies that use radioactive sources in the field.

In 2013, the SNSA did not carry out any procedures for the approval of packaging for the transport of radioactive material.

2.2.5. The import, transit and export of radioactive and nuclear material

The SNSA and the SRPA issue permits for the import and export of radioactive and nuclear materials outside the EU and approve prescribed forms for the shipment of radioactive material between EU Member States.

In 2013, the SRPA issued three permits for the import of radioactive sources from non-EU countries and approved 72 applications of consignees of radioactive material for a total of 18 isotopes. Each isotope from an individual producer intended for the same end user is counted separately.

In 2013, the SNSA approved 10 applications of consignees of radioactive material from other EU Member States. The SNSA also issued three permits for the import of radioactive material; three permits for multiple import; two permits for multiple shipments of contaminated equipment between other EU Member States, and two permits for multiple import and export of contaminated equipment; one permit for multiple shipments of nuclear material between other EU Member States, and two permits for the import of nuclear material, including one for the import of fresh nuclear fuel.

In 2013, the SNSA did not issue any permits for the transit of radioactive material or for the transit of nuclear material.

The shipment of radioactive waste and spent nuclear fuel between EU Member States as well as between EU Member States and third countries is regulated by Council Directive 2006/117/EURATOM on the supervision and control of shipments of radioactive waste and spent fuel. In 2013, the SNSA issued two consents for the return of radioactive waste after treatment in Sweden.

2.2.6. Achieving goals under the Resolution on Nuclear and Radiation Safety

The Resolution on Nuclear and Radiation Safety in the Republic of Slovenia for the period 2013–2023 determined the following broad-ranging goals in the field of nuclear and radiation practices:

Goal 1:

Nuclear and radiation facilities and operators fulfil the statutory requirements, ensure continuous improvement of nuclear and radiation safety, and monitor international improvements in the field.

Realization in 2013:

All nuclear and radiation facilities in the state (Krško NPP– NEK, the TRIGA research reactor, the Central Storage for Radioactive Waste in Brinje, the mine repository and mill tailings site) fulfilled the statutory requirements and fostered the improvement of nuclear and radiation safety. NEK accomplished the first two modifications from the safety upgrade programme based on the lessons from the Fukushima accident in 2011 (the installation of the passive autocatalytic system for hydrogen reduction and the installation of the passive containment filtered vent system). These two modifications are of crucial importance in severe accident conditions.

There were several cases of the non-fulfilment of statutory requirements in radiation practice. However, there were no excessive radiological impacts on the population or the environment. The causes were quickly analysed and corrective actions were implemented.

3. RADIOACTIVITY IN THE ENVIRONMENT

Protection against ionizing radiation is implemented for three categories: radiation workers, patients undergoing medical diagnostics that use radiation, and the general population. Protection of the population is ensured by the competent authorities by measuring radioactivity throughout Slovenia, with special attention devoted to the protection of populations living in the vicinity of nuclear and radiation facilities

The main purposes of radioactivity monitoring in the environment are to monitor the levels of radioactive contamination, to monitor trends in the concentrations of radionuclides in the environment, and to provide timely warnings in the event of a sudden increase in radiation levels in Slovenia.

Radiation protection of the population is ensured through the on-line monitoring of external radiation levels and radioactivity in the environment, as well as through continuous control of radioactivity in drinking water, food, feed, and products in general use on the basis of laboratory measurements.

Supervision of nuclear and radiation facilities is carried out through operational monitoring; the programme for such is drawn up by the competent authority, whereas the operator is liable for the implementation of this programme. The control of emissions from all facilities and the extent of radioactivity in the surrounding areas are covered by this programme. Sampling and measurements of samples are carried out by accredited technical support organizations, which are in turn authorized by the competent administrative authorities.

Radioactivity released into the environment by the nuclear power plant in Krško, the former uranium mine at Žirovski Vrh, the TRIGA Research Reactor and the Central Storage for Radioactive Waste, which are both located in Brinje near Ljubljana, is monitored. The doses received by the population living in the vicinity of these nuclear and radiation facilities, which emit radioactive substances into the environment, are estimated on the basis of measured or modelled data. The doses received by the population should be lower than the dose constraints set by the competent administrative authority.

The monitoring of radioactivity in the environment that is a result of global contamination from the Chernobyl nuclear accident and past nuclear testing has been carried out in Slovenia for over five decades and mainly involves tracking the long-lived fission radionuclides ^{137}Cs and ^{90}Sr by different transmission pathways.

This chapter contains a summary of reports on the state of environmental radioactivity on the territory of Slovenia in 2013.

3.1. The Early Warning System for Radiation in the Environment

An automatic on-line warning system for environmental radioactivity has been established in Slovenia. It is intended to immediately detect elevated radiation levels in the environment and is one of the key elements of the warning and emergency response during nuclear or radiological emergencies. In the event of elevated levels of external radiation and air concentrations of radioactive particles, soil, drinking water, food, and feed would be contaminated due to the subsequent deposition of radioactive particles on the ground. Automatic probes for real-time measurements of external radiation are positioned around Slovenia. They are managed by the Slovenian Nuclear Safety Administration (SNSA), the Krško Nuclear Power Plant and Slovenian thermal power plants. Data are collected at the SNSA, where they are constantly analysed, archived and made available to the public on the internet. If the values are elevated, an automatic alarm is sent to the officer on duty. In 2013, there were no events that triggered an alarm due to increased radiation in the environment.

Since 1997, the SNSA has been sending data from the Slovenian early warning system to the European EURDEP system, based at the Joint Research Centre in Ispra (Italy), where data from the majority of European national early warning networks are collected. Through this arrangement, Slovenia also gained access to real-time data on external radiation from other participating countries. Additionally, the Slovenian data are exchanged daily with the centres in Vienna (Austria), Zagreb (Croatia), and Budapest (Hungary).

3.2. Monitoring Environmental Radioactivity

Monitoring of the global radioactive contamination due to atmospheric nuclear bomb tests (1951–1980) and the Chernobyl accident (1986) has been carried out in Slovenia for almost five decades. Primarily, two long-lived fission radionuclides, ^{137}Cs and ^{90}Sr, have been monitored in the atmosphere, water, soil and drinking water, as well as in foodstuffs and feedstuffs. Part of the monitoring programme related to the radioactivity of surface waters also includes periodic testing of river water contamination with ^{131}I due to the use of this radionuclide in medicine. Other natural gamma emitters are also measured in all samples, while in drinking water and in precipitation, the levels of tritium (^{3}H) are additionally measured.

The results of the measurements for 2013 showed that concentrations of both long-lived fission products in samples of air, precipitation, soil, milk, foodstuffs of vegetable and animal origin, and feedstuffs continued to slowly decrease and were in most cases already lower than before the Chernobyl accident. On average, the fallout of these radionuclides in Slovenia due to the Chernobyl accident was five times higher than from all preceding nuclear weapon tests together. Concentrations of tritium in liquid samples, namely from surface waters, precipitation and drinking water, decrease very slowly, by only few per cent per year.

In Slovenia, the consequences of the releases resulting from the nuclear accident in Fukushima on 11 March 2011 were negligible. Only short-term values of the isotopes ^{131}I and ^{134}Cs in atmosphere and in precipitation were measurable.

The biggest contribution to the radiation exposure of the public due to environmental contamination by artificial radionuclides comes from external radiation and from food ingestion. The inhalation dose from aerosols with fission radionuclides is negligible. In 2013, the effective dose from external radiation of ^{137}Cs (mainly from the Chernobyl accident) was estimated at about 6.2 μSv, which is 0.24% of the dose received by an average adult in Slovenia from natural background radiation. This value is slightly smaller than the value that was measured and calculated for the previous year (7.7 μSv).

The annual dose from the ingestion pathway (consumption of food and drinking water) was 0.5 μSv, which is comparable with doses in previous years. The dose for 2008 was higher due to the higher average values of the radionuclide ^{90}Sr in the selected samples of vegetables sampled in regions with higher Chernobyl contamination (Figure 21). The contribution of ^{90}Sr to the annual dose due to ingestion is 53%, while the contribution of ^{137}Cs to the annual dose is 45%. The annual contribution due to the inhalation of both radionuclides is only about 0.001 µSv, which is negligible when compared to the radiation exposure from other transfer pathways. The effective dose from drinking water, taking into account artificial radionuclides, was also estimated. Calculations have shown that on average this dose was around 0.042 µSv per year. The annual limit value of 0.1 mSv per year due to natural and artificial radionuclides in drinking water from local water supplies was not exceeded in any sample.

In 2013, the total effective dose of an adult individual in Slovenia arising from the global contamination of the environment with artificial radionuclides was estimated at 6.7 µSv, as shown in Table 6. This is approximately 0.26% of the dose compared to the annual exposure of an adult in Slovenia received from natural radiation in the environment (2,500–2,800 µSv). In the regions with lower radioactive contamination of the soil, such as Prekmurje and the Coastal-Karst region, the corresponding dose is lower, while it is higher in the Slovenian Alpine region.

Considering all the doses specified in this chapter, it should be taken into account that these values are extremely low and cannot be measured directly. The final results are calculated by using mathematical models and are based on measurable quantities of radionuclides, most of which are also low. The measurement uncertainties are therefore considerable and in some cases results differ considerably from year to year. Most importantly, these values are far below the limit values.

Table 6: Radiation exposure of the adult population in Slovenia due to global contamination of the environment with artificial radionuclides in 2013

Transfer pathway	Effective dose [µSv per year]
Inhalation	0.001
Ingestion (food and drinks)	
drinking water	0.042
food	0.5
External radiation	6.2*
Total (rounded)	**6.7****

* This applies to central Slovenia; the value is a bit lower for the urban population and higher for the rural population.
** Radiation exposure from natural radiation is 2,500–2,800 µSv per year.

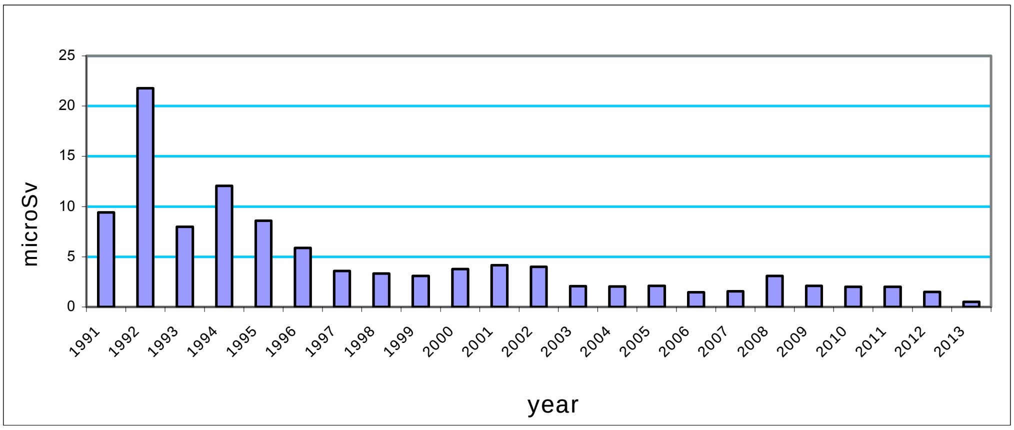

Figure 21: Annual effective doses of members of the public received by ingestion (food and drinks) due to global radioactive contamination of the environment with the radionuclides ^{137}Cs and ^{90}Sr in Slovenia

The reason for the high value in 1992 was that game foodstuffs were taken into account when the dose estimation was calculated. Without those samples, the effective dose for that year would have been lower than 10 µSv.

3.3. Operational Monitoring in Nuclear and Radiation Facilities

Each installation or facility that discharges radioactive substances into the environment is required to be subjected to regulatory control. Radioactivity measurements in the surroundings of the installations must be performed in the pre-operational period, during operation, and for a certain period after the installation ceases to operate. The goal of operational monitoring is to establish whether the discharged activities are within the authorized limits, whether radioactivity concentrations in the environment are inside the prescribed limits, and whether the exposure of the population is lower than the prescribed dose limits.

3.3.1. The Krško Nuclear Power Plant

The radiological situation in the surroundings of the nuclear power plant is monitored by the continuous measuring of gaseous and liquid radioactive discharges and by carrying out radioactivity measurements of environmental samples. The measured values of analysed radionuclides in environmental samples, namely in air, soil, surface and underground water, precipitation, drinking water, agriculture products, and feedstuffs, during the normal operation of the plant are low, usually considerably lower than the detection limits of analytical procedures. The impacts of the nuclear power plant are therefore evaluated only on the basis of data on gaseous and liquid discharges. These discharge data are used as an input for modelling the dispersion of radionuclides in the environment. Low results of environmental measurements during normal operation confirm that radioactive discharges into the atmosphere and in aquifers were low. In the event of an emergency, the established monitoring network allows the immediate sampling and analysis of contaminated samples.

In 2013, independent monitoring confirmed that the measurements of discharges performed by the Krško NPP were fully consistent with the results of measurements carried out by the laboratories of the authorized performers of radioactivity monitoring, i.e. the Jožef Stefan Institute (JSI) and the Institute of Occupational Health (IOS).

2.1.1.7. Radioactive discharges

The activity in gaseous releases is mostly produced by noble gases. In 2013, the total activity of noble gases released into the atmosphere was 2.58 TBq, which resulted in a public exposure of 0.16 µSv or 0.3% of the limit. Releases were twice as much as in the previous year, whereas their values are much lower than the prescribed limit values. The released activities of iodine isotopes in 2013 were 109 MBq (calculated for ^{131}I), which is 0.6% of the annual limit and is one order of magnitude higher than in 2012. Both increases are the result of the nuclear fuel leakage during fuel cycle 26. The activity of dust particles in 2013 was 0.12 MBq, which is 0.001% of the annual limit and comparable with 2012. Due to discharges of tritium (^{3}H) into the atmosphere, a slight increase in the activity of ^{3}H gas emissions was observed from one year to the next for recent consecutive years due to improvements in the sampling method and laboratory analysis. The release level of ^{3}H has slowly been stabilized, as expected. The activity of ^{14}C corresponds to the values that are typical for years with refuelling outages when most of the releases occurred, as anticipated.

In liquid discharges from the plant to the Sava River, tritium (^{3}H), bound to water molecules, predominated. Despite the outage, the total ^{3}H activity released in 2013 was slightly lower, 11.6 TBq, which is 25.9% of the annual regulatory limit (45 TBq). Because of its low radiotoxicity, this radionuclide is radiologically less important despite having a higher activity compared to other radioactive contaminants. The activity of other radioisotopes in liquid discharges was, despite the difficulties with fuel in 2013, slightly lower than in the previous year and amounted to 37 MBq or 0.04% of the annual limit (100 GBq). Regular monitoring of radioactive discharges in past years did not provide measurements of ^{14}C in liquid discharges, although they are performed in some European and American nuclear power plants. In the context of independent monitoring of the Krško NPP in 2010 and 2011, an additional sampling of the radioactive waste monitoring tank was conducted. The results of the IJS analyses confirmed the expectations of relatively significant concentrations of ^{14}C in the wastewater of the Krsko NPP. Estimated annual ^{14}C activity was 1.1 GBq (2010) or 2.0 GBq (2011). In 2013, the IRB systematically began to measure the ^{14}C in quarterly samples of liquid effluents. The total discharged activity released to the Sava River was 0.85 GBq, which is slightly lower than the estimated values.

2.1.1.8. Environmental radioactivity

The programme for monitoring environmental radioactivity from the above-mentioned discharges comprises the following measurements of the concentrations or contents of radionuclides in environmental samples:

- in air (aerosol and iodine filters);
- in dry and wet deposition (dry and wet precipitation);
- in the Sava River water, sediments and water biota (fish);
- in tap water (Krško and Brežice), wells and underground water;
- in food of vegetable and animal origin (including milk);

- in soil on cultivated and uncultivated areas; and
- measurements of ambient dose equivalents at several locations.

Concerning the impact of the Krško NPP, it should be noted that the presence of the radionuclides ^{137}Cs and ^{90}Sr is a consequence of global contamination and not a result of plant operations. The measurable contribution of plant operations results in higher concentrations of tritium (^{3}H) in the Sava River downstream of the plant. As in previous years, the measurements of water from the Sava River showed an increase in the ^{3}H concentration, which is a result of the liquid effluents of the Krško NPP. The annual average concentration of ^{3}H (4.4 ± 2.0 kBq/m^{3}), measured at Brežice, was six times higher than the average measured concentration (0.71 ± 0.06 kBq/m^{3}) at the reference site in Krško (in front of the paper mill) and lower than in 2012 (5.4 ± 0.2 kBq/m^{3}). A direct correlation between ^{3}H discharges and ^{3}H concentration in underground water can be seen from the data from the VOP-4 and Medsave borehole, where the maximum measured values correspond to higher discharges from the Krško NPP. Measured average annual ^{3}H concentrations in the water from other boreholes, pipelines and water catchments are comparable with those measured in previous years, which means that the Krško NPP has a negligibly small or no influence. The concentrations of other artificial radionuclides discharged into the Sava River (^{60}Co and others) were below the detection limits in all samples. The measured concentrations of radioisotope ^{131}I in the Sava River could be caused by discharges from nuclear medicine clinics in Ljubljana and Celje, not by the operations of the nuclear power plant.

2.1.1.9. Exposure of the public

Dose assessment of the public was based on model calculations made by contractors. The calculated dispersion factors for atmospheric discharges, based on realistic meteorological data, showed that the most important pathways for public exposure were the ingestion of food with ^{14}C, external radiation from clouds and deposition, and the inhalation of air particles with tritium and ^{14}C. The highest annual dose was received by adult individuals due to the intake of ^{14}C from vegetable food (0.05 µSv only from the ingestion of local apples), while a ten-fold lower dose was received due to the inhalation of ^{3}H. The dose assessment of liquid discharges in 2013 showed that their additional contribution to the population exposure was very low, 0.43 µSv per year, which is more than in previous years. Namely, since 2013 the model includes ^{14}C, which started to be systematically measured in liquid discharges. The levels of external radiation in the immediate vicinity of some structures of the NPP were higher than in the natural surroundings, but the plant's contribution is hardly measurable at the perimeter fence. It was estimated that the plant-related external exposure was less than 0.5 µSv per year. This estimation is similar to those in recent years and it is now based on more realistic data than in the first period of plant operation, when the estimated values of the external dose were at least one order of magnitude higher.

