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

Annual Report 2004 on the Radiation and Nuclear Safety in the Republic of Slovenia

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Annual Report 2004 on the Radiation and Nuclear Safety in the Republic of Slovenia

June 2005

Prepared by the Slovenian Nuclear Safety Administration in cooperation with:

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

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1. Preface

As in the past several years, in the areas of protection against ionising radiation and nuclear safety in the Republic of Slovenia the year 2004 went by without any significant peculiarities. There were no events that could endanger the members of the public. On 1st of May 2004 Slovenia became a member of the European Union, and accordingly an amendment to the Act on Protection against Ionising Radiation and Nuclear Safety (ZVISJV) and secondary legislation based on the Act were adopted in April 2004 to completely harmonise our legislation in this field with the requirements of the Union.

The biggest nuclear facility in Slovenia, the Krško Nuclear Power Plant (NPP), operated without any event having an impact to the environment. In September, a maintenance and refuelling outage was performed. For the first time a 18-month fuel cycle started, and the next refuelling is expected in spring 2006. In August 2004 the Krško NPP experienced an automatic reactor scram due to a fault in control electronics for control rods. All the systems and the personnel reacted appropriately.

On the basis of the international contract on the ownership of the Krško NPP between the Republic of Slovenia and the Republic of Croatia a Programme of Decommissioning of the Krško NPP was completed. The Programme was ratified by both governments and forms a groundwork for collecting funds in both countries required for the decommissioning. Both owners have been regularly financially supporting the operation of the NPP.

Monitoring of environmental radioactivity showed no deviations from the usual values.

An intensive administrative adaptation of users of sources of ionising radiation due to liabilities according to the Act from 2002 took place. In parallel, inspections were actively checking the status in the field. There were no large discrepancies from standards or unnecessary exposures to population.

The potential danger of illicit trafficking with nuclear and radioactive material across our borders seems to be increasing. There were some occasions of either Italian customs officers or metal foundries in Slovenia detecting elevated radiations of train or truck shipments. In all these events the response of the competent officers was efficient, and the sources found were safely transferred to the central interim storage of radioactive waste. As a long-term solution, only setting up radiation monitoring control points at border crossings would be an efficient solution to prevent illicit trafficking of radioactive substances.

Substantial progress has been made towards the selection of a location for final disposal of low and intermediate radioactive waste. At the end of 2003 a Decree on Measures for Determining the Amount of Indemnities for Limited Land Use at the Nuclear Facility was adopted. The Agency for Radwaste Manageent (ARAO) invited all communities to participate in the site selection process. Hence, public acceptance has become a key criterion for the siting.

This short report is a continuation of the practice introduced two years ago. It provides in a condensed form the essential data on the status in the areas of radiation protection and nuclear safety in the country, and is aimed at a wider group of interested public. In parallel, an extended report (Ref. 1) was prepared consisting of all the details and data which would be of interest to a narrower group of professionals. It is available in electronic form on a CD-ROM or at the homepage of the SNSA (www.gov.si/ursjv).

2. Operational Safety

2.1. Operation of Nuclear Facilities

According to the Act on Ionising Radiation Protection and Nuclear Safety, a nuclear facility is defined as *"a facility for processing or enrichment of nuclear materials or production of nuclear fuel, a nuclear reactor in critical or sub-critical assembly, a research reactor, a nuclear power-plant and heating plant, a facility for storing, processing, treating or disposing nuclear fuel or highly radioactive waste, and a facility for storing, processing or disposing low or medium radioactive waste".* Three nuclear facilities operated in 2004 in Slovenia: the Nuclear Power Plant Krško, the Research reactor TRIGA of the Jožef Stefan Institute and the Central Interim Storage for Radioactive Waste at Brinje.

2.1.1. Nuclear Power Plant Krško

2.1.1.1. Operation and Performance Indicators

In 2004, the Nuclear Power Plant Krško (NEK) produced 5,459,173.8 MWh (5.5 TWh) gross electrical energy on the output of the generator, which corresponds to 5,212,185.7 MWh net electrical energy delivered to the grid. The annual production was 0.72% more than planned. The reactor was critical for 8,118.88 hours or 92.43% of the total number of hours in this year. The thermal energy production of the reactor in the Nuclear Power Plant Krško was 15,495,640.5 MWh.

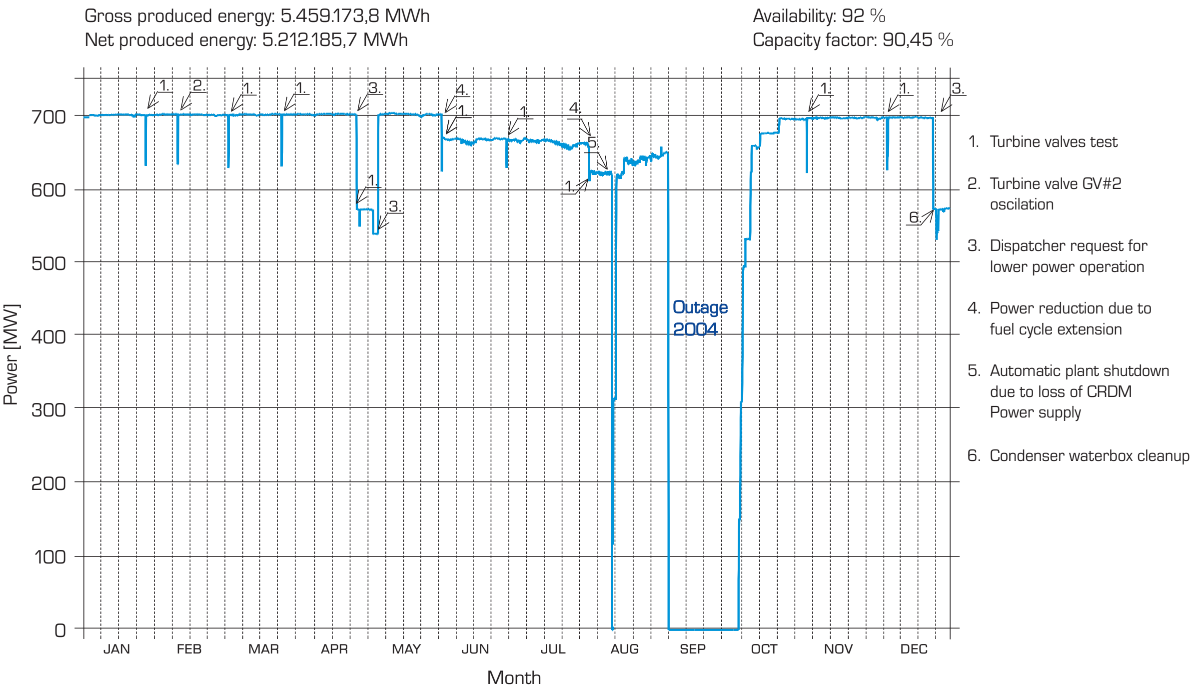
The most important performance indicators are shown in Table 1, and their changes through years are shown in the following parts of this report. The performance indicators confirm the stable and safe operation of the power plant.