Table 7 shows that the total effective dose of an individual who lives in the surroundings of the Krško NPP is less than 0.5 µSv per year. The contribution of ^{14}C ingestion is higher than in 2012, because most of the releases of ^{14}C occurred during the annual outage, when all crops had not yet been picked. This value represents less than 1% of the authorized limit value (a dose constraint of 50 µSv per year) or 0.02% of the effective dose received by an average Slovenian from natural background radiation (2,500–2,800 µSv per year).

Table 7: Assessment of the partial exposures of an adult member of the public due to atmospheric and liquid radioactive discharges from the Krško NPP in 2013

Type of exposure	Transfer pathway	Most important radionuclides	Effective dose [µSv per year]
External radiation	Cloud immersion deposition	Noble gases (^{41}Ar, ^{133}Xe, ^{131m}Xe) Particulates (^{58}Co, ^{60}Co, ^{137}Cs, etc.)	0.00054 <4E-8
Inhalation	Cloud	^{3}H, ^{14}C	0.0038
Ingestion (atmospheric discharges)	Vegetable food	^{14}C	0.05**
Ingestion (liquid discharges)	Drinking water (the Sava River)	^{3}H, ^{137}Cs, ^{89}Sr, ^{90}Sr, ^{131}I, ^{14}C	<0.43*
Total Krško NPP in 2013			**< 0.5****

* The total amount of Krško NPP contributions is not listed, since all contributions cannot be simply summed up due to different reference groups of the population.

** This assessment did not take into account that a person spends 20% of the time outdoors and that the shielding factor for being in a house is 0.1.

3.3.2. The TRIGA Research Reactor and the Central Storage for Radioactive Waste at Brinje

The TRIGA Research Reactor and the Central Storage for Radioactive Waste are both located at Brinje near Ljubljana. The samples irradiated in the reactor are analysed in the laboratories of the Department of Environmental Science of the Jožef Stefan Institute, which are located by the reactor building. Therefore, potential radioactive discharges at this location come from the operation of the reactor, from the Central Storage for Radioactive Waste and from the work in the laboratories. The operation of the facilities was stable and there were no incidents that resulted in radioactive material being released into the environment; thus the results of the operational monitoring for 2013 are essentially the same as for the previous year.

Environmental monitoring of the TRIGA Research Reactor comprises measurements of atmospheric and liquid discharges and measurements of radioactivity levels in the environment. The latter are carried out to determine the environmental impact of the installation and include measurements of radioactivity in the air and underground water, as well as measurements of external radiation, radioactive contamination of the soil, and the radioactivity of Sava River sediments.

Measurements of radioactive aerosol discharges into the atmosphere showed results below the detection limit. Discharges of ^{41}Ar into the atmosphere, calculated on the basis of the reactor operation time, were estimated as 0.8 TBq in 2013, which is comparable to previous years. The measurements of specific activities in the environment showed no radioactive contamination from the operation of the reactor. The external dose due to radiation from the cloud on an individual due to ^{41}Ar discharges was estimated at 0.02 µSv per year under the assumption that the individual spends 65 hours per year at a distance of 100 m from the reactor when mowing grass or ploughing snow and that he stays in the cloud only 10% of the time. An inhabitant of Pšata village who lives at a distance of 500 m from the reactor receives 0.39 µSv per year. A conservative assumption was used for the dose assessment for individuals concerning liquid discharges. If the river water is ingested directly from the recipient Sava River, the annual exposure is estimated at less than 0.01 µSv per year. The total annual dose for an individual, irrespective of the pathway, is still one hundred times lower than the authorized dose limit of 50 µSv per year. The total annual dose of an individual from the public in 2013, irrespective of the model used, is still more than a thousand times lower than the effective dose from the natural background in Slovenia, which is from 2,500 to 2,800 µSv per year.

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

The estimated average radon emission in 2013 was 6 Bq/s, which is, taking into account the measuring uncertainty, similar to the emissions in 2009, 2010, 2011 and in 2012, as shown in Figure 22. The increase of radon ^{222}Rn concentrations in the vicinity of the storage was not measurable and was therefore estimated by a model for average weather conditions to be around 0.35 Bq/m^3 at the fence of the reactor site. In the wastewater from a drainage collector, the only artificial radionuclide measured was again ^{137}Cs, which is a consequence of global contamination and not of storage operation. In 2013, the presence of ^{241}Am was detected again in an underground reservoir (0.23 Bq/m^3; in 2011 it was 0.5 Bq/m^3). The concentrations of radionuclides were far lower than clearance levels and also lower than the derived concentrations for drinking water.

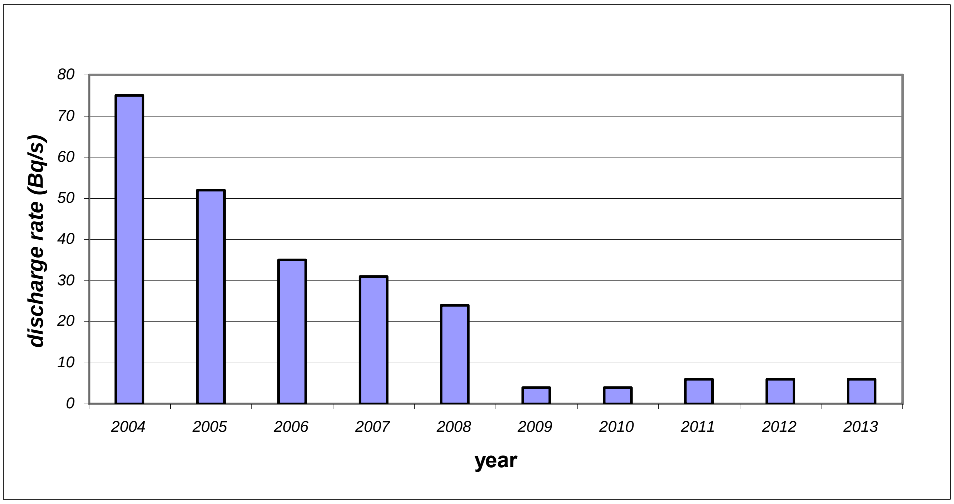

Figure 22: Emission rates of ^{222}Rn from the Central Storage for Radioactive Waste at Brinje

For the dose assessment of the most exposed members of the public, the inhalation of radon decay products and direct external radiation were taken into account. The most exposed members of the reference group are the employees of the reactor centre, who could potentially be affected by radon releases from the storage. In 2013, they received an estimated effective dose of 0.87 µSv, according to the model calculation. The security officer received about 0.41 µSv per year from his regular rounds, while the annual dose received by the farmer adjacent to the controlled reactor area was estimated to be only about 0.02 μSv. These values are comparable with those in 2012 and are much lower than in 2008, mostly due to lower radon releases. Moreover, they are much lower than the authorized dose limit for individuals from the reference group of the population (100 μSv per year). The annual dose collected by an individual from the natural background is 2,500–2,800 μSv.

3.3.3. The Former Žirovski Vrh Uranium Mine

The monitoring of the environmental radioactivity of the former uranium mine at Žirovski Vrh (RŽV), which is currently in the post-operational phase, consists of measuring radon releases, liquid radioactive discharges and concentrations of the radionuclides in the environment. An integrated programme of measurements has been implemented, including the radionuclide-specific activities of the uranium–radium decay chain in the environmental samples, including the concentrations of radon and its decay products in the air, and external radiation. Measurement locations are set mainly in the settled areas in the valley, up to 3 km from the existing mine radiation sources, from Gorenja Vas to Todraž. For the evaluation of the impact of uranium mining and milling, the relevant measurements of radionuclides of natural origin are carried out at reference points outside the influence of mine and repository discharges as an approximation for natural radiation background. The net contribution of radioactive contamination is assessed by correcting the measured values with regard to the natural background of the measured examined radionuclides.

Measurements of external gamma radiation in the vicinity of mine repositories and hydrometallurgical tailings repositories were also performed in 2013, in accordance with the monitoring programme. In 2013, the fifth year following the closure of the Jazbec repository and the third year following the closure of the Boršt repository, the monitoring programme was scheduled in accordance with the Safety Report for the Jazbec repository and should have been more comprehensive than in the previous four-year period. The financial assets available to the RŽV were not sufficient for the execution of the entire programme. RŽV decided to carry out measurements in the applicable range, which allows reasonably reliable dose estimation for the residents living in the vicinity of mining facilities and an environmental impact assessment.

The most important part of the programme in 2013 was measuring the radon concentration and radon short-lived progeny, according to the additional contribution to the population dose from the uranium mine sources.

The radioactivity of surface waters has been slowly but steadily decreasing in recent years, especially ^{226}Ra concentrations in the Brebovščica, the main recipient stream, where the concentrations are already close to the natural background level (3.9 Bq/m^3 in 2013). Only the concentrations of uranium ^{238}U in the Brebovščica stream (an average calculated from quarterly concentrations in 2013 was 131 Bq/m^3) are still increasing, since all liquid discharges from the mine and from disposal sites flow into this stream. In 2013, the mine's contribution of radon ^{222}Rn from the repository sites and the mine to the natural concentrations in the environment is estimated at around 2.6 Bq/m^3.

The calculation of the effective dose received by the population took into account the following exposure pathways: the inhalation of long-lived radionuclides from the decay series of uranium, radon and its short-lived progeny, ingestion without water contribution, and external gamma radiation. The radiation exposure of an adult member of the public living in the vicinity of the mine was estimated at 88 μSv for 2013, which is a little less than in the previous year. The exposure is low because the restoration at the mine repositories at the Jazbec and Boršt sites was finished and represents approximately one third of the effective dose estimated in the last decade of the 20th century. However, the most important radioactive contaminant in the mine environment still remains radon ^{222}Rn with its short-lived progeny, which contributed 55 μSv or two-thirds of the additional exposure in this environment (Table 8).

Table 8: Effective dose received by an adult member of the public living in the surroundings of the former uranium mine at Žirovski Vrh in 2013

Transfer pathway	Important radionuclides	Effective dose [μSv]
Inhalation	– aerosols with long-lived radionuclides (U, ^{226}Ra, ^{210}Pb) – only ^{222}Rn – Rn – short-lived progeny	0.00 1.4 55
Ingestion	– drinking water (U, ^{226}Ra, ^{210}Pb, ^{230}Th) – fish (^{226}Ra and ^{210}Pb) – agricultural products (^{226}Ra and ^{210}Pb)	(8.7)* < 0.6 < 30
External radiation	– immersion and deposition (radiation from cloud and deposition) – deposition of long-lived radionuclides (deposition) – direct gamma radiation from disposal sites	1 / /
Total effective dose (rounded):		**88 μSv**

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

The total effective dose for an adult individual in 2013 due to the contribution of the former uranium mine is 50% lower than in 2007 and amounted to only one-tenth of the general limit value for the population, which is 1000 μSv per year. The estimated dose received by a 10-year-old child was 135 μSv and 121 μSv by a 1-year-old child. These values represent about 2% of the natural background dose in the environment of Žirovski Vrh during the operation of the mine (5500 μSv). Annual changes in effective doses due to the mine are shown in Figure 23.

Measurements and dose estimations for the last several years have shown that the environmental impacts and exposure of the population have decreased because of the cessation of uranium mining and the restoration works that have already been carried out. The estimated dose exposure is already only about one-third of the authorized dose limit of 300 μSv per year.

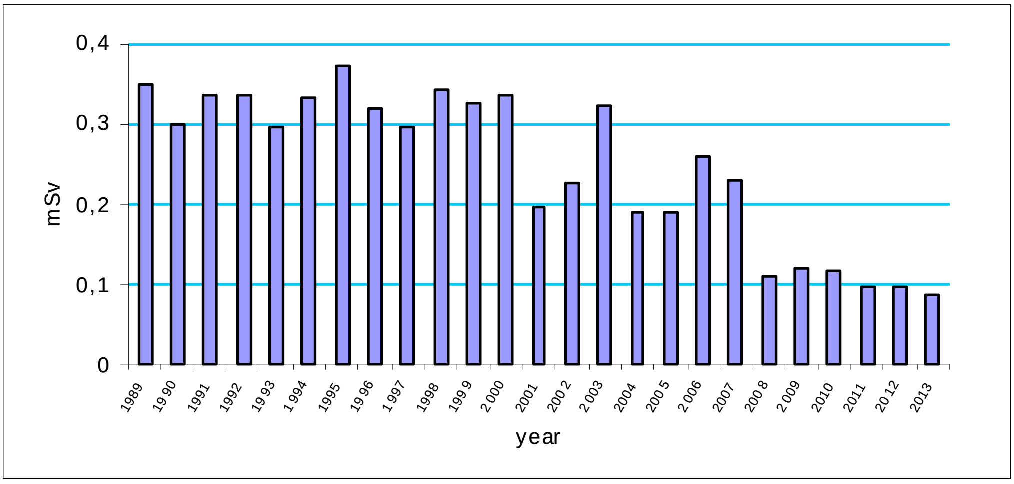

Figure 23: Annual contributions to the effective dose received by an adult member of the public due to the former Žirovski Vrh uranium mine in the period 1989–2013

3.4. Radiation Exposures of the Population in Slovenia

Every person on 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, while only a small part of the population are exposed occupationally due to their work in radiation fields or with radiation sources. The term external radiation means that the source of radiation is located outside the body. Internal radiation occurs when radioactive material enters the body by inhalation, the ingestion of food and drink, or through the skin. The data on population exposure are presented below, while occupational exposures (to artificial and natural sources), as well as medical exposures, are presented in Chapter 4.

3.4.1. Exposure to natural radiation

The average annual effective dose from natural sources received by a single individual on Earth is 2.4 mSv, varying from only 1 mSv to up to 10 mSv at some locations. The average annual dose from natural radiation sources received by an average member of the public in Slovenia is about 2.5 to 2.8 mSv per year. Higher values are found in areas with higher concentrations of radon in living and working environments. From the existing data on external radiation and radon concentrations in dwellings and outdoors, it can be estimated that most of the radiation, about 50%, comes from inhaling indoor radon and its progeny (1.2–1.5 mSv per year) in residential buildings. The annual dose from the intake of radioactivity with food and water is about 0.4 mSv. The annual effective dose due to external radiation from soil radioactivity, building materials in dwellings and cosmic radiation together was estimated to be from 0.8 to 1.1 mSv in Slovenia.

3.4.2. Measurements of radon in living and working environments

The Slovenian Radiation Protection Administration (SRPA) in 2013 continued to implement the government programme adopted in 2006 for systematic examination of living and working environments, as well as to raise the awareness of the population regarding measures to reduce exposure due to the presence of natural radiation sources. Again, the main focus was on determining the exposure to radon because this radioactive noble gas is generally the main source of natural radiation in living and working environments. On average, it contributes more than half of the effective dose received by individuals from all natural sources of ionizing radiation. It penetrates premises mainly on the ground level through various openings, such as manholes, drains, cracks or tears in the floor.

Through this program, 104 rooms in 66 buildings were measured for radon and its progeny, mostly in kindergartens and schools. The average radon concentrations exceeded the threshold for the living environment (400 Bq/m^3) in 29 rooms of kindergartens and schools from a total of 85, and the threshold for a working environment (1000 Bq/m^3) in 8 rooms of other institutions out of a total 19. Effective doses received by staff and children were estimated on the basis of the measurement results and the occupancy time in these buildings. Thirteen of the estimated annual doses exceeded the threshold of 6 mSv for members of the public. The highest estimated dose was around 25 mSv. In 26 cases, the estimated annual doses were between 2 and 6 mSv, in 19 cases between 1 and 2 mSv, and in 46 cases less than 1 mSv.

In 2013, the SRPA conducted seven in-depth inspections of legal persons who operate facilities with increased levels of radon. A decision ordering measures to reduce radon radiation exposure was issued in three cases.

At three meetings with councils of parents and other stakeholders, requested by the concerned kindergartens, schools and parents, the inspector of the SRPA provided information on the problem of radon.

3.4.3. Radiation exposure of the population due to human activities

Additional radiation exposure due to the regular operation of nuclear and radiation facilities are usually discussed only in terms of the local population. The exposures of particular groups of the population, which are a consequence of radioactive discharges from these facilities, are described in Chapter 3.3. In Table 9, the annual individual doses are given for the maximally exposed adults from the reference groups for all objects in consideration. For comparison, an average annual dose received by individuals stemming from the global radioactive contamination of the environment (nuclear tests and the Chernobyl accident), is also shown. The highest exposures of the population are recorded for individuals living in the surroundings of the former uranium mine at Žirovski Vrh. The exposures were estimated as amounting to a maximum of 5% of the exposure from natural sources in Slovenia. In no case did the exposure of members of the public exceed the dose levels defined by the regulatory limits.

The population is exposed to radiation also due to other human activities. These exposures come mainly from deposited materials with enhanced natural radioactivity and originate from past industrial or mining activities, related mostly to the mining and processing of raw materials containing uranium or thorium.

Table 9: Exposures of adult individuals from the general population due to the operation of nuclear and radiation facilities and due to general contamination in 2013

Source	Annual dose [mSv]	Regulatory limit [mSv]
Žirovski Vrh Uranium Mine	0.088	0.300*
Chernobyl and nuclear weapon tests	0.0089	/
Krško NPP	< 0.0005	0.050**
TRIGA Reactor	0.00002	0.050
Central Storage for Radioactive Waste	0.00002	0.100

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

4. RADIATION PROTECTION OF WORKERS AND MEDICAL EXPOSURES

Due to occupational exposure, individuals can receive substantial doses of radiation. Therefore, organizations that carry out radiation practices should optimize work activities to decrease the dose of ionizing radiation to a level as low as reasonably achievable (ALARA). Exposed workers take part in regular medical surveillance programmes and have to receive adequate training. Employers have to ensure that the dose of ionizing radiation is assessed for every worker performing specific activities.

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

The approved dosimetry services for 2013 were the Institute of Occupational Safety (IOS), the Jožef Stefan Institute (JSI), and the Krško Nuclear Power Plant (Krško NPP). Additionally, approval was granted to the IOS to perform internal dosimetry for radon exposure in mines and Karst caves. Currently, 12,581 persons have a record in the central registry, including those who have ceased to work with sources of ionizing radiation. In 2013, the dosimetric service at the IOS took measurements of individual exposures for 3,851 workers, whereas the JSI monitored 902 radiation workers and the Krško NPP 1,288 radiation workers. The Krško NPP performed individual dosimetry with regard to 440 plant personnel and 848 outside workers, who received an average dose of 1.07 mSv of ionizing radiation. As for other work sectors, workers in industrial radiography received the highest average annual effective dose of 2.94 mSv from external radiation, while employees in medicine received an average of 0.30 mSv. The highest average value among these, 0.67 mSv, was recorded for workers in nuclear medicine.

In 2013, the highest collective dose from external radiation was received by workers in the Krško NPP (1278 man mSv), followed by radiation workers in the medical sector (340 man mSv). The total exposure of workers in industry was 160 man mSv.

Since 2010, the data on doses received by radiation workers who took part in NPP outages abroad and data on doses of Adria Airways flight personnel who are exposed to cosmic radiation have been included in the CRPD. In 2013, the collective dose for 16 workers in foreign NPPs was 15 man mSv (an average dose of 0.95 mSv).

During Adria Airways flights, 200 workers were exposed to cosmic radiation, receiving an average dose of 1.17 mSv and a collective dose of 234 man mSv.

The highest doses are received by workers exposed to radon and its progeny. In 2013, 31 out of 138 tourist workers in Karst caves received an effective dose between 5 and 10 mSv and 11 workers received an effective dose between 10 and 15 mSv, whereas none of the workers received a dose exceeding 15 mSv. The highest individual dose was 13.9 mSv. The collective dose was 545 man mSv, with an average dose of 3.95 mSv. Tourist workers in Karst caves are the category of workers most exposed to ionizing radiation in Slovenia.

The findings of a study on the exposure of individuals in Karst caves, financed by the SRPA, show that the doses assessed according to the ICRP 65 (International Commission for Radiation Protection) that the tourist workers in Karst caves received from radon exposure are underestimated. Due to the high unattached fraction of radon progeny, the ICRP 32 model should be used and an approximately two times higher dose factor should be taken into account. Therefore, doses from radon and its progeny are assessed according to the ICRP 32 model in this report. Doses calculated in such manner are thus twice as high as those calculated according to the ICRP 65 model, which was used in the past.

At the Žirovski Vrh Uranium Mine, nine workers received a collective dose of 0.38 man mSv, whereas the average individual dose was 0.04 mSv. The distribution of workers in different work sectors by received dose interval (mSv) is shown in Table 10.

Table 10: The number of workers in different work sectors by dose interval (mSv)

	0–MDL	MDL≤E<1	1≤E<5	5≤E<10	10≤E<15	15≤E<20	20≤E<30	E≥30	Total
Krško NPP	96	861	262	68	1	0	0	0	1288
Industry	353	67	17	6	0	0	1	1	445
Medicine and veterinary medicine	2459	1033	83	1	0	0	0	0	3576
Air flights	0	40	160	0	0	0	0	0	200
Radon	524	214	10	0	0	0	0	0	748
Other	0	32	73	31	11	0	0	0	147
Total	**3432**	**2247**	**605**	**106**	**12**	**0**	**1**	**1**	**6404**

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

Training of exposed workers using sources of radiation

The education level of workers using sources of radiation is in accordance with regulations. Minor deficiencies were found regarding the timely refreshment of knowledge and skills in the field of ionizing radiation protection. Training, refresher courses and tests were carried out by the approved technical support organizations, namely the IOS and the JSI. In 2013, a total of 1,723 participants attended courses on ionizing radiation protection.

Targeted medical surveillance

Medical surveillance of radiation workers was performed by the doctors of five approved institutions:

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

Altogether, 2,959 medical examinations were carried out. Among the examined candidates, 2,599 fully fulfilled the requirements for working with sources of ionizing radiation, whereas 321 fulfilled the requirements with limitations. 12 candidates did not fulfil the requirements temporarily, three did not fulfil the requirements and other work was proposed to them. In 24 cases, the evaluation was not possible.

Diagnostic reference levels for diagnostic radiological procedures

X-ray examinations that are implemented in accordance with good radiological practice provide a radiogram, which contains all the information necessary for a correct diagnosis at the lowest exposure to patients. In 1996, the International Commission on Radiological Protection introduced the concept of diagnostic reference levels (DRR) to promote the optimization of radiological procedures. The level of patients' exposure during an individual examination in each radiology department or when using a single X-ray device can be assessed by comparing the average exposure in this department or X-ray device to a DRR value obtained on the basis of the relevant regional or local data.

By using the DRR, exposure decreases and radiological practice improves. Their use is more efficient when national values of DRR are set. Thus, following a five-year data collection project on the exposure of patients undergoing X-ray examinations in Slovenia, DRR values for fifteen X-ray examinations were presented in 2006. Due to changes in technology and professional guidance, it is necessary to regularly review diagnostic reference levels. Therefore, in 2013, the SRPA continued to collect data on the exposure of patients, on the basis of which the national DRR will be updated in the near future.

When issuing a license for radiation practices or a license for the use of a radiation source in medicine, the level of exposure for each X-ray device or a group of such devices is compared to DRR values. If the average exposure for each examination is greater than the DRR, the SRPA requires the optimization of that radiological procedure.

In nuclear medicine, rather than a diagnostic reference level, the recommended activities of administered radioisotope are used. Due to the small number of departments of nuclear medicine in Slovenia, developing national values is not sensible, so international recommendations, mainly the recommendations of ENMA, the European Association of Nuclear Medicine, are used instead, taking into account the technical characteristics of each imaging device. The SRPA checks typical amounts of administered activity when approving the programs of radiological procedures. In addition, in 2011 systematic reviews of typical values of administered activity for all major examinations in all seven nuclear medicine departments were also conducted within the framework of the “Dose DataMed2” project.

4.1. Exposure of patients during radiological procedures

The use of ionizing radiation in medicine is the main contributor to population exposure due to the use of artificial sources of ionizing radiation. Slovenia assessed the contribution to the total dose received by patients in diagnostic procedures in medicine in 2010 and 2011 within the framework of the project Dose DataMed2, which was carried out under the guidance of the European Commission. The results of the study show that the average inhabitant of Slovenia receives about 0.7 mSv per year from medical procedures. The most important contribution comes from computer tomography (CT), which contributes about 60% of the total dose. Classical X-ray diagnostics contributes about 20%, while interventions and examinations in nuclear medicine contribute approximately 10%. The results show that the exposure of the population in Slovenia is slightly below the European average, which is 1 mSv per year per capita.

Due to the increasing role of X-ray diagnostics in modern medicine and on the basis of trends in other developed countries, a further increase in population exposure is expected due to medical use of ionizing radiation. Therefore, the SRPA carries out activities to improve the application of the principles of justification and optimization, with particular attention devoted to examinations with computed tomography.

5. MANAGEMENT OF RADIOACTIVE WASTE AND IRRADIATED FUEL

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

5.1. Irradiated Fuel and Radioactive Waste at the Krško NPP

5.1.1. Management of Low- and Intermediate-Level Waste

In recent years, the volume of low and intermediate level waste was reduced by compression, super-compaction, drying, incineration, and melting. The total volume of waste accumulated by the end of 2013 amounted to 2,250 m^3 with the total gamma and alpha activity of the stored waste amounting to $1.93 \cdot 10^{13}$ Bq and $2.59 \cdot 10^{10}$ Bq respectively. In 2013, the equivalent of 210 standard drums containing solid waste was stored. As of 31 December, the total gamma and alpha activity of stored drums was $3.01 \cdot 10^{9}$ Bq and $6.45 \cdot 10^{6}$ Bq respectively.

Figure 24 shows the accumulation of low- and intermediate-level radioactive waste in the Krško NPP storage. Periodical volume reductions, which are a consequence of compression, super-compaction, incineration and melting, are marked. After 1995, the accumulation of waste volume was reduced as a result of a new in-drum drying system (IDDS) for evaporator concentrate and spent ion exchange resins.

In 2006, a super-compactor was installed in the storage facility at the Krško NPP, which thus started with the continuous super-compaction of its radioactive waste. In 2013, 20 standard drums with other waste were super-compacted. Super-compacted radioactive waste has been stored in two tubular containers.

Waste for incineration and melting is temporarily transferred to the Decontamination Building due to the lack of space in the storage facility near the super-compactor. In 2013, there were 248 packets of compressible and two other packages of radioactive waste stored in the Decontamination Building. In 2013, the Krško NPP stored 18 packages of incineration products.

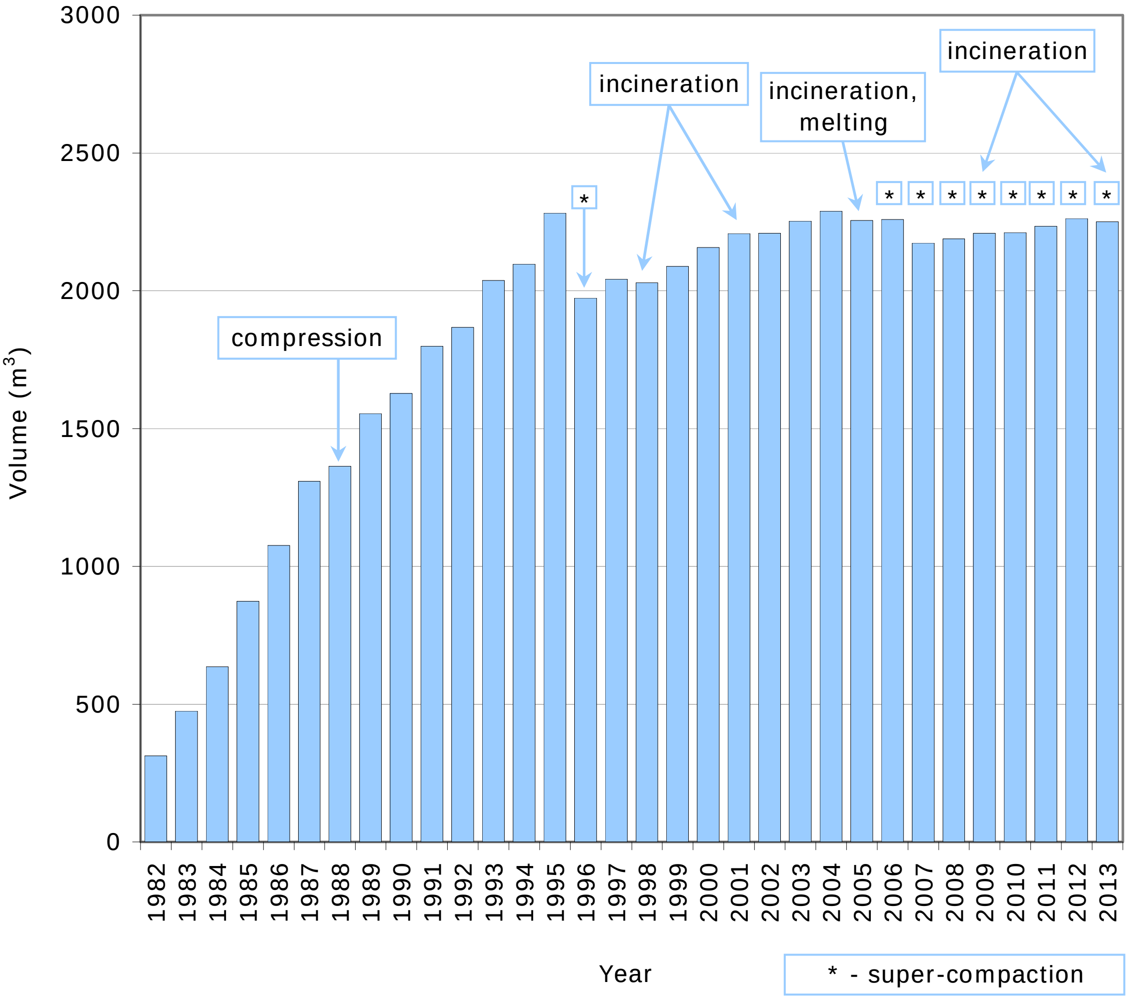

Figure 24: Accumulation of low- and intermediate-level radioactive waste in the Krško NPP storage

In 2013, the Krško NPP began with the design of a facility for manipulation the equipment and shipments of radioactive cargoes. It is planed to be located at the site between the solid radwaste storage facility, the auxiliary building and the fuel handling building. With the construction of the new facility, the plant will be provided premises for the storage of drums in the process of manipulation and the preparation for transport, collection, and sorting of radioactive waste. There will also be space provided for their preparation prior to packing, packing and compaction, super-compaction, radiological measurements and radiological monitoring of shipments, a mobile unit for drying the concentrate, storage of scaffolds, maintenance of shock-absorbers, workshops and warehouses for maintenance staff and improved processing and reuse of primary water.

In 2013, the NPP obtained the design conditions and started with the procedures for obtaining approvals for the construction.

5.1.2. Management of Spent Nuclear Fuel

All spent fuel in the Krško NPP is stored in the spent fuel pool with 1,694 cells. In the autumn of 2013, a regular outage was held (a shipment of fresh fuel arrived in the NPP already in June 2013). At the end of 2013, 1,098 fuel assemblies were stored in the pool for spent fuel, taking into account also two special containers with damaged fuel rods. The number of annually spent fuel assemblies and the total number of such elements in the pool are shown in Figure 25.

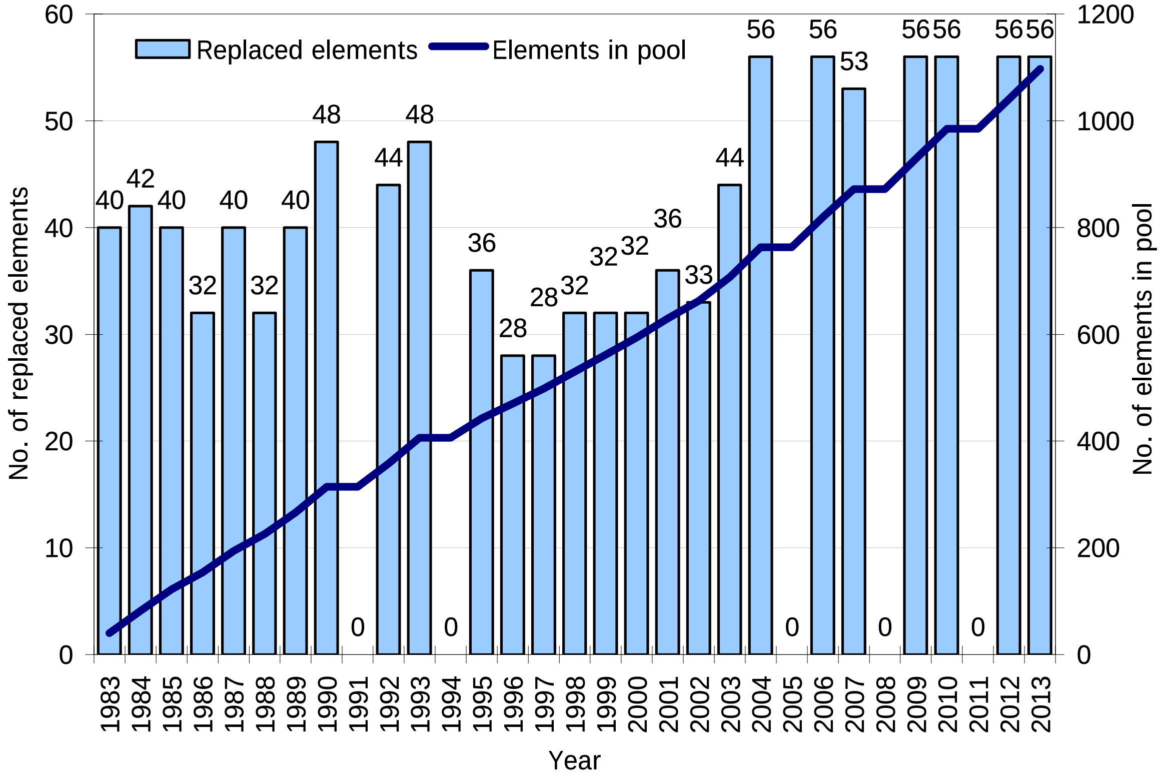

Figure 25: The number of annually spent fuel assemblies and the total number of such elements in the pool of the NPP

Already in 2011, the SNSA issued a decision to the Krško NPP stipulating that safety measures must be undertaken in order to prevent severe accidents and/or mitigate their consequences. The decision, *inter alia*, stipulates that the nuclear operator has to address all the possibilities to decrease the risk associated with spent nuclear fuel management, having in mind also a change in the long-term strategy. In the second half of 2012, the Krško NPP prepared and submitted a document entitled “Evaluation of Spent Nuclear Fuel Storage Options”. The Krško NPP determined that the change of strategy in spent fuel management is important for several reasons. Two possibilities regarding spent fuel management were addressed in this document: reprocessing and dry storage. Reprocessing is deemed to be more complex and difficult to accomplish by 2019. On the other hand, dry storage at the location, which positively affects nuclear safety on-site, is possible. The type of dry storage has not been selected yet, neither the type of packages. The first campaign with dry packages is anticipated to be due between November 2016 and April 2018 or the following cycle. In this context, also the Resolution on the 2006–2015 National Programme for Managing Radioactive Waste and Spent Nuclear Fuel, which expires at the end of 2015, will be revised.

5.2. Radioactive waste at the Jožef Stefan Institute

In 2013, approximately 200 litres of radioactive waste were produced during the operation of the reactor, as well as from the work in the hot cell and controlled areas of the Department of Environmental Sciences. At the end of the year, this waste was still stored in the hot cell facility. The Radiation Protection Unit of the Institute plans to hand the waste over to the Central Storage Facility at Brinje, managed by the ARAO.