Table 1: The most important performance indicators in 2004

Safety and performance indicators	Year 2004	Average 1983-2004
Availability [%]	92.00	84.00
Capacity factor [%]	90.45	80.51
Forced outage factor [%]	0.10	1.24
Realised production [GWh]	5,459	4,642
Fast shutdowns - automatic [Number of shutdowns]	1	3.05
Fast shutdowns - manual [Number of shutdowns]	0	0.32
Unplanned normal shutdowns [Number of shutdowns]	0	1.00
Planned normal shutdowns [Number of shutdowns]	1	0.82
Event reports [Number of reports]	2	3.86
Refueling outage duration [Days]	28.9	51.7
Fuel reliability indicator (FRI) [GBq/m^3]	$1.06 \cdot 10^{-3}$	$9.22 \cdot 10^{-2}$

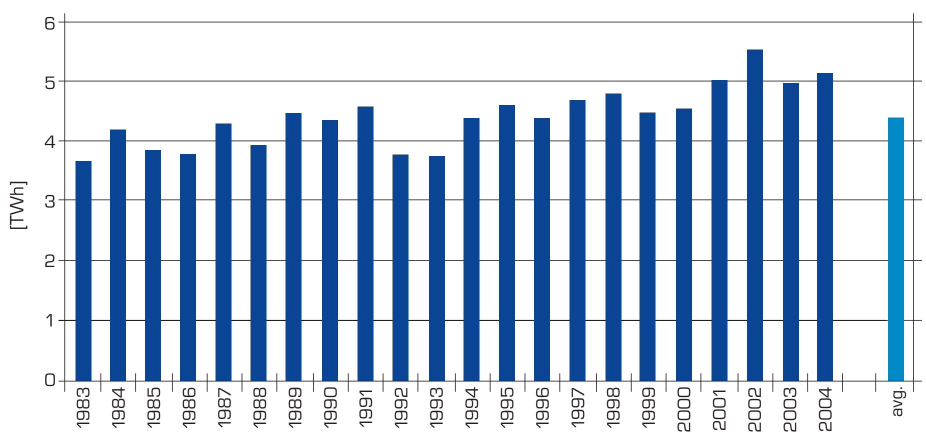
Figure 1 shows the operating diagram of the Krško NPP for the year 2004. As the diagram shows, the power plant operated at reduced power from the end of May till the outage in September due to the extension of the fuel cycle. In August there was an automatic plant shutdown due to a loss of power supply to the control rod system. In addition to that, the power plant operated at reduced power due to a dispatcher request for lower power operation in April, May and December.

Figure 1: Operating power diagram for the Krško NPP in 2004



In Figure 2, the production of electric energy is presented for the years of commercial operation. In 2004, the production was higher than the year before and lower than in the year 2002, when it reached its highest level in the operating history of the NPP. The reason for smaller production than possible was the extension of the fuel cycle since the plant operated on reduced power because of higher fuel burnup.

Figure 2: Production of electricity in the Krško NPP



In Figure 3, the capacity factor is presented. In 2004 it amounted to 90.45% and was higher than in 2003 and above the average value. The capacity factor is used world-wide as the main indicator of successful operation of the power plant.

Figure 3: Capacity factor at the Krško NPP

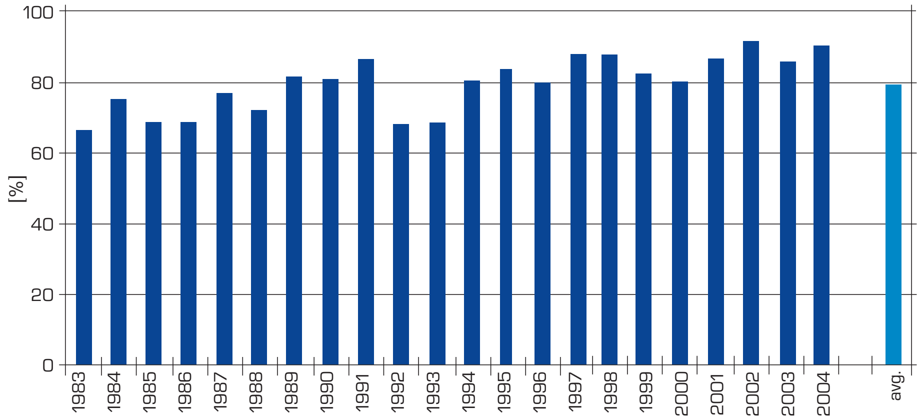
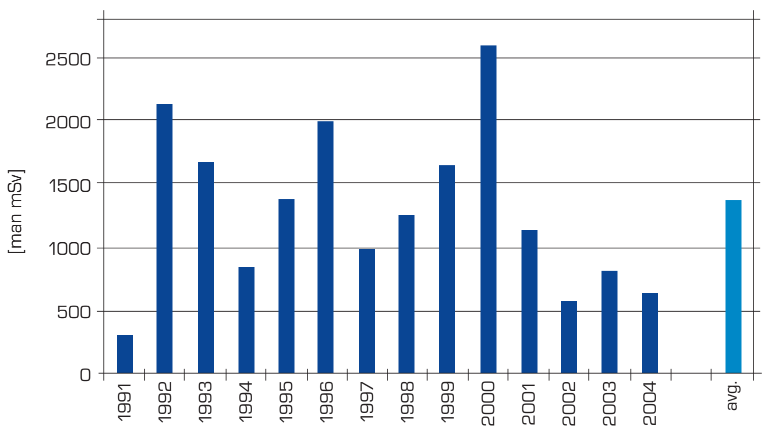


Figure 4: Collective exposure to radiation in the Krško NPP



The collective exposure to radiation, shown in Figure 4, is lower than the year before and under the average value. The value of the collective dose factor for the year 2004 was 688.52 man mSv, which is above the target value of INPO (650 man mSv for year 2005) and below the target value of NEK (700 man mSv for year 2004).

In Figures 5 and 6, the number of reactor shutdowns is shown.

Figure 5: Fast reactor shutdowns - manual and automatic

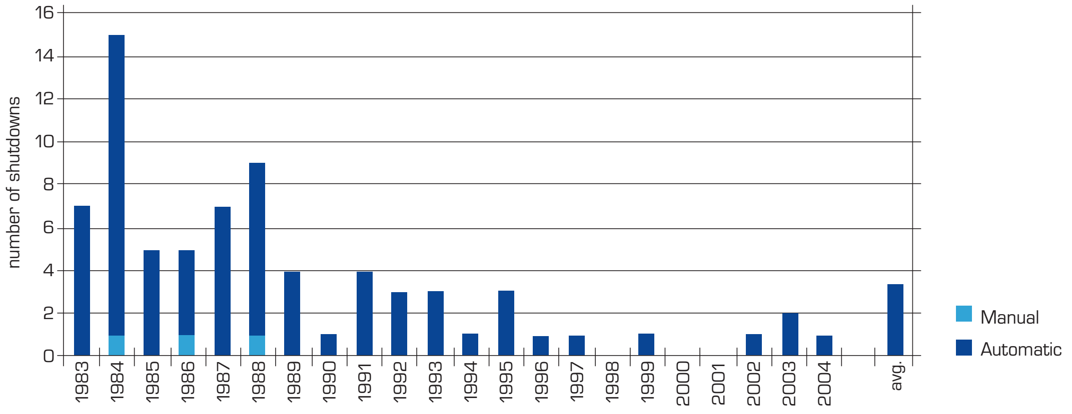
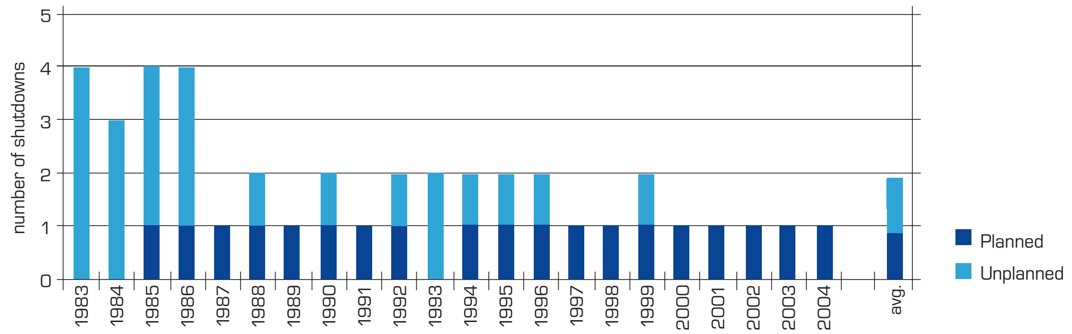


Figure 6: Normal reactor shutdowns - planned and unplanned



There are two types of reactor shutdowns: fast and normal. Fast reactor shutdowns are caused by the reactor protection system actuation, which can be activated manually or automatically. With normal reactor shutdowns the reactor power reduces gradually. Normal shutdowns are divided into planned and unplanned. An outage is a special type of normal, planned reactor shutdown. In the year 2004 there was only one fast, automatic reactor shutdown, which is below the average.

2.1.1.2. Reports of abnormal events in the Krško NPP

In 2004, the Krško NPP reported two abnormal events, during which the nuclear and radiological safety was not threatened. These events were the following:

- fire protection sprinkler water release in turbine building
- automatic plant shutdown due to human error during replacement of a failed rod control power supply

The shutdown event happened as described below.