There are 7 drums of metal pieces and wood contaminated with naturally occurring radioactive material (NORM) temporarily stored at the location of the Reactor Centre in Brinje. The waste material was produced during the decontamination and decommissioning of buildings used for the processing of uranium ore, which took place from 2005 until 2007. A decision on conditional clearance was issued by the SNSA for this material and for another 12 drums of other waste material contaminated with natural radionuclides. However, the mentioned 7 drums could not be cleared because scrap metal and wood is not allowed to be disposed of in any municipal landfill.

5.3. Radioactive waste in medicine

The Institute of Oncology in Ljubljana has appropriate hold-up tanks to decrease the activity of waste liquids through decay. The tanks are emptied every four months after approved radiation protection experts carry out preliminary measurements of specific activities. Adequate temporary storage for radioactive waste has also been arranged in the new building of the Institute of Oncology. Sealed radioactive sources which are no longer in use were returned to the producer or handed over to the Central Storage in Brinje. Short-lived solid radioactive waste is temporarily stored in a special storage for decay and is then disposed of as non-radioactive waste. However, the Clinic for Nuclear Medicine at the University Medical Centre in Ljubljana has not yet built a system for holding up liquid waste. In the course of renovation of the University Medical Center, the Clinic intends to build new premises with an appropriate system for holding up liquid waste. Since only outpatient treatment is carried out in other Slovenian hospitals, patients leave the hospital immediately after receiving a therapeutic dose and therefore the hold-up tanks are not necessary.

5.4. The Commercial Public Service for Radioactive Waste Management

5.4.1. The Commercial Public Service for Radioactive Waste from Small Producers

The Agency for Radwaste Management (ARAO) is responsible for providing the public service for radioactive waste management. The public service includes:

- collecting radioactive waste from small producers, in the event of accidents or when the waste holder cannot be identified;
- transport, radioactive waste treatment for storage and disposal, storage and disposal;
- managing the collected radioactive waste in a prescribed manner;

- managing the Central Storage for Radioactive Waste in Brinje.

Within the public service for the management of radioactive waste from small producers, in 2013 the ARAO ensured regular and smooth collection of radioactive waste at its place of origin, its transport, treatment and preparation for storage and disposal, and management of the Central Storage Facility, as described in Chapter 2.1.1.4.

For processing the radioactive waste, the ARAO can independently use the premises of the hot cell facility at the Jožef Stefan Institute.

In 2013, the CSRW accepted 138 packages of radioactive waste from 48 producers, namely four packages of solid waste, 26 packages of sealed radiation sources and 108 packages of ionization smoke detectors. The total volume of stored radioactive waste was 3.1 m^3. At the end of 2013, there were 877 packages stored as follows:

- 425 packages of radioactive waste (solid waste, sorted according to compressibility, combustibility, shape and size);
- 178 packages of sealed radiation sources; and
- 274 packages of ionization smoke detectors.

The total activity of 92.4 m^3 of stored radioactive waste at the end of 2013 was estimated at 3.2 TBq, with a total weight of 50 tonnes.

In 2013, almost 80% of the accepted radioactive waste was ionization smoke detectors. Their volume will be significantly reduced after treatment in the hot cell when the smoke detectors are processed, only the radioactive components will be stored in the CSRW and the non-radioactive components are expected to be unconditionally cleared.

In January 2013, 1 package of operational radioactive waste resulting from the processing of smoke detectors by ARAO, which was implemented in the hot cell in 2012, and 2 packages of contaminated housings of smoke detectors that did not meet the criteria for unconditional clearance after treatment in the hot cell were accepted in the CSRW.

ARAO took possession of and transported to the hot cell 20 packages of liquid radioactive waste with a total volume of 202 litres from the Faculty of Medicine, University of Ljubljana. The liquid waste will be solidified and stored in the CSRW at the beginning of 2014. The solidification of liquid radioactive waste from the Faculty of Medicine will continue in 2014, as there are about 400 litres of liquid radioactive waste that are still stored at the Faculty.

In September 2013, over 6 packages of radioactive waste containing radionuclide ^{125}I was able to make it through unconditional clearance by the ARAO, as the activity waste decreased due to radioactive decay of ^{125}I below the clearance level.

5.4.2. Disposal of Radioactive Waste

At the end of 2009, a Decree on the Detailed Plan of National Importance for the LILW repository in Vrbina in Krško Municipality was adopted, which was a huge success for the ARAO and for the whole country. The decree was published on 31 December 2009 and thus the procedure for the siting of the repository was finished. Unfortunately, matters have been moving very slowly since then. For the fifth year, complications have mainly arisen in government bodies due to new administrative burdens. The state has not guaranteed regular funding for the repository construction project, which is run by the ARAO on behalf and for the account of the government. With the delay in the confirmation of the investment and the investment program, the Krško Nuclear Power Plant is facing new challenges. Because its LILW storage is filling up, the NPP will have to ensure normal operation in the next few years by finding a different solution as regards waste manipulation.

The contract on financing the project by means of the Fund for Financing the Decommissioning of the Krško NPP for the year 2013 was not signed until September. Therefore, most of the activities planned for 2013, including the work of the contracting partners, commenced at the end of the year after financial sources were provided. As a consequence, there was a delay in project implementation and low realization of the tasks foreseen in the work programme and in the financial plan for 2013. The start of the repository operation has therefore been postponed. Trial operation is now planned for 2020–2021.

At the request of the investor, a revision of the Investment Programme for the LILW repository project was prepared in 2013, which takes into account actual realization of the project in recent years as well as the amended time schedule and the indexed value of the investment. At the end of 2013, the new revision of the Investment Programme was forwarded for consideration and approval to the competent ministry.

The preparations for purchasing the land necessary for building the LILW repository continued. In 2013, a revision of the analysis of the owners' structure according to the adopted regulation on the national spatial plan for the complete area of the LILW repository was carried out, which is a legal basis for the procedure of purchasing land. In order to perform this task, the ARAO is required to secure the authorization of the Republic of Slovenia to purchase or expropriate land on behalf and for the account of the state. In 2013, this authorization was not issued.

In 2013, a public tender was completed and the contractor for the project "The major research of the geo- and hydrosphere for the purpose of the LILW repository in Vrbina, Krško" was selected. Works commenced in November 2013, but then were stopped in December because further funding in 2014 was not guaranteed. Within the project, on-going monitoring of groundwater to determine the current status of the environment continued.

Expert assessment and international reviews have shown that preparation for disposal, as well as the disposal itself are both demanding tasks, and it is necessary for the technological processes of disposal in subsequent phases of the project to be optimized. Optimization of the deposition technology and the storage silo was followed by the preparation of the study in 2013, which deals with the optimization of the non-disposal part of the repository. Its starting point is to take into consideration the possibility of the preparation and processing of waste by the existing and upgraded technological equipment in the NPP.

In the field of safety analyses and waste acceptance criteria, the ARAO commenced with the second phase of the project, in which various proposals for the optimization of the conceptual project will be qualitatively and quantitatively examined from the safety analysis point of view. Positively evaluated proposals will be the basis for the preparation of project documentation for building permission. In the area of acceptance criteria, work has continued on the basis of newly acquired data on the characterization of individual waste streams. The preparation of a project basis for the phase of obtaining the environmental consent and preparation of the reference documentation that will serve as the basis for the drafting of a safety report, as required by the respective legislation and other regulations and recommendations, started in 2013.

5.5. Remediation of the Žirovski Vrh Uranium Mine

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

The majority of the technical work on both disposal sites was successfully concluded, but a non-stable landslide beneath the Boršt disposal site has prevented its final closure. The remediation of the landslide is required. The rock beneath the hydrometallurgical tailings at the site has been sliding despite the finished remediation work at the site; the sliding is larger than accepted and determined in the safety analysis report.

In 2013, the company RŽV, d.o.o., carried out on-going activities at both disposal sites: sampling, measurements, control of the overall state, maintenance, collecting and storing information, record keeping, preparation of reports for the authorities, etc.

Maintenance work included the cleaning of channels for a storm water outlet at both disposal sites, the removal of bushes along both disposal sites and infrastructure facilities and cutting the grass on and alongside the disposal site surfaces. Control of the overall state of the final remediated mine facilities was performed and even intensified at the request of the mine inspectorate because the rock base of the disposal and Boršt disposal site itself is still moving and not stabilizing.

At the Boršt disposal site, the implementation of the measures that were imposed by a technical inspection commission on 16 May 2011 has not started yet. In the technical inspection it was determined that due to the observed landslide movement (i.e. the movement of the Boršt tailings site), remediation is not being carried out in such a way that would exclude danger to the health or life of humans and the environment. In recent years the movement of the landslide has increased over the anticipated design value (1.5 cm per year).

For this reason, an operating license was not issued and also the safety report was not updated. In order to update the safety report a study needs to be made that would demonstrate that due to landslides the radiological impact on the environment and population will increase significantly, and that therefore the risk due to a landslide is at an acceptable level. Such a study could also be the basis for the amendment of the mining project.

Also the requirement of the inspection after the completion of the mining project, i.e. the implementation of intervention drainage measures to reduce the level of groundwater after the mining project, was not fulfilled in 2013 due to a lack of funding.

An inspection of the concrete lining of the tunnel and landslide beneath the Boršt disposal site was performed. In addition, a review of the functioning of the drainage wells and the movement of the landslide with an extensometer placed in the tunnel were also carried out. In September, at the time of the earthquake in the area of the village Smrečje, which is located on the south-western edge of the Žirovski Vrh massif, 8 km SE of the Boršt landfill, the extensometer showed a shift of 10 mm.

Shifts at the surface of the Boršt disposal site were constantly monitored with a GPS system and regularly reported to the Inspectorate for Energy and Mining and the SNSA.

Surveying in the area of the Boršt landfill in April 2013 was carried out by the Department of Geodesy, Faculty of Civil Engineering, and University of Ljubljana. Measurements show that the speed of the movements during the period 2011–2013 (a period of two years; measurements in 2012 were not carried out) compared to the previous measurement decreased slightly. The contractor performing the measurements wrote in the conclusion of the report that the precision of classical geodetic measurements unambiguously confirms the movement of the landslide after the completion of the remediation.

RŽV d.o.o. does not have its own funds with which to pay compensation for limited land use in the area to the Municipality Gorenja Vas – Poljane, and did not receive any funds from the state budget for this purpose. Therefore, compensation for limited land use was not paid in 2013.

The financing of the activities of RŽV d.o.o. from the budget was arranged by an agreement on temporary financing. Due to problems with financing, the programme of monitoring radioactivity in the environment in the fifth year of the transitional period for the Jazbec disposal site was not fully implemented. The programme was supposed to be more extensive than in previous years. But the measurements and analyses of hay and milk from reference sites and fishes were not done. In the river Sora only uranium was measured, while some measurements, for example bioindicators, were performed at the start of 2014. Despite the reduced levels of radiation monitoring, the average individual exposure of individuals in the population was assessed from the obtained results. Details on monitoring can be found in Chapter 3.3.3.

RŽV, d.o.o., submitted an application for the approval of the closure of the Jazbec disposal site to the SNSA. During the administrative procedure a hearing with the parties was held and by the end of 2012 all amendments of the safety analysis report had been implemented. The SNSA issued a permit for the closure of the Jazbec site on 8 March 2013. In the authorization process for the closure the SNSA decided to terminate the status of the radiation facility and, based on a government decision, issued a decision determining that it was to become a national infrastructure facility. The government decision was issued on 20 December 2012. RŽV, d.o.o., appealed both decisions. The appeal regarding the decision on determining it to be a national infrastructure facility was rejected by the second-instance authority, i.e. the Ministry of Agriculture and the Environment, while the appeal regarding permission to close the Jazbec site was partly granted, permission revoked, and the procedure returned back to the SNSA for reconsideration. In the framework of the procedure, an oral hearing was held. On 20 December 2013, however, RŽV d.o.o. submitted an application for a new disposal site next to Jazbec. SNSA had to include this new application as a part of the on going administrative procedure for closure of the entire Jazbec site, therefore the closure of the Jazbec site has been postponed.

After adequate licensing, the Agency for Radioactive Waste will take over the long-term monitoring and maintenance of the disposal site.

An amendment of the assessment of the radiation protection of the exposed workers at the Boršt disposal site was approved by the SRPA in 2013.

5.6. The Fund for Financing the Decommissioning of the Krško NPP and for the Deposition of Radioactive Waste from the Krško NPP

The Fund for Financing the Decommissioning of the Krško NPP and for the Management of Radioactive Waste from the Krško NPP (hereinafter "the Fund") was established pursuant to the Act on the Public Fund for Financing the Decommissioning of the Krško Nuclear Power Plant and the Disposal of Radioactive Waste from the Krško NPP.

In 2004, the "Programme for the Decommissioning of the Krško NPP and the Disposal of Low- and Intermediate-Level Waste and Spent Fuel" (hereinafter "the Programme") was prepared. It determined the levy per kWhe to be paid. The Government of the Republic of Slovenia was informed of the Programme at its 93rd regular session on 7 October 2004. The Programme was approved on 4 March 2005 during the 7th session of the Interstate Commission for Monitoring the Inter-governmental Agreement between the Government of Slovenia and the Government of Croatia. Since April 2005, the company ELES GEN, d. o. o., which was renamed GEN energija, d.o.o., in July 2006 when the company's founding act was amended, is paying 0.003 EUR per kWhe into the Fund. In 2013, GEN energija, d. o. o., paid a total of 7.6 million EUR into the Fund. With that contribution, the company fully and by the agreed deadline fulfilled all obligations to the Fund deriving from the contribution for decommissioning. In comparison to 2012, 3.7% less funds were paid due to the extension of the outage and the unexpected shutdown of the Krško NPP. In all the years of its existence, the fund has received a total of 152.1 million EUR from the Krško NPP and GEN energija, d.o.o.

Since 1998, the Fund has been co-financing the "Work Programme of the Agency for Radwaste Management", namely the projects concerning the safe management of low- and intermediate-level radioactive waste. In 2013, the Fund paid a total of 3.6 million EUR to the ARAO; 0.7 million EUR to finance ARAO's activities related to the preparation and implementation of projects for the management of low- and intermediate-level radioactive waste and 2.88 million EUR as compensation to local municipalities. From 1998 until the end of 2013, the Fund paid a total of 29.63 million EUR to the ARAO for the activities implemented by the ARAO.

In accordance with Article 11 of the Decree on the criteria for setting the compensation level payable for limited use of land within the area of the nuclear facility, the Fund is obliged to pay compensation for the limited use of land within the area of the nuclear facility. Since 2004, municipalities have received 23.7 million EUR as compensation for the limited use of land.

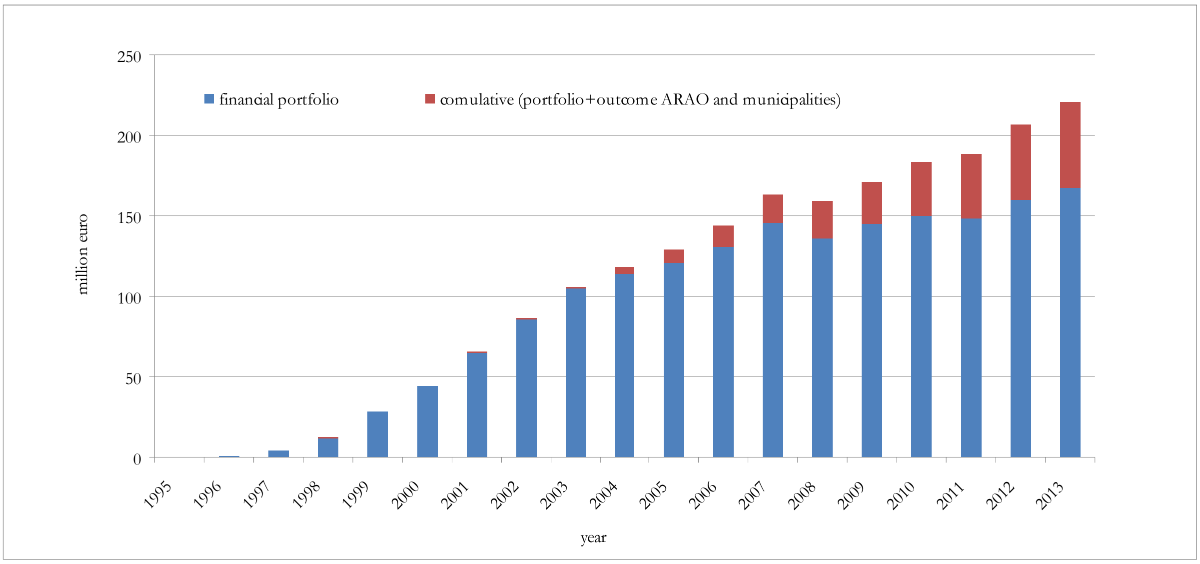

Figure 26: Total assets of the Fund in millions EUR as of December 31, 2013

As of 31 December 2013, the Fund managed 167,560,635.54 EUR of financial investments in securities. 19.53% of the sum was invested in banks in the form of deposits, CDs and MM Funds; 41.82% in state securities; 11.61% in bonds, which are 100% state-owned; 4.25% in corporate non-financial bonds; 3.03% in corporate financial bonds; 3.87% in bond funds; 14.30% in mutual funds (equity and mixed funds) and ETFs; and 1.59% in stocks. The structure of the financial portfolio does not take into account the unallocated funds in the transactional account amounting to 58,019.60 EUR. The amount of 167,560,635.54 EUR relates to book value and does not include interest accrued, interest purchased and dividends in the amount of 2,377,761.11 EUR. Taking into the account the amount mentioned above and the funds in the transactional account, the assets of the Fund at the end of the year amounted to 169,996,416.25 EUR.

In comparison to 2012, the major increase of investment grade in 2013 was in the grade of equity securities, namely by 7.95 percentage points). In accordance with the investment policy of the Fund for 2013, the share of investments in bonds of banking and financial issuers decreased (1.16 percentage points). The share of such bonds decreased because of some investment sell-offs and partially because of a rate reduction/write-off of the domestic issuers' bonds (Banka Celje, Faktor Banka). The share of investments in equity mutual funds and ETFs increased by 7.93 percentage points, whereas the Fund decreased its share in bond funds and ETFs by 3.02 percentage points. During 2013, the Fund progressively decreased its share of investments on the money market. At the end of 2013, the share of investments in money market instruments amounted to 19.32%, i.e. 4.44 percentage points less than at the end of 2012.

In its investments policy for 2013, the Fund mainly planned investments in government securities and deposits.

In 2013, the Fund created 13.8 million EUR in income, which is at the planned level. The income was 1.78% lower than in 2012. The expenses reached 6.8 million EUR, which was 26% lower than planned and 2.69% lower than in 2012. The fund had a surplus of income over expenses in the amount of 6.97 million EUR, which is 57.05% more than planned.

In 2013, the Fund received 80.9 million EUR from repayments of granted loans (due and sold investments) and assets from sold capital shares. Received repayments of granted loans and assets from sold capital shares were 20.74% higher than planned. The granted loans and the increase in capital shares amounted to 87.8 million EUR, which is 6.94 million EUR more than the received repayments of granted loans.

In 2013, the yield of the portfolio, calculated on the bases of the internal rate of return (IRR), was 3.60%. This reflects the crisis in the Slovenian banking sector. At the end of 2013 the regulator cancelled the subordinated bonds of the three biggest banks in state ownership (NLB, Abanka, NKBM), as well as those of Probanka and Faktor Banka (these banks have been under supervised liquidation since September 2013). In the years 2012 and 2013, the Fund successfully sold the majority of its subordinated bonds from Slovenian banks, but due to less liquidity the bonds of Faktor Banka and Banka Celje, with a nominal amount of 1.4 million EUR, are still in the portfolio. For example, if the subordinated bond of Banka Celje was not cancelled (bonds are not cancelled formally), the yield of the portfolio would reach 4.2%.

The expenses of managing the portfolio in relation to the financial portfolio amounted to 0.21%.

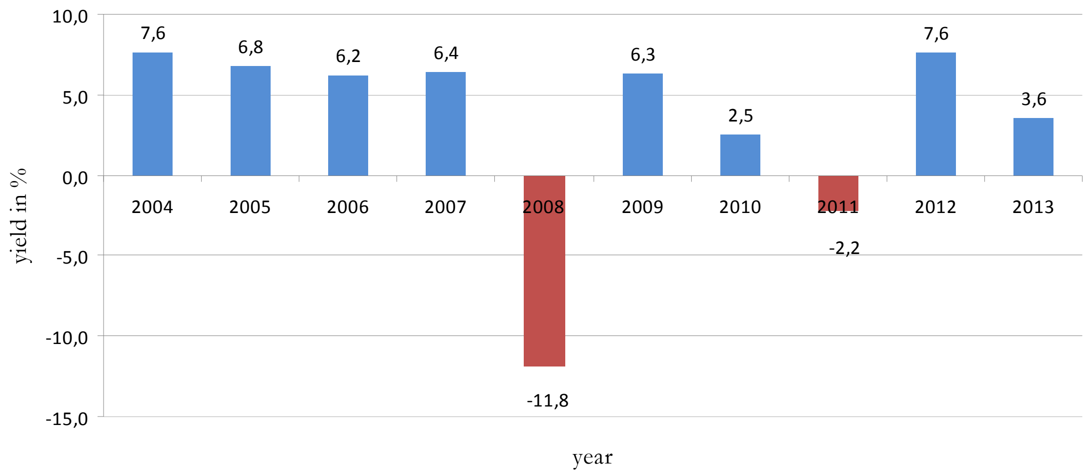

Figure 27: The yield of the portfolio of the Fund from 2004 to 2013

6. EMERGENCY PREPAREDNESS

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

Nuclear and radiological accidents are incidents that pose a direct threat to the people as well as to the environment and demand prompt protective measures. In general, every incident is not already an accident. Such could also be, for example, a reduction in nuclear or radiation safety, which also require an appropriate response from the relevant authorities.

The response to a radiation emergency in Slovenia is defined in the National Radiation Emergency Response Plan. The Administration for Civil Protection and Disaster Relief (ACPDR) has a leading role when dealing with an emergency, whereas the Slovenian Nuclear Safety Administration (SNSA) gives advice and makes recommendations.

6.1. The Slovenian Nuclear Safety Administration

At the SNSA, the responsibility for emergency preparedness and response falls under the Emergency Preparedness Division. The division's primary functions are:

- providing training and staff and ensuring the appropriate response of the SNSA emergency team;
- maintaining the team's documentation and procedures;
- maintaining the team's equipment and keeping the emergency centre operational.

The SNSA's functional capability is ensured by the regular training of emergency team members, response verification and exercises, regular checks of computers and other equipment, and participation in international activities, as well as through regular reviews of all associated organizational regulations and guidelines.

In 2013, the SNSA carried out 96 training sessions, running to a total of 216 hours, with 354 participants or 778 man-hours of training. The SNSA also participated in the 2013 annual Krško NPP exercise, the regional exercise "Evacuation 2013" and several international ConvEx and ECURIE exercises. The SNSA made detailed analysis of the 2012 annual Krško exercise. Possible improvements in all areas were identified (143 observations and 64 suggestions of participants).

If there were sufficient resources the Emergency Preparedness Division would be strengthened with new employees. Thus, the division would be able to carry out an adequate number of training events and exercises, so that the SNSA would respond well to any accident. Furthermore, if the number of employees at the SNSA were increased, the work of the emergency team could be organized in three shifts, since the current solution with a 12-hour shift would be difficult to maintain for a long-lasting event. The SNSA would increase its activities at the national level and help the Administration for Civil Protection and Disaster Relief (ACPDR) and other organizations raise the preparedness for a nuclear or radiological emergency to the appropriate level.

6.2. The Administration of the RS for Civil Protection and Disaster Relief

In accordance with statutory powers, in 2013 the Administration for Civil Protection and Disaster Relief (ACPDR) maintained and ensured preparedness and as well developed procedures for an effective response of the system for protection against natural and other disasters to nuclear or radiological emergencies.

In the context of preparedness for nuclear or radiological accidents, in 2013 the ACPDR, together with individual contractors, continued the coordination of emergency response plans in the event of a nuclear or radiological emergency and activities with the national plan.

In 2013, the ACPDR adopted the Threat Assessment for a Nuclear or Radiological Emergency in the Republic of Slovenia (version 1.0), which is composed of two parts. The first part is the Threat Assessment in the Event of an Emergency at Nuclear Facilities and Due to Radioactive Materials – Issue 3, SNSA, February 2013 and the second part comprises the criteria for the classification of municipalities and regions in the risk classes developed by the ACPDR.

The ACPDR continued with the implementation of a new concept that involves the prior distribution of potassium iodide tablets in the event of a nuclear or radiological emergency. All households living in an area of 10 km around the Krško NPP received an informative publication entitled *Potassium iodide tablets, an effective measure to protect the thyroid gland in the event of a nuclear or radiological emergency*. All beneficiaries of the tablets also received a coupon to obtain tablets. Thus, in June 2013 the pre-distribution of potassium iodide tablets began at pharmacies in the area 10 km around the Krško NPP. A dedicated website was launched to support the campaign: www.kalijevjodid.si.

The ACPDR has also participated in the international exercises ConvEx-2b and ConvEx-3, which were held in June and November 2013, respectively. The ACPDR was also involved in the “Evacuation 2013” exercise, which was a regional exercise organized in the framework of a European project of the Krško municipality entitled Readiness for Evacuation in the Event of a Nuclear Accident.

In 2013, the Interministerial Commission for coordinating the implementation of the national plan continued its work. On its initiative, the ACPDR prepared a set of radiological topics that will be added to the current programme for the training of rescue and other services, which are targeted at intervention in the event of a nuclear or radiological emergency. In addition, two working groups were established at the end of 2013, the first for assessing the national threat assessment for a nuclear accident at the Krško NPP, which will be the basis for the revision of the National Plan in the light of Fukushima and the new guidelines of the IAEA. The second working group is to solve the problem of emergency monitoring in the event of a nuclear or radiological emergency.

6.3. The Krško NPP

In 2013, the activities of the Krško NPP in the area of preparedness for emergencies included:

- training, drills and exercises (the annual Krško NPP exercise);

- maintenance of support centres, equipment and communications;
- updating the document "Krško NPP Protection and Rescue Plan", procedures and other documentation;
- replacing staff and appointing new members to the emergency organization.

Moreover, the staff of Krško NPP actively cooperated with the planners and providers of protection and rescue services at the local and national levels, as well as with the administrative authorities, namely the SNSA and the ACPDR.

In 2013, the Krško NPP mobile unit conducted four exercises on the ground, and one tour with the ELME, the IJS mobile radiological laboratory. The Krško NPP mobile unit also participated in the comparative measurements EXAMPLE 2013, at Brinje Reactor Centre, near Ljubljana.

6.3.1. The Annual Krško NPP Exercise – 2013

The NPP operational exercise 2013 was held on 20 June 2013, from 4 p.m. to 8. p.m. The SNSA, the Brežice Regional Notification Centre and the National Notification Centre of the Republic of Slovenia participated in the exercise as well.

The purpose of the exercise was primarily to test the initial activation of the expert groups. Based on the given scenario, tests of individual components within the scope and in accordance with the assumptions set in the decision to carry out exercises were performed.

The exercise demonstrated that the Krško NPP was adequately prepared to deal with the simulated incident. Minor deficiencies were identified and are being eliminated in accordance with the action plan and the Krško NPP corrective programme.

6.4. Achieving the goals under the Resolution on Nuclear and Radiation Safety

Goal 10:

The preparedness for nuclear and radiological emergencies in the Republic of Slovenia is at the appropriate level in order to minimize the impact on people and the environment in such a case.

Realization in 2013:

From the preceding chapters, it is clear that the use of nuclear energy and radiation implementing activities in the Republic of Slovenia take into account the preparedness and response to an emergency and that the organizations involved are committed to improving their preparedness and response capabilities. The Interministerial Commission for coordinating the implementation of the national plan meets regularly and is responsible for directing and coordinating preparedness at the national level. Such preparedness and responses are regularly tested by exercises.

7. SUPERVISION OF RADIATION AND NUCLEAR SAFETY

7.1. Education, research and development

The issue of the education of experts in the field of nuclear and radiation safety, research in this area, and its development should be given much more attention in Slovenian strategy papers. In some strategic documents (e.g. The Resolution on National Development Projects for 2007–2023, adopted in 2006 and amended in 2008, or the Draft of Slovenia's Development Strategy for 2014–2020), the use of nuclear energy is foreseen and evaluated in economic terms, while the demand for personnel, research and professional support is not determined.

Unfortunately, the Resolution on the National Research and Development Programme for the Period 2006–2010, which was the basic document for the implementation of development policy in research activities, the nuclear and radiation safety segment has not been addressed; furthermore, it cannot be observed in the Resolution on the Research and Innovation Strategy of Slovenia 2011–2020.

The economic crisis that hit Slovenia in recent years has had a strong influence on the implementation of research activities. Already limited resources have decreased and drastically reduced the funds supporting research and development in the field of nuclear safety.

The Slovenian Research Agency has run so-called “targeted research programmes” that have also supported the field of nuclear safety. Unfortunately, the last projects in the field of nuclear energy and safety in this context were funded in 2010. With respect to education, research and development, the legislation in the field of nuclear and radiation safety is strictly limited to the provision of Article 134 of the Ionizing Radiation Protection and Nuclear Safety Act (hereinafter: ZVISJV), according to which state budgets (assigned to the SNSA and the SRPA) provide funds to finance the training of authorized radiation protection experts, authorized medical physics experts, and authorized experts in radiation and nuclear safety, as well as to finance the development of studies and independent expert verification and international technical cooperation in the field of radiation protection and nuclear safety. Unfortunately, in recent years, due to the economic crisis, the SNSA and SRPA have not been able to fund projects that would support the work of authorized experts.

At the end of 2012 the SNSA organized a working meeting of Slovenian nuclear experts, where possible ways to promote research in the field of nuclear and radiation safety were also discussed. In 2013, due to the complex refuelling outage at the Krško NPP, such a meeting was not carried out, so it was organized again only at the beginning of 2014. The most important message of the meeting was that a rapid return to stable and adequate funding of research, development and research-based education in the field of nuclear safety is needed.

The Resolution on Nuclear and Radiation Safety in the Republic of Slovenia for the Period 2013–2023 in Section 7.1 indicates the minimum number of full-time researchers, which should be ensured by providing dedicated funding. Unfortunately, mechanisms of dedicated funding have not been established due to which some specific areas of research are dying out. Thus, for example, the situation in the field of reactor physics is critical. In Slovenia, there are currently only one to two researchers who are engaged in research in the field of reactor physics. Practically, only one expert is able to carry out a determination of the operating parameters of the reactor core of the Krško NPP.

7.1.1. Achieving the goals under the Resolution on Nuclear and Radiation Safety

The objectives envisaged in the Resolution that should be achieved in the field of education, research and development in the period 2013–2023 are as follows.

Goal 9:

The system of authorized experts provides optimum expertise to decision-making governing bodies on radiation and nuclear safety and where it is ensured that the applicant shall bear the costs of the preparation of an expert opinion.

Realization in 2013:

Based on ZVISJV, the system of authorized experts provides formal coverage of all professional fields in the area of nuclear and radiation safety and the relatively large number of organizations (and individuals) that have and maintain the appropriate authorizations and, as such, at least formally satisfies the objectives set by the Resolution. Practice, unfortunately, shows that only a small number of authorized experts submit tenders for the preparation of expert opinions. There are most probably many reasons for such situation, but among them is also a lack of motivation to do the work and bear the relatively high financial costs of creating professionally qualified personnel and maintaining their skills. The selection among authorized experts, who may formally be of equivalent quality, is done by the holder of an operating license, where the selection of the cheapest bidder is almost unavoidable. Furthermore, due to the modest and insufficient state budget, the state cannot provide funds to finance the training of authorized radiation and nuclear safety experts.

After 2010, the SNSA did not have resources that could be allocated to finance development-oriented tasks, thus it could not perform this task! The risk is therefore increasing that in the near future there will be no authorized experts from Slovenia for individual fields of nuclear and radiation safety.

Goal 11:

In Slovenian educational institutions study programmes exist whose graduates, with appropriate additional training, may assume important positions in organizations in which they can ensure nuclear safety.

Realization in 2013:

At the Faculty of Mathematics and Physics of the University of Ljubljana, where the second level Nuclear Engineering Master's programme is organized within the Department of Physics, the programme enrolled 5 students in the academic year 2013/14. They joined other five students who were enrolled in the programme in the academic year 2012/13. There were 10 students in the module Nuclear Engineering within the Ph.D. programme "Mathematics and Physics", most of them employed at Jožef Stefan Institute. Due to savings and financial restrictions, lectures are conducted in a cyclical manner: each subject is offered every second year. All teachers participate in the programme through secondary employment agreements or contracts with the Faculty of Mathematics and Physics. There is no permanent position of teacher of nuclear engineering at the University of Ljubljana.

At the Faculty of Civil Engineering of the University of Maribor, the “Nuclear Energy and Technology” study programme (a three-year Ph.D. programme) is offered, which in the academic year 2013/14 enrolled three students.

At the Faculty of Energy, which is also a part of the University of Maribor, an “Energy” study programme is conducted at all three Bologna levels, which includes, among others, subjects in the nuclear field. At the first (university) level, one nuclear subject i.e. “Nuclear Energy Systems” is mandatory, while three others in the nuclear field are optional. On the second (master’s) level there is also one compulsory subject from the nuclear field and five optional courses. In the academic year 2013/14, subjects in the nuclear field were attended by 15 students in a university (i.e. bachelor’s) programme and 44 students in the master's program.

From the above we can conclude that within Slovenian educational institutions, there are study programs that educate graduates for basic work in the field of nuclear and radiation safety. Unfortunately, after graduation there are not enough jobs where graduates can be employed, which would be the largest support to educational programmes. The exception is the Krško NPP, which attracts competent resources from this area and succeeds in maintaining an adequate level of staffing. Unfortunately, in recent years it has become clear that there is limited or no employment of nuclear and/or radiation experts in other organizations. This is due to cost savings, since employment in institutes funded by the state is practically impossible, while in the private sector a decline in contract orders and cuts in outsourcing services is evident. Without a clear decision to develop the nuclear profession, as well as a decision to build a radioactive waste repository and the second unit of the nuclear power plant in Krško, it cannot be expected that nuclear operators and/or entities carrying out radiation practice will more intensively support the educational programmes.

Goal 12:

In the Republic of Slovenia, stable conditions for the financing and implementation of research and educational activities in the field of nuclear and radiation safety are established by which a “critical mass” of experts that can competently cover all key aspects of the safe use of nuclear energy and ionizing radiation sources is ensured.

Realization in 2013:

This goal also represents a long-term policy whereby it is necessary to foster the synergistic effects of the efforts of various interested stakeholders. The above-mentioned limited budget of the SNSA prevents not only long-term and systemic funding of applied research (such as support for meeting on-going challenges in the field of nuclear and radiation safety), but also even less basic research in this area. The participation of Slovenian scientific and research organizations in international research projects and programs under the auspices of the OECD/NEA is partly regulated, but unfortunately only the costs of the participation of experts in the relevant committees and other working bodies of the NEA is covered.

In 2013, the SNSA prepared a document entitled The SNSA “Strategy for Research and Development”. The strategy includes four basic areas of research: nuclear safety, radioactive waste management, radiation protection and monitoring, and emergency preparedness. More than 20 research and development activities that are needed in the medium term to support administrative decision-making are listed in the area of nuclear safety. Unfortunately, financial resources do not allow their implementation. The document was discussed and approved by the Expert Council for Radiation and Nuclear Safety.