Automatic plant shutdown due to human error during replacement of a failed rod control power supply
On 10 August 2004 at 18:32, the "ROD CONTROL NON-URGENT ALARM" was activated due to a control rod cabinet power supply malfunction. The failed main power supply was automatically replaced by the auxiliary power supply. Plant staff decided to immediately replace the failed main power supply with a spare one. Before the replacement, the spare power supply was tested for one hour at full load. The instrumentation maintenance team started to perform the replacement of power supply at 22:30. Since they used an unsuitable schematic drawing of power cabinet wiring, which did not conform with the actual wiring in the cabinet, they disconnected simultaneously the failed and the auxiliary power supply. The outcome was the drop of some control rods groups into the reactor core, which led to an automatic shutdown at 22:48.

The event did not jeopardize nuclear safety. All safety systems responses were adequate and there were no radiological releases to the environment. Plant operators followed appropriate procedures and practice before and after the shutdown and stabilized the plant in the hot standby mode. After the shutdown some of the valves which were inspected and improved during the outage in 2004, malfunctioned. After the shutdown the main power supply charger was replaced and the wiring repaired also in the other control rod cabinets. The operation of the plant was restarted the next day (11 August 2004) at 4:57.

The SNSA inspection survey and the Krško NPP event report have pointed out both human and management deficiencies in staff training. The Krško NPP report gave recommendations and offered possible improvements to avoid such events in the future. The plant did not adequately implement the international operating experiences relating to such events. The SNSA also performed an event root cause analysis and presented a list of corrective actions that should be performed by the regulator to prevent re-occurrence of such events.

The control rod system is not a safety system, but it has caused malfunctions and other events in the last few years, including plant shutdowns and control rod dropping into the core. Instrumentation staff training, the procedures applied and the documentation are not perfect. Instrumentation equipment in many cases operates beyond the factory warranted life time, and replacement of relevant equipment with original parts is impossible since this equipment is out of production. With regard to the instrumentation system, the SNSA inspection triggered a detailed survey and assessment of past malfunctions relating to nuclear safety. The Krško NPP presented a report which explains the causes for these malfunctions. In the report the Krško NPP also announced a strategy to suppress control rod system problems.
From the Krško NPP standpoint the event did not jeopardize nuclear safety.

2.1.1.3. Modifications in the Power Plant

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

Following proper administrative procedures, the SNSA approved 10 modifications on the facility, and agreed to 35 other modifications. For 17 modifications, NPP Krško found during the preliminary safety evaluation that there was no open safety issue, so it only informed SNSA about those changes. In the year 2004 SNSA also approved 5 changes of conditions and limits for operation which were the consequence of modifications in the power plant.

In the year 2004 Krško NPP issued the 11th revision of the Updated Safety Analysis Report in which all modifications confirmed until December 2004 were considered.

2.1.1.4. Periodic safety review in the Krško NPP

The Periodic Safety Review (PSR) in the Krško NPP is an up-to-date, mostly European method of comprehensive verification of the level of nuclear safety in the NPP. The method uses up-to-date safety standards and is implemented as a rule at least every ten years of NPP operation. The review encompasses the following safety fields: operational safety, safety evaluation and analyses, qualification of equipment, ageing of materials, safety culture, emergency preparedness, influence to the environment, treatment of radioactive waste and compliance with requirements of the operational licence.

In the year 2004, SNSA reviewed NPP Krško's PSR final report, which was delivered at the end of 2003. The report defines the areas where improvements are possible, especially for testing and maintenance procedures, control and supervision of safety-important systems, probability safety analyses and supervision of materials ageing.

The main finding of the final report is that there are no major safety deficiencies. The result of the review will be used for the planning and realisation of safety improvements in NPP Krško. Some of the deficiencies determined have already been removed, and the rest of them will be ranked in the action plan which will be approved in 2005.

The report contains 468 recommendations for plant improvements, of which 346 were considered to have a direct link to plant safety, while the other 122 issues were identified as a re-evaluation of the safety basis. The Krško NPP evaluated these recommendations and determined to perform 116 of them by the year 2010 or by the beginning of the new PSR cycle. The higher graded issues are linked to instrumentation and control of safety-important systems. In this area the Krško NPP already started making improvements in 2004. A lot of minor PSR recommendations, such as the update of procedures and organisational changes such as the separation of the Independent Safety Evaluation Group from the Engineering Department and putting it directly under the director general, have been already implemented. The higher graded issues, which arise from the re-evaluation of the safety basis, are linked to evaluation of probabilistic safety analysis of external events, like flooding of the Sava river frequency, the Sava river dam failure frequency and strong storms frequency.

2.1.1.5. Inspections

During the year 2004, the SNSA Inspection at the Krško NPP carried out 60 planned inspections, one unplanned inspection and one unannounced inspection. Inspectors were continuously present during the outage which lasted 29 days. The outage started on 4 September 2004 and was completed on 3 October 2004. Major activities during the outage were as follows: refuelling, maintenance activities, testing and implementation of modifications, all of which assures safe, reliable and stable operation of the NPP during the next, 18 month cycle.

The unplanned inspection was carried out immediately after the automatic shutdown on 10 August 2004. An inspection was carried out dealing with transportation of fresh fuel to the Krško NPP (56 new fuel elements) for the new core (cycle 21).

In the year 2004 no deviation requiring immediate measures was found by the inspectors.

2.1.2. Research Reactor TRIGA

2.1.2.1. Operation

The Reactor TRIGA Mark II of the Jožef Stefan Institute operated as a neutron source for experiments, and for education and training. In 2004 it operated 188 days and released 282 MWh of heat. Irradiations were performed in the carrousel and F-channels (1164 samples) and with the pneumatic post (432 samples). The reactor mostly operated in stationary mode. In pulse operation mode 26 pulses were performed. For special requirements of experiments, six core design changes were performed, as well as fuel shuffling in the core. In the year 2004 there were no abnormal events which could affect nuclear safety and no major failures of reactor components. The reactor TRIGA was normally used by researchers from different research groups of the Jožef Stefan Institute. Students of physics and postgraduate students of nuclear technology of the Faculty for mathematics and physics of the University of Ljubljana performed exercises on the reactor. About 400 visitors (foreign researchers, participants in courses, pupils from elementary and secondary schools) also visited the reactor.

In 2004, there were 202 planned and 11 automatic shutdowns. The number of automatic shutdowns decreased by 8 in comparison with the year 2003. Most of the unplanned shutdowns occurred due to a local electronic controller failure. Other shutdowns were caused by loss of power supply, exceeded power in linear channel and failure of bimetal protection of the pulse rod compressor. In order to suppress the failure of the local controller, an air-conditioning device has been installed to maintain the air temperature. These automatic shutdowns had no influence on nuclear safety.

2.1.3. The Central Interim Storage for Radioactive Waste at Brinje

The Central interim storage for radioactive waste at Brinje (CSRAO) is managed by the Agency for Radioactive Waste Management (ARAO).

In 2004 the reconstruction of the storage was finished. The works were performed in compliance with the construction permit. Additional work on the air vent was required by the Jožef Stefan Institute and some work was necessary due to previous imperfect design projects.

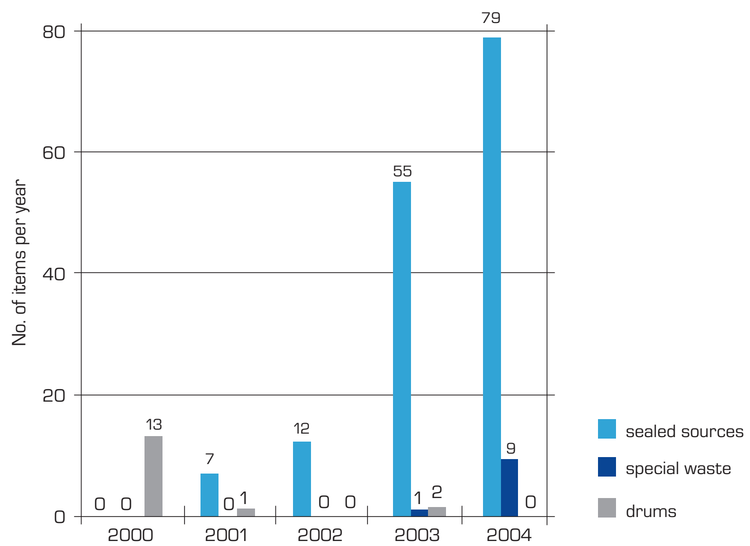
On 22 July 2004 an application for approval of starting a trial operation was put in by ARAO to SNSA. As a mandatory part of the application a safety analysis report was attached. SNSA requested an addendum and the report was re-delivered for approval in December 2004.

In 2004 ARAO accepted in the CSRAO radioactive waste from 25 users. 79 sealed radioactive sources and 9 pieces of special waste were accepted. As the CSRAO does not have an operation licence, each intake was approved by SNSA.

At the end of the year 2004, there were 256 drums with radioactive waste, 326 sealed sources, 149 pieces of special waste and 30 pieces of unspecified radioactive waste stored in CSRAO. The total activity of all waste amounted to 3.9 TBq.

In Figure 6 the record of accepted radioactive sources in recent years is presented. An increase is noticed, due to the licensing procedure according to new regulations and the decision that sources temporarily stored at users' premises are to be delivered to CSRAO.

Figure 7: Number of radioactive waste items annually accepted in the Central interim storage at Brinje.



2.1.3.1. Inspections

SNSA inspectors performed 9 planned inspections of ARAO and the Central interim storage for radioactive waste at Brinje. (CSRAO). The ARAO activities on the reconstruction of CSRAO were primarily inspected. The concordance of performed work with approved project was controlled.

In the course of planned inspections SNSA inspectors also dealt with regular ARAO activities with regard to performing their duty of dealing with radioactive waste. The inspections also concerned storage activities, training of employees for working in the storage, emergency preparedness and review of control of radioactivity of storage surroundings. The deficiencies and irregularities found in the course of these inspections were corrected by ARAO within the required time.

2.2. Radiation practices and the use of sources

The Act on Protection Against Ionising Radiation and Nuclear Safety recently introduced some changes on the administrative level, such as reporting an intention to carry out practices involving radiation or use of a radiation source, evaluation of protection of exposed workers against radiation, a permit to carry out a practice involving radiation and a permit to use a radiation source.

The nature and extent of a radiation risk for exposed workers, apprentices and students based on the evaluation of protection of exposed workers against radiation are determined in advance. In addition, a program of optimisation of radiation protection measures in all working conditions based on this evaluation is made in advance. The document must be prepared by the applicant, who is obliged to consult an approved expert in protection against radiation. If the applicant has insufficient knowledge and experience related to the field of radiation protection, the evaluation can be prepared by an authorised expert in this field. Presently, there are two authorised institutions in Slovenia: Jožef Stefan Institute and the Institute of Occupational Safety. In 2004 the Slovenian Radiation Protection Administration approved 127 evaluations in total.

2.2.1. Use of ionising sources in industry and research

Harmonisation in dealing with radioactive sources with legislation requirements continued in 2004. In order to achieve the goal, SNSA took suitable and reasonable measures to minimise economic threat to companies and nevertheless maintain radiation safety of citizens and workers. Therefore SNSA informed users of radiation sources of the new legal requirements through several means of communication, such as issuing the bulletin »Radiation News«, providing information on the SNSA website and sending letters to potential organisations carrying out radiation practice or users of radioactive sources. In 2004 most of the users reported intention to carry out practices involving radiation sources and to use radioactive sources. They also started an authorisation procedure in order to obtain a permit to carry out practices involving radiation.

Sevalne novice

Številka 1 maj 2004

Da bomo vsi vedeli več

Pred vami so novice, s katerim bo Uprava RS za jedrsko varnost izvajalce sevalnih dejavnosti, uporabnike virov sevanja, upravne organe in tiste, ki pri svojem delu lahko pridejo v stik s sevanjem, obveščala o dogodkih doma in po svetu, do katerih prihaja pri uporabi virov sevanja. S tem želimo uporabnikom in nam olajšati vsakdanje delo in razširiti naše upravno delovanje na področje preventive in svetovanja.

V posameznih številkah novic vas bomo sproti seznanjali tudi z novostmi s področja zakonodaje, ki ureja varstvo pred ionizirajočimi sevanji in izvajanje sevalnih dejavnosti.

Namen glasila je predvsem izboljšanje varnostne kulture pri delu z viri sevanja. Bolj ko se zavedamo, kako pomembna je skrbnost pri ravnanju z viri, manjša je verjetnost za morebitni neljub dogodek ali za veliko gospodarsko škodo. Opažamo pa tudi, da se v državi na tem področju marsikaj dogaja, da pa nimamo sistema, s katerim bi si med seboj hitro izmenjevali informacije. Vabimo vas, da nam pomagate z vašimi prispevki. Izdajali jih bomo občasno, ko se bo nabralo dovolj gradiva.

Uprava RS za jedrsko varnost je organ v sestavi Ministrstva za okolje, prostor in energijo. Zadolžena je za upravni nadzor jedrske varnosti pri upravljalcih jedrskih objektov ter za nadzor nad uporabo virov ionizirajočega sevanja v celotni državi, razen v medicini in veterini. Tam je za nadzor zadolžena Uprava RS za sevalno varnost (URSVS) pri Ministrstvu za zdravje. Obe upravi pa seveda delujemo po istih zakonih.

Andrej Stritar
Direktor URSJV

Upravne novosti

Letos sprejeti predpisi na podlagi ZVISJV:

Pravilnik o izvajanju zdravstvenega nadzora izpostavljenih delavcev (SV6); 15.01.2004

Pravilnik o obveznostih izvajalca sevalne dejavnosti in imetnika vira ionizirajočih sevanj (SV8); 12.02.2004

Pravilnik o pooblaščanju izvajalcev strokovnih nalog s področja ionizirajočih sevanj (SV7); 27.02.2004

Pravilnik o načinu vodenja evidenc o osebnih dozah zaradi izpostavljenosti ionizirajočim sevanjem (SV4); 6.04.2004

Uredba o sevalnih dejavnostih (UV1); 30.04.2004

Uredba o mejnih dozah, radioaktivni kontaminaciji in intervencijskih nivojih (UV2); 30.04.2004

Uredba o območjih omejene rabe prostora zaradi jedrskega objekta in o pogojih gradnje objektov na teh območjih (UV3);13.04.2004

Vsi že sprejeti podzakonski akti so dosegljivi na strani http://www.gov.si/ursjv/si/mps/podzakonski.php

Konec aprila pa je spremembe doživel tudi Zakon o varstvu pred ionizirajočim sevanjem in jedrski varnosti (ZVISJV). Večina sprememb je zaradi vstopa Slovenije v EU, bistveno drugačne pa so tudi kazenske določbe. Izšel je v Uradnem listu RS, št. 46/2004 dne 30.4.2004, neuradno prečiščeno besedilo pa dobite na naslovu http://www.gov.si/ursjv/si/mps/ZVISJV.doc

Milena Černilogar Radež
URSJV

Kovinske kapsule z radioaktivnimi snovmi Co-60 in Ir-192

Letošnje (neprijetne) novice iz soseščine

V Srbiji in Črni Gori so ukradli vir sevanja (Ir-192)

V Italiji so ukradli štiri vire sevanja (Ir-192), industrijsko rentgensko napravo in stalili ščiten vir sevanja (Cs-137)

Na Češkem so izgubili vir sevanja (Cs-137)

FOTOKOPIRANJE IN RAZMNOŽEVANJE JE DOVOLJENO IN ZAŽELENO!

In 2004, 70 permits to carry out practices involving radiation were issued, 188 permits to use a radiation source, 5 certificates of entry in the register of radiation sources, and 12 approvals issued to external operators of practices involving ionising radiation at the Krško Nuclear Power Plant. The valid licences issued in accordance with the law from the year 1984 will be progressively replaced by the new ones.

In 2004, 60 organisations in the Republic of Slovenia used approximately 130 X-ray devices in industry and research, most of them for industrial radiography and for cargo and luggage control. Approximately 490 sealed sources were used in 110 organisations, the majority of them in technological and automization processes, field measurements of density and humidity, and industrial radiography. Due to the delay in the reconstruction of the Central Interim Storage for Radioactive Waste in Brinje the unused ionising sources are accumulated at the users' storehouses. However, the number of these sources has decreased.