The establishment of stable and sufficient funding for research, development, and research-based education in the field of nuclear safety – which is independent from the producers of nuclear energy – is one of the essential prerequisites for ensuring nuclear safety in the country. Immediate and decisive action is needed, otherwise the economic crisis and threatening brain drain may jeopardize the existing scientific centres, which at the moment continue to struggle with minimal research resources made available through the Slovenian Research Agency and the research programmes of the European Commission.

In this context, it would also make sense that when the scientific evaluation of researchers is carried out; greater weight is given to applied research in order to meet the needs of the economy.

7.2. Legislation

The most important piece of legislation in the field of nuclear and radiation safety in the Republic of Slovenia is the Ionizing Radiation Protection and Nuclear Safety Act. The Act was adopted in 2002 (ZVISJV, Official Gazette RS, No. 67/02). It was amended for the first time in 2003 (Official Gazette RS, No. 24/03 – ZVISJV-A) and for the second in 2004 (Official Gazette RS, No. 46/04 – ZVISJV-B). In 2011, the Act was amended for the third time (Official Gazette RS, No. 60/11 – ZVISJV-C).

The SNSA began preparation of the text of the Resolution on Nuclear and Radiation Safety in Slovenia for the Period from 2013 to 2023 in 2012, which was successfully finished in 2013. After a one-month public consultation, which ended in mid-January 2013, the Government of the Republic of Slovenia adopted the text of the draft resolution and sent it to the National Assembly on 25 April, 2013. The National Assembly adopted the Resolution at its session on 20 June 2013 and it was published in the Official Gazette RS, No. 56/13.

Based on the ZVISJV, 28 implementing regulations were adopted by the end of 2012, namely seven governmental decrees, ten rules issued by the Minister of the Environment, nine rules issued by the Minister of Health, and two rules issued by the Minister of the Interior.

In 2013, no new legislation in the narrow field of nuclear and radiation safety was adopted. In the physical protection area, two new pieces of implementing legislation were adopted:

- Rules on the physical protection of nuclear facilities, nuclear and radioactive materials and the transport of nuclear materials (Official Gazette RS, No. 17/13); and
- Rules on the initial programme of professional training and the periodic programme of professional training of security staff performing work related to the

physical protection of nuclear facilities, nuclear and radioactive material and the transport of nuclear materials (Official Gazette RS, No. 12/13).

Detailed information regarding executive acts and acts under preparation can be found at the SNSA website: http://www.ursjv.gov.si/si/zakonodaja_in_dokumenti/.

The activities initiated in 2012 to prepare the amendments to the ZVISJV were continued in 2013, such that at the end of 2013 the draft Act (on the amendments) was, following a public hearing, sent to the Ministry of Agriculture and the Environment for inter-ministerial coordination. This draft of the amendments to the ZVISJV no longer contains changes that would create a legal basis for the establishment of a public agency for nuclear and radiation safety; it was estimated by the SNSA management that political support and support from experts for such change were inadequate for its successful realization.

7.2.1. Achieving Goals under the Resolution on Nuclear and Radiation Safety

In the area of the legislative and institutional framework, the resolution determines two goals.

Goal 7:

The Republic of Slovenia maintains its legislation in the field of nuclear safety and radiation protection in accordance with international best practices. The legislation provides for the priority of nuclear and radiation safety while enabling the main purpose of the use of nuclear energy and ionizing radiation sources.

Realization in 2013:

The legislation in the field of nuclear and radiation safety (as well as in the broader sense of the use of nuclear energy for peaceful purposes) in Slovenia is in line with international best practices. In 2013, there were no major changes in international practice, so that in this area only preparatory work for minor changes of the ZVISJV took place.

Objective 8:

The Republic of Slovenia shall maintain appropriate separation and independence of the regulatory authorities responsible for the supervision of nuclear and radiation safety from those entities whose primary mission is to promote the use of nuclear energy or ionizing radiation sources. The supervisory authorities shall have the adequate financial resources and appropriate personnel to perform their duties.

Realization in 2013:

During 2013, the management of the SNSA decided to abandon the original intention of transforming the SNSA into a public agency for nuclear and radiation safety and to merge it at the same time with the Slovenian Radiation Protection Administration (SRPA). During the preparations it was shown that the general climate in the country is highly reluctant to create new independent public agencies. In addition to obvious advantages, such transformation would also bring some additional risks, which could be difficult to control without wider external support.

In Slovenia, the separation and independence of the regulatory authorities responsible for the supervision of nuclear and radiation safety from those entities whose primary mission is to promote the use of nuclear energy or ionizing radiation sources is already adequately ensured, so that the fulfilment of this objective of the Resolution is not compromised.

7.3. The Expert Council for Radiation and Nuclear Safety

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

The Expert Council convened three regular sessions in 2013. In addition to the regular reporting of the SNSA Director to the Council on news and developments in the field of radiation and nuclear safety between the meetings, the Council considered the following subject areas: the action plan on measures taken after the Fukushima accident, the SNSA's strategy for applied research prepared on the basis of the conclusions and recommendations of the IRRS Mission, the activities of mobile units intervening in the event of a nuclear accident and the implementation of radiological control required in the event of a nuclear accident with large emissions, the management of radioactive waste from small producers and outage activities at the Krško Nuclear Power Plant.

The regular sessions considered a draft amendment to the Ionizing Radiation Protection and Nuclear Safety Act and approved two practical guidelines (Practical Guideline PS 1.04: The Content of the Safety Report of Radiation and Nuclear Facilities, and Practical Guideline PS 1.02: Consideration of Changes in Radiation and Nuclear Facilities).

In 2013, the Expert Council also adopted:

- the Annual Report on Radiation and Nuclear Safety in Slovenia for 2012; and
- the Slovenian National Report on the Convention on Nuclear Safety.

7.4. The Slovenian Nuclear Safety Administration

Based on the Decree on Administrative Bodies within the Ministries (Official Gazette RS, No. 58/03 and subsequent amendments), the Slovenian Nuclear Safety Administration (SNSA) performs specialized technical and developmental administrative tasks, as well as tasks concerning inspection in the areas of radiation and nuclear safety; activities involving radiation and the use of radiation sources, except in medicine and veterinary medicine; protection of the environment against ionizing radiation; the physical protection of nuclear materials and facilities; the non-proliferation of nuclear materials and safeguards; radiation monitoring; and liability for nuclear damage.

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

At the beginning of 2013 the SNSA had 42 employees. During the year, a fixed-term contract ended for one trainee after completing his traineeship. Due to the retirement of one civil servant during the year the number of employees decreased to 41.

Due to the economic crisis and employment restrictions, the risk stemming from the human resource field has markedly increased. The last new employment was allowed in 2011. For the third consecutive year, the average age of SNSA employees has steadily increased; at the end of 2013 it was just over 46 years of age. The replacement of retired employees or employees on extended sick or maternity leave was not allowed. The SNSA even had to let go a promising young colleague who had previously been awarded scholarships for several years. The implementation of any long-term personnel policy, such as scholarships, targeted training, workplace promotion, etc., is severely obstructed. The training of new employees for demanding work in the field of nuclear safety lasts up to two years, so it is even harder to replace senior employees who are already fully competent. In the absence of a flow of young people into the team, the risk due to the eventual departure of senior workers (either due to retirement or new and better employment possibilities) has markedly increased.

The SNSA's financial situation remains critical. While the parent ministry has provided additional funds to cover basic needs and to prevent further reductions in the SNSA’s budget, the general financial restrictions and cuts in the SNSA’s budget in the long term increases the risk of a direct violation of the provisions of Slovenian legislation. The risks, as listed in last year's report, continue to increase and may lead to the following:

- increased likelihood of a nuclear or radiological accident due to a lack of expertise of the SNSA staff and the inability to perform an adequate number of inspections;
- inability to participate in the development of international safety standards and in their transfer into daily practice in Slovenia due to financial s;
- inability to maintain and develop the legislative framework in the field of nuclear safety;
- losing the ability to detect increased radioactivity in the environment and intervene in case of such event;
- impaired ability to act in the event of a nuclear or radiological emergency;
- inability to report to the National Assembly, the EU and under international conventions;
- violations of international agreements and a loss of reputation of Slovenia;
- inefficient operation of the SNSA, which would impose an unnecessary burden on its clients.

The individual chapters of this report highlight the actions for reducing risks that could be performed if sufficient human and financial resources were available.

The management system

All SNSA activities are carried out in accordance with a management system based on the requirements of the ISO 9001:2008 standard and the requirements of the IAEA standards relating to management systems. In 2007, the SNSA management system was also certified.

In January 2013, the SNSA successfully passed a regular annual external control audit according to the ISO 9001:2008 standard. Since no non-conformances were identified, the certification body confirmed that the management system introduced was implemented in line with the ISO 9001:2008 standard.

Due to the lack of financial resources, the SNSA had decided not to pursue the external recertification audit, which was foreseen in December 2013 and thus the SNSA lost the certificate of management system compliance with ISO 9001:2008. Even though the SNSA no longer has a formal certificate of compliance of the management system with ISO 9001: 2008, the SNSA will continue to carry out all activities in accordance with the requirements of this standard and the IAEA standard GS-R-3 and will ensure continuous improvement of the effectiveness and efficiency of its operations.

The Expert Commission for the Verification of Professional Competences and the Fulfilment of other Requirements in Respect of Workers Performing Duties and Tasks in Nuclear and Radiation Facilities

In 2013, the Expert Commission for the Verification of Professional Competences and Fulfilment of other Requirements in Respect of Workers Performing Duties and Tasks in Nuclear and Radiation Facilities (hereinafter: the Commission) carried out exams for Senior Reactor Operators, Reactor Operators and Shift Engineers of the Krško NPP. The Commission also organised exams for the licensing of Reactor Operators of the TRIGA reactor and for the Storage Facility Manager of the Central Radioactive Waste Storage Facility.

Five candidates acquired a Reactor Operator license for the Krško NPP for the first time and altogether five candidates also acquired a Senior Research Operator license for the first time. Extensions of licenses were granted to six senior reactor operators, eight reactor operators and nine shift engineers.

In 2013, one candidate received a Reactor Operator license for the TRIGA reactor for the first time and one candidate acquired the initial license to work as a Storage Facility Manager of the Central Radioactive Waste Storage Facility.

The SNSA granted the appropriate licenses to all candidates from nuclear and radiation facilities.

7.5. The Slovenian Radiation Protection Administration

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

As a special operational unit within the SRPA, the Inspectorate for Radiation Protection is responsible for monitoring sources of ionizing radiation used in medicine and veterinary medicine and for the implementation of legislation on the protection of people against ionizing radiation. In 2013, the SRPA had five employees.

The activities of the Administration were focused on performing duties in the field of radiation protection and on strengthening the system for health safety against the harmful impacts of radiation in the Republic of Slovenia. Within this framework, the activities of the SRPA comprised issuing permits and certificates as prescribed by the Act; issuing approval to radiation protection experts; performing inspections; providing information and increasing public awareness about procedures regarding health protection against the harmful effects of radiation; and co-operation with international institutions involved in radiation protection.

The SRPA supervised radiation practices in medicine and veterinary medicine and the use of radiation sources in these activities, the protection of exposed workers in nuclear and radiation facilities, and radon exposure. Altogether, 94 permits to carry out a radiation practice, 196 permits to use radiation sources and three permits to import radioactive sources were granted. Additionally, 144 programmes of radiological procedures and 155 evaluations of the protection of exposed workers were confirmed. Furthermore, 73 statements of consignees of radioactive materials were issued. In 2013, the SRPA granted three approvals for radiation protection experts (2 to natural persons and 1 to a legal entity) and two approvals of natural persons as medical physics experts.

In 2013, the Inspectorate carried out 117 inspections. Of these, 16 were in-depth inspections in medicine and veterinary medicine. 3 decisions requiring the correction of established deficiencies and 4 decisions requiring the sealing of X-ray devices were issued. Six requests to submit evidence regarding corrected authorised deficiencies, 20 requests to submit evidence regarding the termination of the use of an X-ray device and 56 requests regarding harmonisation with the existing legislation were issued. The SRPA took action in two cases when an operational monthly personal dose of 1.6 mSv was exceeded.

Within the scope of the use of radiation sources in industry and research, the SRPA took action seven times regarding instances where an operational monthly personal dose of 1.6 mSv was exceeded; three of these were in-depth inspections. As for the radiation protection of exposed workers, the SRPA surveyed the Krško NPP, the JSI and the ARAO. Altogether, three in-depth inspections were performed in these institutions. The SRPA also supervised the Žirovski Vrh mine, the Postojna Cave and the Škocjan Caves, as well as primary schools, kindergartens, hospitals and other public buildings with increased radon concentrations. Seven in-depth inspections were carried out. Three decisions on the need to reduce ionizing radiation were issued. As for other natural sources of ionizing radiation, the SRPA monitored flight operator Adria Airways.

Thus far, the SRPA has operated with a small number of employees and modest financial resources. Despite this, a high level of radiation protection was ensured in its areas of competence. The SRPA does not have any internal financial or staff reserves and any further reduction of resources would mean that the SRPA will not be able to carry out its legally binding obligations and that the level of radiation safety would decrease.

7.6. Approved experts

Approved experts for radiation and nuclear safety

The operators of radiation or nuclear facilities must obtain the expert opinion of approved experts with regard to specific interventions in their facilities. In 2013, there were no major changes in the operation of the experts in comparison to previous years. Their staffs maintained their level of competence and the equipment used was well maintained and updated. The organizations established quality management programmes certificated in compliance with the ISO 9001:2008 standard. The approved experts provided professional support to the Krško NPP by preparing independent reviews. An important part of their work focused on the independent review and assessment of plant modifications.

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

In 2013, the Commission for the Verification of Compliance with the Requirements of Approved Experts considered seven applications, three for obtaining an approval and four for the extension of an approval. The SNSA approved three new expert organizations and extended the approvals of four existing experts.

In 2013, 20 legal entities and 1 natural person were approved by the SNSA to perform the tasks of an Approved Expert for Radiation and Nuclear Safety.

The SNSA website (http://www.ursjv.gov.si/si/info/za_stranke/pooblasceni_izvedenci_za_sevalno_in_jedrsko_varnost/) provides information on approved experts in various fields of radiation and nuclear safety.

Approved radiation protection experts

Approved radiation protection experts: co-operate with employers in drawing up evaluations of the protection of exposed workers against radiation; give advice on the working conditions of exposed workers, on the extent of the implementation of radiation protection measures in supervised and controlled areas, on the examination of the effectiveness thereof, on the regular calibration of measuring equipment, and on the control of the usefulness of protective equipment; and carry out training of exposed workers in radiation protection. Approved radiation protection experts regularly monitor the levels of ionizing radiation, the contamination of the working environment, and the working conditions in supervised and controlled areas.

Approval can be granted to individuals to provide expert opinions and present topics relating to training on radiation protection, as well as to legal entities to give expert opinions, perform control measurements and technical checks of radiation sources and protective equipment, and to perform training regarding radiation protection for occupationally exposed workers. Individuals can obtain an approval if they have appropriate formal education, work experience and expert skills. Legal entities can obtain an approval if they employ appropriate experts and have at their disposal appropriate measuring methods accredited according to the SIST EN ISO/IEC 17025 standard. Authorizations are limited to specific expert areas.

In 2013, the SRPA issued a total of three approvals for radiation protection experts. Approvals were granted on the basis of the opinion of a special commission that assesses whether candidates fulfil the requirements.

Approved dosimetric services

Approved dosimetric services perform tasks related to the monitoring of individual exposure to ionizing radiation. An approval can be granted only to legal entities that employ appropriate experts and have appropriate measuring methods meeting the SIST EN ISO/IEC 17025 standard at their disposal.

In 2013, the SRPA did not issue any approvals for dosimetric services.

Approved medical physics experts

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

In 2013, the SRPA authorized two medical physics experts. The granting of such approval was based on the opinion of a special commission that assessed whether the candidates fulfilled the requirements.

Approved medical practitioners

Approved medical practitioners carry out medical monitoring of exposed workers. An approval is issued by the Minister of Health on the recommendation of the SRPA and the Expanded Professional Collegium for Occupational Medicine.

In 2013, the SRPA prepared four opinions with regard to the fulfilment of the requirements for carrying out medical monitoring of exposed workers.

7.7. The Nuclear Insurance and Reinsurance Pool

The Nuclear Insurance and Reinsurance Pool has been operating since 1994, when eight members (insurance and reinsurance companies with registered offices in Slovenia) signed a contract to establish the Nuclear Insurance and Reinsurance Pool.

For several years the membership has been stable, such that in 2013 the members of the pool were the same as in the previous years: the insurance company Triglav, Ltd.; the reinsurance company Sava, Ltd.; Adriatic Slovenica, Ltd.; the reinsurance company Triglav Re, Ltd.; the insurance company Maribor, Ltd.; the insurance company Tilia, Ltd.; and the insurance company Merkur, Ltd.

The Nuclear Insurance and Reinsurance Pool insures domestic nuclear facilities and reinsures foreign nuclear devices within the capacities and interests provided by the Nuclear Insurance and Reinsurance Pool members on a yearly basis. The capacities of the Nuclear Insurance and Reinsurance Pool in 2013 for both domestic and foreign risks amounted to 12,199,603 EUR per individual risk facility.

The third-party liability of nuclear operators with headquarters in the Republic of Slovenia is insured in accordance with the Act on Liability for Nuclear Damage, which entered into force on 4 April 2011. Under this policy, the Nuclear Insurance and Reinsurance Pool covers risks as prescribed by the law, thereby ensuring payments to victims in the event of a nuclear accident. Costs, interests and expenses that the insured is obliged to pay to the plaintiff in respect of a nuclear incident are also covered. The insurance policy covers legal liability arising from the insured's operations when damage is caused by accidents at nuclear installations during the period of insurance coverage.

The Nuclear Insurance and Reinsurance Pool participate in third-party liability insurance risk up to its capacity level, while the rest of the risk is reinsured by foreign pools.