In 2004, the Institute of Occupational Safety performed 996 surveys in industry and medicine. Jožef Stefan Institute performed surveys of 28 radioactive sources in industry, two radioactive sources and three accelerators in medicine, four laboratories dealing with open radioactive sources, and 23 X-ray devices.

2.2.1.1. Interventions due to discovery of ionising sources

In 2004 SNSA inspectors carried out 10 interventions, compared to only three in 2003.

This increase is mainly due to greater supervision of SNSA over the use of ionising radiation sources in industry and research with the special emphasis on determining the current status of conduct of the radiation practices in the field. At the same time the number of regular preventive check-ups increased, amounting to more than 30. With the check-ups it was ascertained that numerous sources are no longer in use and that they are improperly stored.

Mistreatment of radiation sources can result in contamination of living space, unintentional radiation exposure of civilians or workers, and substantial economic damage. In all the 10 cases fast response was necessary in order to prevent unintentional radiation exposure of civilians or workers and/or substantial economic damage.

Three interventions related to an elevated recorded monthly dose of workers exposed to ionising radiation. In one case, the elevated dose was obtained when servicing smoke detectors containing ^{241}Am, and in two other cases the workers were overexposed when using moisture and density gauges (TROXLER probe). In all cases a number of irregularities were discovered in connection with safe treatment of radioactive sources. The doses recorded were elevated due to improper safety measures against radiation, and therefore the inspectorate issued a regulatory provision. During one of the interventions, contamination of the site with radioisotope ^{241}Am was also found. Four interventions related to mistreatment of spent disused sources. The SNSA inspectorate imposed delivery of the sources to the Central interim storage.

Other interventions related to radioactive sources found in scrap metal. Two interventions were performed in successful co-operation with the Maribor Customs, the branch office of Gruškovje. In these cases the customs representative upon the SNSA inspectorate proposal, banned the importation of shipments containing radiation sources. In one case the owner of the source found in scrap metal took care of the removal with the help of Agenca for Radwaste Management. The Agency also attended proper storage of the source in the Central interim storage.

2.2.2. Use of ionising sources in medicine and veterinary medicine

2.2.2.1. X-ray devices in medicine and veterinary medicine

According to data from the register of Slovenian Radiation Protection Administration (SRPA), 743 X-ray devices were used in medicine and veterinary medicine at the end of 2004. The categorisation of the X- ray devices based on their purpose is given in Table 2.

Table 2: Number of X-ray devices in medicine and veterinary medicine by purpose

Purpose	Status 2003	New	Written-off	Status in 2004
Dental	357	26	12	371
Diagnostic	258	20	18	260
Therapeutic	4	0	0	4
Simulator	2	0	0	2
Mammography	31	1	0	32
Computer Tomography CT	18	0	0	18
Densitometers	24	7	1	30
Veterinary	23	5	2	26
Total	**717**	**59**	**33**	**743**

On the basis of the reports of authorised organisations about X-ray devices, in 2004 SRPA started expanding its register of devices in eight categories: N - device procured in current year, A -

perfect device, AB - obsolete but technically satisfying device, B - device requiring servicing, C - device proposed for disuse, D - device disused in current year, P - device deteriorating on the day of survey and R - in reserve. During regular inspections SRPA requires from users the register of improved deficiencies for devices in category B and for devices in category C to stop using them.

24 permits to carry out a practice involving radiation were issued in 2004. In addition 67 permits to use X-ray devices in medicine and veterinary medicine were granted. 28 confirmations of evaluation of the protection of exposed workers against radiation were issued and 18 confirmations of the programme of radiological interventions. Four provisions requiring implementation of legally prescribed conditions for radiation practices and the use of ionising radiation sources were issued during the inspections to the General hospital Šempeter, the Orthopaedical clinic Ljubljana, the Health centre Škofja Loka and the General hospital Murska Sobota. Two X-ray devices were sealed up.

2.2.2.2. Unsealed sources in medicine

Seven hospitals or clinics in Slovenia use unsealed sources (radiopharmaceuticals) for diagnostics and therapy in nuclear medicine departments: the Medical Centre Ljubljana - the Department of Nuclear Medicine, the Institute of Oncology and general hospitals in Maribor, Celje, Izola, Slovenj Gradec and Šempeter near Gorica. In 2004, in nuclear medicine departments for diagnostics and therapy applied 10.292 GBq of isotope ^{99m}Tc, 1469 GBq of isotope ^{131}I, 300 GBq of isotope ^{133}Xe and minor activities of isotopes ^{67}Ga, ^{111}In, ^{18}F, ^{90}Y, ^{186}Re, ^{51}Cr, ^{125}I, ^{123}I, ^{153}Sm and ^{87}Sr.

No emergency events were reported to SRPA in 2004. The nuclear medicine departments are inspected twice per year by the Jožef Stefan Institute or the Institute of Occupational Safety, and until now no major deficiencies have been found.

3. Radioactivity in the Environment

3.1. Monitoring of environmental radioactivity

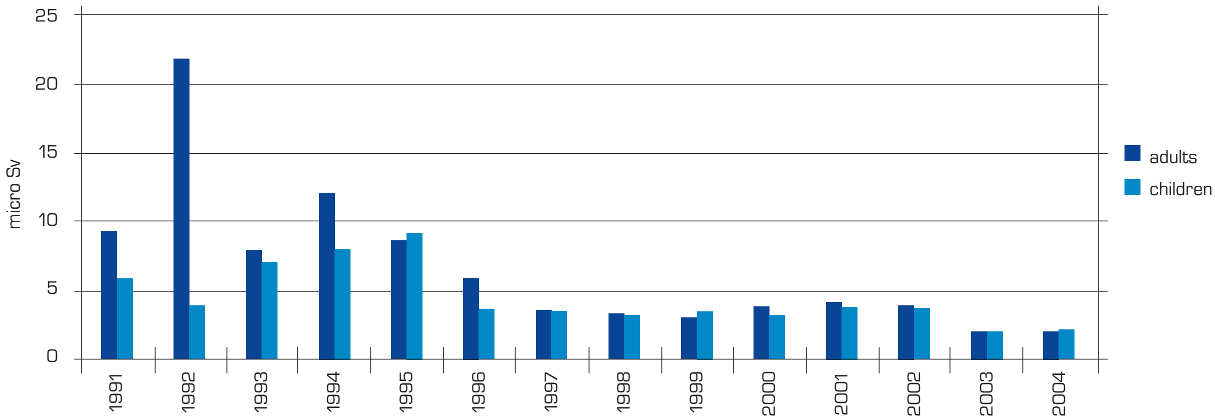
Monitoring of the global radioactive contamination due to the former atmospheric nuclear bomb tests (1951-1980) and the Chernobyl accident (1986) has been carried out in Slovenia for more than four decades. Above all, two long-lived fission radionuclides have been followed, namely ^{137}Cs and ^{90}Sr, which are measured in the atmosphere, water, soil and in the food chain. A part of the monitoring programme comprises also river water contamination with ^{131}I due to medical use of this radionuclide. In all samples also other gamma emitters are measured, as well as tritium ^{3}H in water samples. In 2004 radioactivity monitoring of feedingstuffs was not performed because the competent ministry did not provide financial resources to fulfil its legal obligations.

The results for 2004 showed that concentrations of both long-lived fission products in samples of air, precipitation, soil, milk and grass were further slowly decreasing and were mostly lower than before the Chernobyl accident. Only the specific surface activity of ^{137}Cs in the upper layer of uncultivated soil is still enhanced. On average, at the time of the Chernobyl accident approximately five times higher contamination (20-25 kBq/m^2) was measured in Slovenia compared to the contribution of all nuclear bomb tests in the past. The highest contamination of the ground was measured in the Alpine and forest regions, which caused enhanced contents of this radionuclide in forest fruits, mushrooms and game, and in Alpine milk and cheese. In 2004 no radioactive contamination of the environment was detected related to any nuclear or radiation event.