8. NON-PROLIFERATION AND NUCLEAR SECURITY

8.1. The Treaty on the Non-Proliferation of Nuclear Weapons

Over the last few years, the international community has focused more attention on nuclear non-proliferation. A few countries that are not contracting parties to the Treaty on the Non-Proliferation of Nuclear Weapons, namely India, Pakistan, North Korea and Israel, continue to implement their nuclear weapons programmes. The situation in Iran shows that their civil nuclear programme has not always been transparently presented.

The 8th Review Conference on the Treaty on the Non-Proliferation of Nuclear Weapons took place in spring 2010. Between 22 April and 3 May 2013, the second out of three Preparatory Meetings was held in Geneva ("NPT PrepCom"). The countries represented there reiterated again the importance of the NPT as well as endeavours to find ways to ensure a safer world without nuclear weapons. This PrepCom – with the final minutes of the chairperson – was deemed to achieve merely modest progress and form a stepping stone for concrete achievements amongst the main countries concerned by and in the year 2015. The 3rd PrepCom in a row is to take place in New York in spring 2014. In 2015, at the same place, the 9th Review Conference is to be held.

Slovenia completely fulfils its obligations under the adopted international agreements and treaties. Together with other countries, it endeavours to prevent the further proliferation of nuclear weapons.

8.2. Nuclear safeguards in Slovenia

At the international level, nuclear safeguards are regulated by the Treaty on the Non-Proliferation of Nuclear Weapons and the Treaty Establishing the European Atomic Energy Community. Slovenia's legal framework had to be adapted in the process of accession to the EU. Slovenia now completely fulfils its obligations regarding nuclear safeguards.

In Slovenia, all nuclear material, namely the fresh and spent fuel at the Krško NPP, the Jožef Stefan Institute, the Central Storage for Radioactive Waste in Brinje, and at the other holders of small quantities of nuclear material, is under the supervision of international inspection.

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

There were twelve IAEA/EURATOM inspections in 2013, whereas EURATOM carried out seven inspections by itself.

8.3. CTBT

The Comprehensive Nuclear Test-Ban Treaty (CTBT) is one of the international instruments aimed at combating the proliferation of nuclear weapons. Slovenia signed the treaty on 24 September 1996 and ratified it on 31 August 1999. Currently, there are 183 states signatory to the treaty, 161 of them have also ratified it. The CTBT will enter into force when it has been ratified by 8 of the remaining 44 countries listed in Annex II of the Treaty (Egypt, India, Iran, Israel, China, Pakistan, North Korea and the USA). Slovenia monitors activities relating to the treaty. In recent years there has been no need for active participation.

8.4. Export control of dual-use goods

In the scope of international activities in this area, the SNSA and the Ministry of Foreign Affairs participate in the Nuclear Suppliers Group (NSG) and the Zangger Committee. Slovenian representatives attend sessions of both organizations. The mission of both bodies is to prevent the export of dual-use goods, i.e. goods that might be used for manufacturing nuclear weapons, to those countries that wish to acquire such weapons. The annual Plenary Week of the NSG was held between 10 and 14 June 2013 in Prague, the Czech Republic.

On the basis of the Act on Export Controls of Dual-Use Goods, a special Commission for the Export Control of Dual-Use Goods was established at the Ministry of Economics. Dual-use goods are goods that can be used not only for civil but also for military purposes (including nuclear weapons and other weapons of mass destruction). The commission is made up of representatives of the Ministry of Economic Development and Technology, the Ministry of Foreign Affairs, the Ministry of Defence, the Ministry of the Interior, the Customs Administration, the SNSA, the Slovenian Intelligence and Security Agency, and the Chemicals Office. An exporter of dual-use goods must obtain a permit from the Ministry of Economic Development and Technology, which is issued on the basis of the Commission's opinion. In 2013, the Commission had 6 regular and 17 correspondence sessions. The role of the SNSA in this commission is primarily related to the export of goods that might be used in the production of nuclear weapons or nuclear dual-use items. In November 2013, the SNSA took part in an outreach for industry/exporters; the seminar, which encompassed the area of trade with dual-use items, was sponsored by the Ministry of Economic Development and Technology as well as the Chamber of Commerce and Industry of Slovenia.

8.5. Physical protection of nuclear material and facilities

The operators of nuclear facilities and carriers of nuclear material implemented physical protection measures in accordance with their plans on physical protection, which were approved by the Ministry of the Interior (MI). Within the changes and amendments of the main Nuclear Act (ZVISJV), several changes and amendments of the chapter dealing with physical protection were prepared. They touched upon, in particular, background checking and security vetting. The Ministry of Agriculture and the Environment has conveyed, together with the MI, SNSA and nuclear operators (in accordance with the Private Security Act and the Decree on the Obligatory Establishment of a Security Service) the harmonization of decisions on the mandatory organization of protection in nuclear facilities in Slovenia. The aim and the next step is to send them to the Slovenian Government for endorsement.

Based upon a new 2nd tier regulation, nuclear operators carried out a detailed revision of their physical protection plans and submitted them to the SNSA for its approval, and the final approval was given by the MI. In the framework of these revisions, several operational meetings were held – where the MI, the Police and the SNSA submitted a number of observations to be considered already in the preparatory phase of such physical protection plans. The nuclear operators included in their plans more thorough co-operation with the Police; additional requirements from the regulation were also fulfilled, including measures vis-à-vis cyber security, the maintenance and testing of physical protection systems, the security awareness of all employees, the establishment of coherent and harmonised procedures, etc.

The role of the Commission on the Physical Protection of Nuclear Facilities and Nuclear and Radioactive Material is to monitor and harmonize different tasks in the sphere of physical protection. The Commission provides its opinions on the threat assessment of nuclear facilities and nuclear and radioactive material, monitors and coordinates the implementation of measures for the physical protection of nuclear facilities and nuclear and radioactive material, makes suggestions to improve these measures, and makes proposals in the preparation of legislation in the area of the physical protection of nuclear facilities and nuclear and radioactive material. In 2013, two regular sessions of the Commission were held; the Commission accepted a proposal regarding the threat assessment for Slovenian nuclear facilities as well as for the transport of fresh nuclear fuel for the Krško NPP.

In 2013, regular training programmes for the security staff that protect nuclear facilities or the transport of nuclear material were held. In May 2013, physical protection measures were in place during the transport of nuclear material for the Krško NPP – with no incidents. The Inspectorate for Interior Affairs of the Ministry of the Interior carried out an inspection of the aforementioned transport. The inspection control included not only the organizer of the transport but also the person liable for private security, dealing with weapons, confidential data and the adequate treatment of both issues. The administrative procedure has not yet been finished.

Between 1 and 5 July 2013, the IAEA hosted an international – the first of such kind – ministerial conference on nuclear security in Vienna ("Nuclear Security – Enhancing Global Efforts"). Approximately 1,300 attendees from 125 member states and various international organizations participated, including several ministers and other high-ranking officers. The Slovenian delegation was led by H.E. Karl Erjavec, the Minister of Foreign Affairs. The conclusions from this conference also proved to be valuable input for the IAEA Nuclear Security Plan 2014–2017. The ministerial statement endorsed the efforts made thus far. However, it pointed at the future as well, with the aim of enhancing global efforts in this area and accomplishing additional steps.

8.6. Illicit trafficking of nuclear and radioactive materials

By the end of 2013, the SNSA had issued 21 approvals for measuring the radioactivity in scrap metal shipments. All approved organisations sent their annual reports to the SNSA. According to those reports, 37,497 measurements of shipments were carried out in 2013. Elevated doses were measured in four cases.

A duty officer at the SNSA was available for providing assistance and consultation to other state offices and scrap metal recyclers. Due to a lack of financial resources, the availability of such officer was reduced to from 8:00 on Mondays to 22:00 on Fridays. Ten calls to the duty officer were registered in 2013.

The SNSA regularly receives and to a certain extent analyses the information on incidents and trafficking cases in foreign countries. The SNSA disseminates it appropriately to the other Slovenian stakeholders whose scope of responsibilities also includes (combating) illicit trafficking of nuclear and other radioactive material. In 2013, Slovenia (the SNSA) reported once to the IAEA "Incident and Trafficking Database" (ITDB); one $^{152/154}Eu$ radioactive source was discovered in Pivka. The source most probably derived from a lightning rod.

At the end of September 2013, the representatives from the SNSA, the Customs Administration, the Market Inspectorate and the Ministry of the Interior met and reviewed the current situation in the area of the illicit trafficking of nuclear and other radioactive material.

8.7. Achieving the goals under the Resolution on Nuclear and Radiation Safety

As can be seen from the previous chapters, Slovenia has completely achieved the set goal:

Goal 6:

As Slovenia does not have any intentions regarding the non-peaceful use of nuclear energy, it is firmly bound by the NPT and fully respects its obligations; Slovenia is entirely open for international inspection control of nuclear material on its territory ("safeguards").

Slovenia co-operates with international organizations dealing with the non-proliferation of nuclear weapons and dual-use goods – primarily based upon its abilities, and performs its duties regarding reporting and the control of dual-use goods; Slovenia endeavours to make a contribution as regards the global efforts regarding the non-proliferation of nuclear weapons based upon its human and financial resources.

9. INTERNATIONAL COOPERATION

9.1. Cooperation with the European Union

The Working Party on Atomic Questions (ATO)

The Working Party had prepared a draft regulation establishing a community system for the registration of carriers of radioactive materials on its agenda, but work on it stopped in the second half of 2013 because it was not deemed a priority by the incoming Presidency. Another activity was drafting the amended Nuclear Safety Directive, which was thoroughly considered article by article, while additional comments were also made by the representatives of the European Commission and ENSREG. The ATO delegates received information about the negotiations of Euratom with Canada, the Russian Federation and the Republic of South Africa. The ATO also dealt with a proposal for the Drinking Water Directive. As usual, the ATO supported the renewal of the Euratom – KEDO agreement. Member countries gave their opinions on the proposals of the directives. During the meetings different information was delivered to the delegates (e.g. on the meetings of ENSREG and WENRA, on the protection of nuclear materials regarding which IAEA and Euratom cooperate).

In 2013, a new directive laying down basic safety standards for protection against the dangers arising from exposure to ionizing radiation (BSS) was adopted. Directive 2013/59/EURATOM integrates several directives in the field of radiation protection (the medical directive, the directive on the protection of outside workers, the directive on the control of high activity sources and orphan sources, and the directive on informing the public in the event of an emergency) and will be the basic document for legislative regulation of radiation protection in all EU Member States. The representatives of the SRPA took part in the process of adopting the BSS Directive.

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

The High-Level Group on Nuclear Safety and Waste Management (ENSREG) is an independent expert body established in 2007 by a decision of the European Commission. The group is composed of the highest representatives of regulatory bodies responsible for nuclear safety, radiation protection, and the safety of radioactive waste from all Member States of the European Union. The representatives of the European Commission take part in the ENSREG under the same rules as other members.

The main topics of the meetings were the proposed changes in the Nuclear Safety Directive, the ENISS (European Nuclear Installations Safety Standards) proposal to introduce uniform verification of new generic designs of nuclear power plants and the Action Plans based on lessons learned from the Fukushima accident.

On 11 and 12 June, the second European Conference of Nuclear Safety Regulators: “Nuclear Safety in Europe” was organized by ENSREG and the European Commission in Brussels. Approximately 300 representatives of European administrative authorities responsible for nuclear safety and other stakeholders in the field of peaceful uses of nuclear energy attended the event. The SNSA Director Andrej Stritar chaired the conference. The conference was an opportunity to present the activities of most international associations in the field of nuclear safety.

Consultative Committees under Euratom

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

The committee under Article 31 prepares recommendations for the European Commission regarding legal acts in the field of radiation protection and public health. In 2013, the meetings of this committee focussed in particular on the draft amending the Nuclear Safety Directive. The committee, taking into account the opinion of the special working group of the committee, highlighted the most important parts of the Directive. It also discussed progress on the directive regarding basic safety standards for protection against ionizing radiation (BSS), where the committee proposed the organization of a General Conference after the adoption of the new BSS Directive, the preparation of instructions in relation to this directive, thematic workshops in connection with the implementation of the BSS in the EU and an analysis of unresolved issues between the BSS and other directives and documents. Other items on the committee's agenda were related to the Drinking Water Directive, the consequences of the exposure of the population in Fukushima, and the activities of the working groups of the committee under Article 31 of the Euratom Treaty.

Euratom requires Member States to establish a system of radiation monitoring in the environment and consequently to report to the European Commission within the committee under Article 35. The Slovenian representative attended the meeting under this Article in October 2013. The activities of the European Commission in the field of radiation protection since Chernobyl were presented, as well as the environmental radiation monitoring reports of the Member States and the results of studies on radon indoors in Europe.

The main task of the committee under Article 37 is to prepare opinions for the European Commission regarding the impact of an individual nuclear object on neighbouring Member States. Representatives mainly run correspondence meetings. In the period between 2009 and 2013, the Slovenian representative did not attend any meeting of the working group under this Article.

Consultative Committees of the European Commission

The Consultative Committee Instrument for Nuclear Safety Co-operation (INSC) advises the European Commission on issues regarding assistance to third countries in the area of nuclear and radiation safety. The INSC Consultative Committee has been operating since 2007, when it launched a new Financial Perspective. In 2013, there were two meetings of the INSC Consultative Committee, both of which considered the programme for the year 2013, which included assistance to regulators in areas such as radioactive waste management, emergency responses, education and training, as well as assisting in remediation following the Chernobyl accident. Member States welcomed the assistance aimed at the Central Asian countries for the mitigation of the effects of uranium mining. Support to the regulatory bodies of Belarus, Jordan, Indonesia, Thailand, Vietnam, China, Armenia and Iraq was also envisaged. The European Commission pointed out that after 2013 no further financial contribution is foreseen for the Chernobyl Fund.

The Euratom-Fission Consultative Committee is a group of experts whose role is to advise the European Commission regarding nuclear research projects that are completely or partially financed by the EU. In 2013, a meeting was held in March. With the beginning of the new "*Horizon 2020*" research programme, the Euratom-Fission Consultative Committee ceased to exist. Thus, in October 2013 the first meeting of the *"Fission Expert Group"* was held for the preparation of the work programme 2014–2015. From 2014 the work will be conducted in the Euratom comitology committee, chaired by the EC. In the new programming period 2014–2015, one of the highlights will be co-operation with other disciplines (e.g. socio-economic, cooperation with civil society) and domains (e.g. low-carbon technology, health).

9.1.1. Cooperation in EU Projects

Cooperation in the Project of Training and Tutoring for Third Countries

In 2013, a project on education and mentoring in the field of nuclear safety for the administrative authorities of third countries was conducted. The project started in 2012 and is funded by the European Commission. It is implemented by a consortium led by the Italian company ITER. Among other consortium members, the Jožef Stefan Institute and the SNSA also participate in the project. In May, the Institute conducted a one-week course on probabilistic safety analyses, and in September a course on the nuclear safety of research reactors. Upon the completion of the courses and internships at the Institute, two experts from Jordan and Vietnam came to the SNSA for one-month practical training, while in October, experts from the Philippines, Indonesia and Iraq were trained at the SNSA.

ESOREX

For several years, the SRPA has been involved in the project the European Study of Occupational Radiation Exposure (ESOREX). The ESOREX project is dedicated to the collection, processing and comparison of occupational doses data at the international level. In the project framework, countries share experience on organizing individual monitoring and managing the national data registry. The project is supported by the European Commission, but it is not limited only to EU Member States. In 2013, ESOREX started to prepare an internet platform for the exchange of information, which will be maintained by the Member States after the end of the project. Preparation of the platform is directed by the ESOREX Steering Group, consisting of representatives of the five Member States (including the representative of Slovenia), a representative of the European Commission and a representative of UNSCEAR. In 2013, the ESOREX Steering Group met three times.

Other Projects

In 2013, SRPA enabled two one-day training courses in the field of radiation protection in medicine for an inspector from the Croatian Radiation and Nuclear Safety Administration within the framework of the EU project "EuropeAid/130051/D/SER/HR - Strengthening the Administrative Capacity of the State Office for Radiological and Nuclear Safety, the Regulatory Body for Nuclear Safety and Security".

9.2. IAEA

During 2013, Slovenia successfully cooperated with the International Atomic Energy Agency (IAEA). In 2013, the Slovenian delegation also attended the regular annual session of the General Conference. The most important Slovenian activities are as follows:

- Slovenia received 44 individual applications for the training of foreign experts in Slovenia in 2013. More than 30 training courses were implemented, three training applications were withdrawn by the IAEA, three training requests were rejected by the Slovenian institutions, while eight individual applications for training will be implemented in 2014.
- Slovenia submitted three new proposals for a research contract project, which were all prepared at the Jožef Stefan Institute. Fifteen research contract projects were in progress from the previous years, four were completed in 2013.
- A two-year technical cooperation and assistance cycle ended in December 2013. Due to the delay in the implementation of the planned activities and assignments within the three national projects, the programme of the previous cycle (2012–2013) will be continued and completed by June 2014 at the latest. The Board of Governors approved two new Slovenian national projects. One is related to the radioactive waste and spent fuel management of the Agency for Radwaste Management, while the other is a capacity building project of the SNSA. Both projects will be carried out in the years 2014 and 2015.
- Participation in workshops, training courses, and technical meetings organized by the IAEA is one of the most important ways to ensure the expert training of Slovenian specialists. In most cases, the IAEA is willing to cover the participants' attendance costs.
- Slovenia continues its active policy of hosting activities organized by the IAEA. In 2013, Slovenia hosted four such events, i.e. workshops, courses, and meetings.
- The participation of Slovenian specialists and their involvement as experts in various IAEA committees, missions and workshops abroad is an important contribution to IAEA activities.