In 2004, the media informed the public about the contamination of the Slovene exports of the concentrate for blackberry juice. The story was initiated by the authorities of Serbia and Montenegro, who rejected an import of the blackberry juice produced by the Slovenian enterprise Fructal. It was found, however, that the concentration of the ^{137}Cs in juice was less than 30 Bq/l, while the European limit is 600 Bq/l. Consequently, the Slovenian authorities did not take any measures.

The biggest contribution to radiation exposure of members of the public comes from external radiation and from food ingestion, while the inhalation dose due to aerosols with fission radionuclides is negligible. In 2004 the effective dose to an adult from external radiation of ^{137}Cs was estimated to be 6.4 µSv, which is similar to previous years. The annual dose from ingestion (food and drinking water consumption) was 2.1 µSv, just like in the year before; the radionuclide ^{90}Sr accounted for 60% of the dose, while the contribution of ^{137}Cs was 40%. The annual contribution due to inhalation of both radionuclides was below 0.01 µSv, which is negligible if compared with radiation exposure from other transfer pathways. In 2004, the total effective dose to an adult individual of Slovenia arising from the global contamination of the environment with fission products was estimated to be 8.5 µSv, as shown in Table 3. This is approximately a three hundred times lower dose compared to the annual exposure from natural radiation in the environment (2500-2800 µSv). The effective dose for drinking water, taking into account natural and artificial radionuclides, was estimated. It was shown that the limit value of 0.1 mSv per year due to water ingestion from any local water supply was not exceeded.

Figure 8: Annual exposure of members of the public in Slovenia due to global radioactive contamination of the environment, taking into account the radionuclides ^{137}Cs and ^{90}Sr.



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

Table 3: Radiation exposure of the population in Slovenia due to global contamination of the environment in 2004

Transfer pathway	Effective dose [µSv/year]	
	Adults	Children (up to 12 years)
Inhalation (^{137}Cs, ^{90}Sr)	< 0.01	< 0.01
Ingestion: drinking water (^{137}Cs, ^{90}Sr) food (^{137}Cs, ^{90}Sr)	 0.04 2.1	 0.05 2.2
External radiation	6.4	6.4
Total in 2004 (rounded)	**8.5**	**8.6**

3.2. Operational monitoring

Each installation or facility that discharges radioactive substances into the environment is the subject of control according to the legislation. Radioactivity measurements in the environment have to be performed in pre-operational, operational and post-operational period. The goal of operational monitoring is to find out if the discharged activities are within the authorised limits, environmental specific activities inside the derived limits and also if the population exposures are below the dose constraints or limits. Radioactivity measurements follow the monitoring programmes approved by the competent authorities according to the operational conditions.

3.2.1. Krško Nuclear power plant

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

Radioactive discharges

Atmospheric discharges from the nuclear power plant differ with regard to how specific groups of radionuclides contribute to the exposure of population. Radioisotopes of noble gases of argon (Ar), krypton (Kr) and xenon (Xe) are monitored, radionuclides tritium ^{3}H and carbon ^{14}C, beta- and gamma-emitting aerosols (isotopes of cobalt (Co), caesium (Cs), strontium (Sr), etc.), as well as iodine isotopes in different chemical forms. In 2004 the total released activity of noble gases (0,15 TBq) was less than 2% of the limit, while the released activities of iodine isotopes and aerosols were even lower (less than 0.05% of the limit).

In liquid discharges from the plant to the Sava river the activity of tritium (^{3}H, abbreviated as T) in the form of water (HTO) prevailed in 2004, with 10.8 TBq. The discharged activity of fission and activation products was more than a thousand times lower, i.e. 0.24 GBq or 0.12% of the limit value, while the activity of alpha emitters was under the detection limit.

Environmental radioactivity

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

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

None of the environmental measurements showed the presence of radionuclides that could be attributed to atmospheric discharges from the nuclear power plant. Measured radioactivity of radionuclides ^{137}Cs and ^{90}Sr in water samples, precipitation, soil, sediments and foodstuffs is a consequence of global contamination and is not a result of the nuclear power plant operation. On the contrary, a direct impact of liquid discharges was indicated as higher concentrations of tritium ^{3}H downstream the plant. Concentration of tritium of 1.6 kBq/m^3 was measured at Krško upstream the plant, and at Brežice downstream the plant, the value of 4.0 kBq/m^3 was obtained. The limit value, prescribed with the governmental decree, is 7400 kBq/m^3 (as derived concentration for drinking water). Concentrations of other artificial radionuclides discharged to the Sava river (^{58}Co, ^{60}Co, and others) were measured below the detection limits in all samples. The concentrations of radioisotope ^{131}I in the Sava river downstream the plant were caused by discharges from the clinics of nuclear medicine in Ljubljana and Celje, not by the nuclear power plant operation. The annual average concentration upstream, at Krško, was 12 Bq/m^3 and downstream, at Brežice, 9 Bq/m^3. Radioactive iodine ^{131}I was measured also in fish samples (between 0.1 and 0.8 Bq/kg) and in sediments upstream and downstream the plant. In tap waters and water intakes no impacts due to the nuclear power plant were detected.

The dose assessment of the public was based on a model calculation. The calculated dispersion factors for atmospheric discharges, based on real meteorological data, showed that for the public exposure assessment, external radiation from the cloud and deposition has to be considered, as well as inhalation of tritium and ^{14}C and ingestion of food with ^{14}C; these are the most important exposure pathways. The highest annual dose (less than 1 μSv) is received by individuals due to ^{14}C intake with milk ingestion (children) and cereals (other age groups), and a little lower dose is received due to inhalation of tritium (HTO) and ^{14}C. The calculation on liquid discharges in 2004 equally showed their low contribution to the population dose: it was about 0.1 μSv. The levels of external radiation in the vicinity of the installation (on-site) are higher than in the surroundings, but they are not measurable at large distances and are estimated as negligible (order of magnitude 0.1 μSv per year). This estimation is much lower than in recent years but it is now based on realistic data.

From Table 4 it is clear that the total effective dose for an individual living in the surroundings of the Krško nuclear power plant is around 1 μSv per year (single dose contributions must not be summed because they are not additive). This figure is an order of magnitude lower than those obtained in the previous years and represents about 2 percent of the authorised dose limit (50 μSv) and equals less than a half of a thousandth of the dose received by an average Slovenian from natural background radiation (2500-2800 μSv).

Table 4: Assessment of partial exposures of the adult member of the public due to atmospheric and liquid radioactive discharges from the Krško NPP in 2004

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

3.2.2. Research Reactor TRIGA and the Central Storage of Radioactive Waste in Brinje

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

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

Measurements of radioactive aerosol discharges into the atmosphere showed results below the detection limit, while in liquid discharges - from the laboratory of the Jožef Stefan Institute - two radioisotopes ^{22}Na and ^{137}Cs were identified, both of the order of 0.1 MBq per year. No radioactive contamination due to reactor operation was detected by environmental measurements. Taking into account the average continuous power of the reactor operation and the annual decreasing trends of radioactive discharges from the waste tank used by the laboratory of the Jožef Stefan Institute, the exposure of population in 2004 was estimated to be similar as in previous year. The external immersion dose due to ^{41}Ar discharges to the atmosphere was estimated by a model calculation to be approximately 0.26 μSv per year. A conservative assumption was used for dose assessment to individuals from the population for liquid discharges: if river water is ingested directly from the recipient river (Sava), the annual exposure is less than 0.01 μSv, which is three times lower than in the previous year. The total annual dose (0.27 μSv) to the individual from the public equals to that from 2003 and reaches only 0.03% of the general dose limit (1000 μSv) or one ten thousandth of natural background radiation in Slovenia (about 2500-2800 μSv).

The Central storage of low and intermediate radioactive waste at Brinje was reconstructed in 2004, which led to a decrease of radioactive discharges into the environment, i.e. to the atmosphere and to the surface and underground water as well. Monitoring of environmental radioactivity of the Central storage of radioactive waste at Brinje comprised control measurements of radioactive atmospheric discharges (radon and its short-lived progeny from the storage as the consequence of the stored ^{226}Ra sources), radioactive waste water (partly from the old tank and partly from the newly built drainage collector) and direct external radiation (on outside walls of the storage). In the same extent as in previous years, environmental concentrations of radionuclides were measured in underground water (well water), the Sava river sediment, in soil nearby the storage and external radiation (at several distances from the storage) as well.