In 2013, an IAEA project in the field of the optimization of medical use of ionizing radiation (two consecutive regional projects, i.e. RER/9/080 and RER/9/093), in which the Slovenian Radiation Protection Administration had been collaborating since 2005, was completed. In the first phase of the project the SRPA was actively involved in the field of radiation protection in intervention procedures emphasizing interventional cardiology. In a few years a good overview of the situation in Slovenia was established, as well as optimization of the procedures where needed. During the last period, the SRPA's involvement in this project was focused on the optimization of computed tomography (CT) examinations in paediatric patients. Due to extremely good project results, Slovenia, with the support of seven countries, made an initiative for the project to be extended for the period 2014–2017. In 2013, Slovenia started to participate in IAEA activities in the field of the justification of medical radiological procedures and integrated data management of medical radiological procedures.

At the end of 2013, the cooperation of the Republic of Slovenia had outstanding obligation to the IAEA budget amounting to EUR 310,472 due to the inability to pay this amount. Funds in the 2014 state budget allocated for the payment of IAEA and NEA contributions amounted to EUR 348,415. In 2014 the SNSA paid to the IAEA the arrears for the year 2013. Additionally, payment in the amount of EUR 11,856 was also made to the 2014 regular budget. At the time of writing this report, Slovenia has an outstanding debt of EUR 353,612 to the IAEA's budget since the obligations to the IAEA's amount to EUR 365,469 in 2014. The SNSA observes that the trend regarding arrears has been increasing, although it did not exceed the amount of one annual obligation to the IAEA. In the 2016–2018 biennial period it is planned that Slovenia will become a member of the IAEA Board of Governors, so it would be reasonable to reverse the increasing trend in arrears as soon as possible.

9.3. The Organisation for Economic Cooperation and Development – Nuclear Energy Agency

Since 2011, Slovenia has been a full member of the Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development (OECD). The mission of the NEA is to assist its member states in maintaining and further developing the scientific, technological and legal bases required for the safe, environmentally friendly and economical use of nuclear energy for peaceful purposes. The agency cooperates closely with the Atomic Energy Agency in Vienna and European Commission in Brussels.

Organizationally, the Agency has seven standing committees under the leadership of the Steering Committee, which reports on its work to the Council of the OECD. In 2013, Slovenia actively participated in five committees – the Radioactive Waste Management Committee, the Committee on Radiation Protection and Public Health, the Committee on the Safety of Nuclear Installations, the Committee on Nuclear Regulatory Activities and the Nuclear Law Committee, while Slovenian representatives were not able to participate in the Nuclear Development Committee and in the Nuclear Science Committee. Slovenian representatives also participate in different working groups operating within the framework of the standing committees.

There is continuous cooperation of Slovenia, namely the Krško NPP and the SRPA, in the International System of Occupational Exposure (ISOE). The ISOE is an information system on occupational exposure to ionizing radiation in nuclear power plants, supported by both the OECD/NEA and IAEA. The information system is maintained by several technical centres with the support of the above-mentioned organizations and with the cooperation of nuclear power plants and administrative authorities.

Financial s restricted the participation of Slovenian members in the work of the NEA committees also in 2013, which in turn means less information from abroad regarding the latest findings and experiences. It seems strange that since it became a member of the OECD/NEA in 2011 Slovenia's representatives have participated less in the work of the committees and subcommittees than they did when Slovenia was just an observer.

9.4. Cooperation with Other Associations

The Western European Nuclear Regulators' Association (WENRA)

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

In 2013, WENRA dealt with the upgrade of safety reference levels, taking into account the experience gained from the accident in Fukushima, also including completed safety assessments (so-called stress tests), which were performed in Europe after the Fukushima accident, as well as with the safety requirements of the IAEA arising from the conclusions of the second extraordinary Meeting of the Parties to the Convention on Nuclear Safety, which was held in August 2012.

The European Nuclear Security Regulators' Association (ENSRA)

ENSRA is an association consisting of representatives of nuclear regulatory authorities that cover nuclear security. It was established in 2004. Slovenia joined the ENSRA in 2008. The main objectives of ENSRA are to exchange information on nuclear security, on current security issues and events, on the development of comprehensive understanding of the fundamental principles of physical protection, and to promote common principles of protection in Europe.

The International Nuclear Law Association (INLA)

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

CAMP

Under the agreement with the US NRC (the US nuclear safety regulator), the SNSA cooperates in international research and development activities coordinated by the US NRC under the CAMP programme (the Code Application and Maintenance Programme). The CAMP programme facilitates cooperation in the field of maintaining and using software to prevent and control accidents and abnormal events in nuclear power plants. The Slovenian National Coordinator of the CAMP programme is the Jožef Stefan Institute, which regularly monitors and reports on the activities of CAMP and actively cooperates in the development of computer programmes with its contributions.

In May 2013, the national coordinator took part in the “Spring 2013 CAMP Meeting” in Pisa, Italy, and in November also the “Fall 2013 CAMP Meeting” in Washington, USA.

Association of the Heads of European Radiological Protection Competent Authorities

A representative of SRPA is a member of the Association of the Heads of European Radiological Protection Competent Authorities – HERCA. In 2013, the Association dealt with radiation protection measures and their harmonization in the event of an emergency: HERCA also deepened cooperation with international organizations in the field of radiation protection and radiological equipment manufacturers. The preparation of training for inspectors regarding the clinical aspects of radiological procedures continued in 2013, wherein the SRPA actively contributed with the participation of its inspector and authorized medical physics expert at the evaluation training and the presentation of results at the meeting of the working group for the medical use of radiation sources.

The European ALARA Network

As one of 20 European countries, Slovenia participates in the European ALARA Network (EAN). EAN is dedicated to optimizing radiation protection and sharing good ALARA practices in industry, research and medicine. In the framework of EAN, international workshops in specific fields are organized. In addition, EAN issues a newsletter with information on practical implementation of the ALARA principle, examples of good practices and other news. EAN has an active role in studies conducted by the European Commission and other international organizations in the field of radiation protection. The network is also involved in other aspects of implementing the ALARA principle in practice. There are several sub-networks in the framework of EAN. SRPA is active in ERPAN (the European Radioprotection Authorities Network), which is dedicated to the exchange of operational information on surveillance and measures in radiation protection.

9.5. Agreement on the Co-ownership and Management of the Krško Nuclear Power Plant

Irrespective of the importance of the Intergovernmental Agreement on the Co-ownership of the Krško NPP (Official Gazette RS, No. 23/03 – International Treaties; hereinafter referred to as the Agreement) for operation of the Krško NPP and for the electricity power system in Slovenia, the Interstate Commission, established on the basis of Article 18 of the Agreement, as the responsible body for the implementation of the Agreement, has not held any meetings since 2010.

In accordance with Article 1 of the Rules of Procedure of the Interstate Commission, in 2013 the Republic of Croatia was requested to inform the Republic of Slovenia of the new members of the Croatian delegation to the Interstate Commission. Due to the change in leadership of the ministry responsible for energy in 2013, the new members of the Slovenian delegation to the Interstate Commission should have been appointed. That did not happen, which was obvious because the Interstate Commission did not meet in 2013 either. Issues concerning the joint management of radioactive waste, joint storage and common preparation for disposal remain open. Such delay in the coordination and optimization of the joint long-term management of radioactive waste, spent nuclear fuel and decommissioning creates a potential problem for the future.

In spite of the above-mentioned, it should be noted that both owners, GEN Energija in Slovenia and Hrvatska elektroprivreda in Croatia, regularly and fully meet their financial obligations to NPP Ltd., and hence ensure nuclear safety. It is also important to update and approve the five-year plan of the facility modernization, which is a prerequisite for long-term nuclear safety.

9.6. Cooperation in the Framework of International Agreements

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

Bilateral Co-operation

In May, the Slovak regulatory body in Skalica hosted the so-called Quadrilateral Meeting, namely a regular annual meeting of the Czech Republic, Hungary, Slovakia and Slovenia, whose regulatory bodies have signed bilateral agreements between themselves. Participants exchanged information on developments in their countries in the past year. It turned out that all regulatory bodies updated their legislation and the framework laws on nuclear safety. Stress tests and the resulting action plans will ensure nuclear safety improvement and enable better preparedness for emergencies regarding the existing nuclear plants in the forthcoming years. A similar bilateral meeting was organized with Austria in October in Ljubljana. As usual, the longest agenda item was the Slovenian nuclear programme.

The Sixth Ordinary Meeting of the Parties to the Convention on Nuclear Safety

The SNSA together with the Krško NPP prepared a national report for the sixth ordinary meeting of the Parties to the Convention on Nuclear Safety, which was held in March 2014. The Parties are obliged to report on the nuclear safety of their respective nuclear power plants and therefore the report was mainly focused on the Krško NPP. Despite the fact that in August 2012 the IAEA organized the second extraordinary meeting of the Parties to the CNS, which considered the response of the Parties following the Fukushima accident, the report for the sixth Review Meeting also addressed relevant issues in this connection. The report was published in early September on a dedicated IAEA website. By December, the States Parties reviewed the reports and exchanged questions. Slovenia posed 82 questions, while it received 63 questions.

9.7. Achieving goals under the Resolution on Nuclear and Radiation Safety

As can be seen from the above chapters, Slovenia efficiently and rationally strives to achieve the goals set out in the Resolution. The document also reports on problems due to a lack of funding (the non-payment of membership fees, the inability to attend the meetings).

Goal 2:

In principle, the Republic of Slovenia joins international conventions, agreements, contracts or other methods of cooperation allowing a rapid and equitable exchange of information and mutual assistance in ensuring nuclear and radiation safety and reducing risks to humans and the environment both in the territory of the Republic of Slovenia as well as elsewhere.

The Slovenian authorities and other organizations in the field of nuclear and radiation safety and physical protection are involved in international associations based on their needs and benefits that they can gain from such membership. This collaboration has to contribute to the maintenance of nuclear and radiation safety in Slovenia on a comparable international level.

International cooperation should be encouraged and maintained in all areas of nuclear and radiation safety, including science and education.

The Republic of Slovenia, the Slovenian authorities and other organizations in the field of nuclear and radiation conclude bilateral agreements on cooperation in the field of nuclear and radiation safety if this facilitates the achievement of planned goals. Such agreements are especially important when they provide Slovenia with early information in the event of a radiological emergency in the territory of another country.

Goal 3:

The Republic of Slovenia will continue to actively participate in all activities within the EU where its presence is mandatory and where Slovenia can meet its specific long-term interests.

Goal 4:

The Republic of Slovenia is and remains an active member of the IAEA. As a member of this Agency, it contributes a mandatory membership fee. In accordance with its capabilities, it also provides human and financial resources to third parties, especially in the areas where its direct or indirect interests can be met.

In the area of technical cooperation, Slovenia supports projects that have great potential especially in countries in geographical proximity, in countries with similar programmes or technology, and particularly in areas where Slovenian experts are able to provide their assistance.

The Republic of Slovenia will receive technical assistance especially in the areas where no domestic capabilities are available to achieve selected nuclear and radiation safety goals.

The Republic of Slovenia would like to change its status from a recipient country of technical assistance to a donor country.

The Republic of Slovenia will continue to support and motivate its experts for professional work in third countries within the framework of the IAEA and invite international expert advisory groups on periodic advisory missions to facilities and institutions to independently verify the country's capabilities. Above all, it will invite expert groups that Slovenia is committed to inviting.

Goal 5:

The Republic of Slovenia remains an active member of the OECD Nuclear Energy Agency (NEA). For its collaboration, Slovenia contributes the agreed amount of the membership fee. In line with its human and financial resources, Slovenia participates in the work of NEA committees, the NEA Data Bank and those subcommittees that are important for ensuring a high level of nuclear and radiation safety.

10. USE OF NUCLEAR ENERGY IN THE WORLD

At the end of 2013, there were 434 nuclear reactors for electricity production operating in 32 countries. In 2013, four new nuclear power plants were put into operation, of which three were in China and one in India. Four nuclear power plants in the USA, one in Spain and two in Japan ceased operation. In Japan, all nuclear power plants remain shut down because of the accident at Fukushima in 2011. The construction of eight new nuclear power plants started in 2013, of which one was in each of Argentina, South Korea, United Arab Emirates and China and four in the USA.

In Europe, there are nuclear power plants under construction in Finland, France, the Ukraine, and Slovakia. New builds are planned in Poland, Hungary and the Czech Republic. Detailed data on the number of reactors by country and their installed power is given in Table 11.

Table 11: The number of reactors by country and their installed power

Country	Operational		Under construction	
	No.	Power [MW]	No.	Power [MW]
Belgium	7	5,927		
Bulgaria	2	1,906		
Czech Republic	6	3,804		
Finland	4	2,752	1	1,600
France	58	63,130	1	1,600
Hungary	4	1,889		
Germany	9	12,068		
Netherlands	1	482		
Romania	2	1,300		
Russia	33	23,643	10	9,297
Slovakia	4	1,816	2	880
Slovenia	1	696		
Spain	7	7,114		
Sweden	10	9,395		
Switzerland	5	3,278		
Ukraine	15	13,107	2	1,900
United Kingdom	16	9,231		
Europe total:	**184**	**161,538**	**16**	**15,277**
Argentina	2	935	2	717
Brazil	2	1,884	1	1,245
Canada	19	13,500		
Mexico	2	1,530		
USA	100	97,710	5	5,633
Americas total:	**125**	**115,559**	**8**	**7,595**
Armenia	1	375		
India	21	5,308	6	3,907
Iran	1	915		
Japan	48	42,388	2	2,650
China	20	15,882	29	28,774
Korea, Republic of	23	20,739	5	6,320
Pakistan	3	725	2	630
Taiwan	6	5,028	2	2,600
United Arab Emirates			2	2,690
Asia and Middle East total:	**123**	**91,360**	**48**	**47,571**
South Africa	**2**	**1,860**		
World total	**434**	**370,317**	**72**	**70,443**

11. RADIATION PROTECTION AND NUCLEAR SAFETY WORLDWIDE

The International Nuclear and Radiological Event Scale (INES) is used worldwide as a tool for consistent reporting to the public on the safety significance of nuclear and radiological events. International reporting on events is performed for more significant events rated at Level 2 or higher and for events that have attracted the interest of the international public. The INES reports are published on the web-based communication system NEWS: http://www-news.iaea.org.

Significant events rated according to the INES scale

In 2013, 25 event reports were published via the NEWS system, including two reports on events in Slovenia. 5 reports covered events in NPPs, while for events in a research reactor, radioactive waste storage, research facility and radioisotope production facility, there was 1 report published for each facility. 12 reports were published for events where a radioactive source was used or found, 1 report was for a transport event, and 3 reports for events concerning the radioactive exposure of workers in medicine. 2 events were rated as level 3, one occurred when a worker was exposed beyond the authorized limit when performing radiography, the other due to the leakage of radioactive water from an NPP reservoir into the environment. 16 reports on level 2 events, 5 reports on level 1 events, and 2 reports on level 0 events were published.

A level 3 event occurred in the handling of a radiographic camera in an oil refinery in Germany. A worker tried to repair a radiographic camera and violated the basic safety rules while doing so. The worker was exposed to a whole body dose of 75 mSv and the dose for his left hand and skin was estimated at 10-30 Sv. There were deterministic effects of the radiation exposure on the left hand including skin redness and burns.

A level 3 event occurred in the nuclear power plant Fukushima Dai-ichi, where radioactive water leaked from a tank. About 300 m^3 water leaked into the environment, with a total activity of several thousand TBq. No significant increase in radioactivity was detected in the seawater near the ditch that flows into the sea.

A level 2 event occurred during an outage in a nuclear power plant where there was an external contamination of a worker by a radioactive hot particle. The worker absorbed a dose that exceeded the authorized limit.

In a research reactor a deficiency in the safety analysis was discovered. A possible failure of a primary reactor drain line would have resulted in the fast draining of the reactor vessel and fuel damage. Since a real event did not occur, this safety deficiency was rated as INES level 2 according to the criterion of the degradation of defence in depth.

In a radioactive waste storage an event occurred with external and internal contamination of three workers during the opening of drums with compressed radioactive waste containing the isotope ^{241}Am.

A worker was overexposed during a low-level waste and rubble sorting operation at a research centre for activated material analysis that is in the process of being decommissioned.

In a radioisotope production and handling facility, a level 2 event occurred when a worker contaminated a hand with ^{131}I because a protective glove was damaged and leaking. Even after the hand decontamination was performed there was an increased level of ^{131}I detected in his thyroid. The worker was overexposed but no deterministic radiation effects were observed.

Most events were connected with the use of radioactive sources. 5 level 2 events and 1 level 1 event with the overexposure of workers and a member of the population occurred due to the incorrect functioning of radiographic devices or the improper actions of workers. A level 2 event occurred during the transportation of a spent ^{241}Am liquid source from an institute to a radioactive waste storage facility located in a different part of the country. The source leakage resulted in the contamination of rooms in both the institute and the storage and four workers were contaminated due to the inhalation of radioactive vapours. The measured internal contamination dose received by the workers exceeded the authorized limits and there were no indications of deterministic effects of irradiation.

An event where a neutron source was stolen was rated as level 2. After recovering the source, it was determined that thieves had extracted the source from the shielding container.

Three level 2 events occurred in medicine. In two cases workers in the field of radio-pharmacy experienced excess exposure. In the third event, a personal dosimeter showed the overexposure of a worker performing radiotherapy in a hospital. The cause of the event was inadequate working procedures, resulting in deficient radiation protection.

INES events in Slovenia

In Slovenia, there were two events in 2013 that were reported in the NEWS system. The first event was fuel leakage in the Krško NPP (see Chapter 2.1.1.3 of this report). According to the criteria in the INES manual, this event was rated as level 0 on the INES scale.

A second event that was reported was the overexposure of workers during the performance of industrial radiography at the building construction site of the Šoštanj thermal power plant (see Chapter 2.2.2 of this report). The event was preliminarily rated as level 2 on the INES scale.

Other internationally interesting events in 2013

The IAEA website reported on an event in Mexico where robbers stole a truck with a radioactive source – ^{60}Co with activity of 111 TBq (category I) – that was being transported from a hospital to a radioactive waste storage facility. The radioactive source was later found after an extensive search, but the source had already been extracted from the shielding container. A member of population was exposed to the unshielded radiation from the ^{60}Co source and deterministic effects of exposure were observed on his shoulder skin where he had carried the source. The event has not yet been rated according to the INES criteria.

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