After the reconstruction of the storage, the radon releases into the environment decreased from the former annual average value of 75 Bq/s to 52 Bq/s. Enhancement of radon ^{222}Rn concentrations in the vicinity of the storage was estimated by a model for average weather conditions, and equals to 7.6 Bq/m^3 at the distance of 30 m and to about 3 Bq/m^3 at the distance at 50 m, i.e. at the fence of the Reactor centre. In waste water from the drainage collector the radionuclide ^{241}Am was detected for the first time; it is supposed to be a consequence of cleaning the storage after the reconstruction. Contamination with this radionuclide originated from keeping and handling with radioactive smoke detectors in the past. In underground water none of the radionuclides attributed to the storage operation was detected. In the river sediments only ^{137}Cs as a remnant of Chernobyl contamination was found, thus being different from previous years, when short-lived radionuclide ^{131}I from sewage discharges into the river was detected as a consequence of patient treatment with high administered activity.

For dose assessment of the most exposed members of the public only inhalation of radon decay products and direct external radiation were taken into account. The novelty of the assessment in 2004 was that a new reference group was introduced, namely employees of the reactor centre who are potentially under the impact of radon releases from the storage. According to the calculation the highest dose was received by this group in 2004, namely 4 µSv (the annual effective dose from natural background in the country is 2500-2800 µSv). The security officer received 2 µSv due to his regular rounds, while the annual dose to the farmer at the fence of the controlled reactor aera was estimated to be only about 0.1 µSv. These values are lower than in previous years (7 µSv and 0,3 µSv per year), mostly due to lowering of radon releases, lower dose conversion coefficients in accordance with the new regulations, and taking into account the actual prevailing wind directions.

3.2.3. Žirovski vrh uranium mine

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

Concentrations of radionuclides in some environmental media have decreased after the cessation of mine operation. The differences are the most evident in lower values of long-lived radionuclides in air and surface water radioactivity, and they have been observed also for radon concentrations. Radioactivity of the surface waters in both streams in the last years is slowly but steadily decreasing, especially ^{226}Ra concentrations in Brebovščica, in the main recipient stream, which are close to the natural background level. Only uranium concentrations in the Brebovščica stream (155 Bq/m^3) have increased, because all liquid discharges from the mine and from the disposal sites flow into it. Radioactivity of sediments in the Brebovščica and Todraščica streams is still 2 to 3 times higher than in the Sora, the recipient river. Average concentrations of radon ^{222}Rn in the surroundings of the mine (at Gorenja Dobrava) were between 25 and 30 Bq/m^3, i.e. by 5 to 9 Bq/m^3 higher than a long term value concentration at the reference point outside the influence of the mine (about 20 Bq/m^3). In the last years the mine's contribution of radon was about 5 Bq/m^3 (2001: 5.1 Bq/m^3, 2002: 5.4 Bq/m^3, 2003: 8.4 Bq/m^3). In 2004 the average value of radon contribution was 5.4 Bq/m^3. The enhanced concentrations have been very rarely measured in food products, but it is reported that the concentrations in the grass from the farmland around the mine is higher, especially in the grass from the pile slopes. The contents of the radionuclides ^{226}Ra and ^{210}Pb in grass exceed the level of 100 Bq/kg, while the normal values are scattered around 1 and 10 Bq/kg respectively.

Calculation of the effective dose to population takes into account the following exposure pathways: inhalation of long-lived radionuclides, radon and its short-lived progeny, ingestion (intake with food and water) and external gamma radiation. Radiation exposure of the population living in the vicinity of the mine was estimated to be 0.19 mSv in 2004. This value is somewhat lower than in previous years, and is partly attributed to the lower dose conversion factor for the radon and its short-lived progeny, according to the Regulations on conditions andt methodology for dose assessment (Off.J. RS No. 115/03). If the previous conversion factor is used, this would increase the estimated dose for 2004 to about 0.22 mSv, which is similar to the one in 2001-2002. The most important radioactive contaminant of the mine environment was still radon with its short-lived progeny, which contribute almost three quarters of additional exposure (Table 5).

Table 5: Effective dose to population in the surroundings of the former uranium mine at Žirovski vrh in 2004

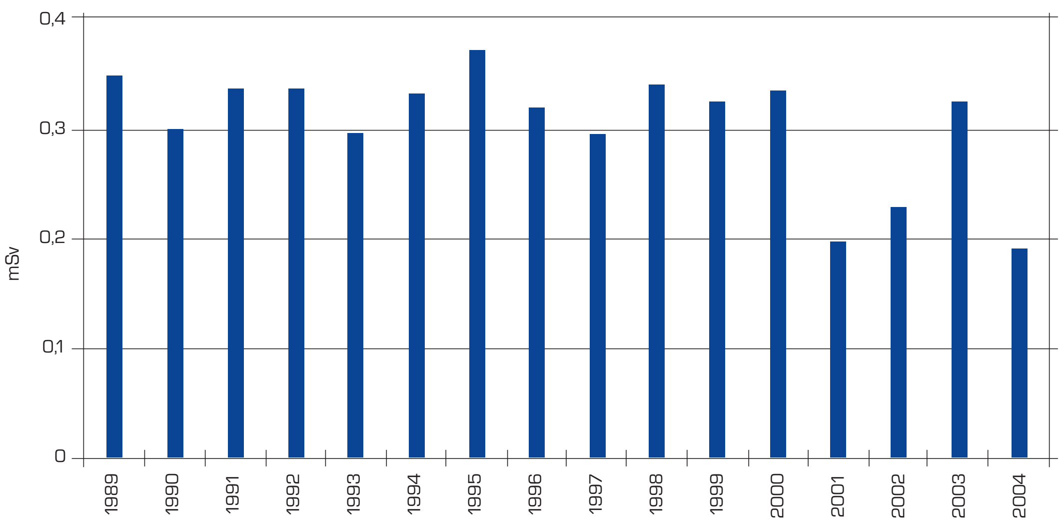
Transfer pathway	Important radionuclides	Efective dose [mSv]
Inhalation	• aerosols with long-lived radionuclides (U, ^{226}Ra, ^{210}Pb) • only ^{222}Rn • Rn - short-lived progeny	0.005 0.004 0.160*
Ingestion	• drinking water (U, ^{226}Ra, ^{210}Pb, ^{230}Th) • ribe (^{226}Ra, ^{210}Pb) • local food (^{226}Ra in ^{210}Pb)	(0.0125)** 0.0008 < 0.016
External radiation	• immersion and deposition of radon progeny • deposition of long-lived radionuclides • direct gamma radiation from disposal sites	0.001 - 0.002
	Total effective dose for 2004 (rounded):	**0.19 mSv**

* According to the methodology of ICRP 50, 1988, the estimated effective equivalent dose is 0.186 mSv.

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

The total effective dose due to contribution of the former uranium mine reached one fifth of the general limit value for the population in 2004: this figure represents about 8 percent of the annual dose due to natural radiation background in Slovenia (2.5-2.8 mSv) and less than 4 percent of natural background dose in the Žirovski vrh environment (5.5 mSv). Annual changes of effective doses due to the mine contribution are shown in Figure 9.

Figure 9: Annual contributions to the effective dose of population due to the Žirovski vrh Mine.



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

3.3. Early warning system for monitoring radioactivity in the environment

A complex automatic early warning system for radioactivity measurements was established in the Republic of Slovenia more than a decade ago. Its aim is immediate detection of increased radiation and it is one of the key elements in the system of alarming and taking measures when an accident with radioactive releases to the environment occurs. During such accidents the levels of external radiation and concentrations of radioactive particles in the air increase, and the deposited radioactivity causes contamination of drinking water and food. For on-line measurements of external radiation 43 automatic dose rate measuring stations were set up, operated by the Krško nuclear power plant, the Environmental Agency of the Republic of Slovenia, the Slovenian Nuclear Safety Administration (SNSA) and each of the thermal power plants. The data are collected at the SNSA, and they are currently analysed and archived, and are available on the Internet. At any increased measured levels the relevant alarm is triggered.

In 2004 no events occurred that would trigger an alarm due to increased radiation in the environment.

From 1997 onwards, data have been regularly sent from the SNSA to the European system EURDEP at the Joint Research Centre, Ispra (Italy), where data from most of the European national networks of early warning are being collected. Slovenia has thus also gained access to the on-line data of external radiation of all participating countries. Our data are exchanged also with the Austrian Centre in Vienna and the Croatian Centre in Zagreb, and they are also sent to the Hungarian Centre in Budapest.

In 2004 the SNSA and the Environmental Agency of the Republic of Slovenia jointly prepared a project of upgrading and modernisation of the early warning system. The project was approved by the European Commission and will be financed from the Phare programme. 35 new dose rate measuring stations will be installed, the locations will be equipped with the precipitation monitors, and some of them also with complete meteorological stations. Data transfer, visualisation and analyses of the incoming data, and the mode of alarming in the case of increased dose rate values will be substantially improved. It is expected that the project will be realised by the end of 2005.

3.4. Radiation exposures of population in Slovenia

Every inhabitant of the world is exposed to natural and artificial radioactivity in the environment, a great part of the population receives radiation doses from radiological examinations in medicine and only a small part of population is occupationally exposed due to work with the sources or work in a radiation field. Humans are exposed to external and internal radiation. External radiation means that the source is located outside the body. Internal radiation, on the other hand, occurs if radiation material enters the body by means of inhalation, ingestion of food and drink or through the skin. The population of Slovenia receives various radiation doses from different sources. The data on population exposure are presented in the following subchapters while the occupational and medical exposures are presented in Chapter 4.

3.4.1. Exposure to natural radiation

Exposure to natural radiation is caused by the radioactivity of rocks on the Earth and by radiation coming from space (cosmic rays). According to the data of the United Nations Scientific Committee on Effects of Atomic Radiation (UNSCEAR), the average annual effective dose from natural sources to a single individual is 2.4 mSv, ranging from 1 to 10 mSv. From the existing data on external radiation and radon concentrations in dwellings and outdoors it can be concluded that this value in Slovenia is somewhat higher than the world average, i.e. about 2.5 to 2.8 mSv per year. About 50% of this is due to internal exposure as a consequence of inhalation of radon and its progeny (1.2-1.5 mSv per year) in dwellings. The dose amount due to intake of food and water equals to about 0.4 mSv. The annual effective dose of external radiation originating from soil radioactivity, building material in dwellings and from cosmic radiation together was estimated at 0.8 to 1.1 mSv.

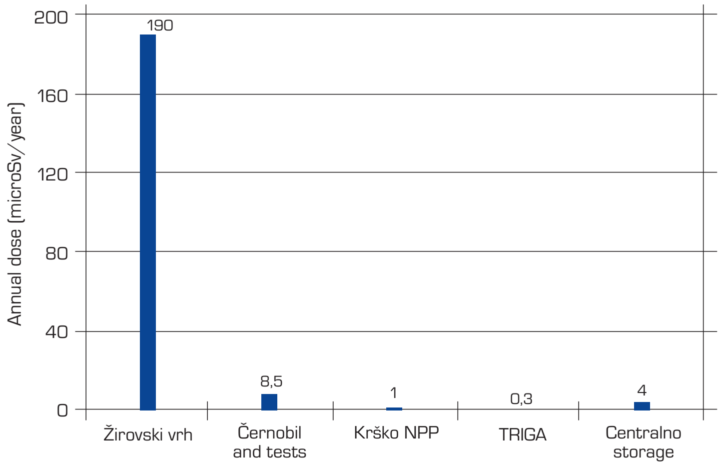
3.4.2. Population dose due to global contamination

Particularly people from the Northern Hemisphere are still exposed to ionising radiation from global contamination of the environment as the consequence of past nuclear bomb tests and the nuclear accident in Chernobyl. The last estimation of this exposure showed that in 2004 the average individual dose to the population from this source in our country was near 9 μSv. The biggest contribution comes from external radiation, while the exposure due to intake of food and water was estimated at only 2 μSv. Due to lower contamination of the ground with ^{137}Cs the population in urban areas is less exposed as the one in rural environment.

3.4.3. Population dose due to human activities

Radiation exposures due to the regular operation of nuclear and radiation installations are usually attributed only to local population. Exposures of particular groups of population originating from radioactive discharges from these objects are described in the chapters on operational monitoring. In Figure 10 the annual individual doses are given for the adults of the reference groups of population living in the vicinity of nuclear and radiation installations in Slovenia. For comparison, also an average annual dose for individuals related to global radioactive contamination of the environment (nuclear tests and Chernobyl accident) is shown. The highest exposures of the population are observed for individuals living in the surroundings of the former uranium mine at Žirovski vrh, being slightly below one tenth of the exposure due to natural sources.

Figure 10: Population exposures due to the operation of installations discharging radioactivity to the environment, and due to global contamination in 2004 (annual dose limit for the population is 1000 μSv, natural background is 2500-2800 μSv).



The population is to some extent exposed also due to some other human activities. These are exposures from deposited materials with enhanced natural radioactivity originating from the past industrial or mine activities, related mostly to mining and processing of raw materials containing uranium and thorium (in Slovenia: mining and processing mercury ore, processing of bauxite, phosphates, coal combustion). Data exist on various types of materials, about their amounts, and higher contents of natural radionuclides. However, the dose assessment has not been sistematically estimated due to insufficient data. The only exception is the Šoštanj thermal plant operation: environmental radioactivity monitoring for last year has shown that individuals of the surrounding population received about 6 μSv.

3.5. Research studies

3.5.1. Radioactive contamination of the Alpine region of Slovenia as the consequence of the Chernobyl accident and bomb tests

Radioactive contamination of the environment is a result of the former atmospheric nuclear bomb tests and the nuclear accident in Chernobyl. In Slovenia, mostly regions with high annual precipitation were affected such as the Alpine highland region (northwestern part). As it can be seen from the results of radioactivity monitoring, especially soil and milk from the regions of Bovec and Kobarid were highly contaminated with long-lived radionuclides ^{137}Cs and ^{90}Sr. For the territory of Slovenia it was estimated that contamination with ^{137}Cs amounted to about 20-25 kBq/m^2.

The research work was performed by the Institute of Occupational Health and comprised above all samples from highland pastures and other grassy areas of the Alps within heights of 1000-2000 metres. The highest surface contamination with the radionuclide ^{137}Cs was measured at Mangartsko sedlo and amounts to 72 kBq/m^2 (108 kBq/m^2 at the time of accident, April 1986), followed by the location of Vršič with 43 kBq/m^2 (primarily 65 kBq/m^2). For comparison, measurements in 2002-2004 showed in the upper layer of soil (0-5 cm) that on average Slovenia is contaminated with only 3 kBq/m^2. The highest level of the radionuclide ^{90}Sr was also measured at Mangartsko sedlo (0.45 kBq/m^2), while a typical level for the upper layer of 0-5 cm elsewhere in the country amounts to only 0.04-0.1 kBq/m^2.

Radioactive contamination of grass from highland pastures with ^{137}Cs was 4-12 Bq/kg (country average 0.3-1.3 Bq/kg). Consequently, its concentration in milk is enhanced: the measured values were 1-2 Bq/l or for an order of magnitude more than the Slovenian average (0.1-0.2 Bq/l). Cheese of sheep contains 1.8 Bq/kg compared to the common value of Slovenian cheeses, which is only 0.1-0.2 Bq/kg. A relatively high content of ^{137}Cs was found in mushrooms (50-80 Bq/kg) from mountain pastures of Zajamniki and Javornik. Contamination of bio-indicators shows much higher values: in lichens values of 700-900 Bq/kg were measured and in pine-needles from 200 to 500 Bq/kg.

The research work showed that our Alpine regions are by at least one order of magnitude more contaminated with ^{137}Cs than the region of Central Slovenia and this holds true for both the ground and for food products (milk, cheese). Some individuals from the local population may receive (via the ingestion pathway) about ten times higher doses than the major part of Slovenian inhabitants, i.e. a few tens of microsieverts per year. This is still very low, since it represents only 1 percent of the annual exposure due to natural radioactivity of the food and about 0.2-0.3 percent of the annual limit for members of the public.

3.5.2. Radioactivity of lake waters and sediments in Slovenia

In Slovenia there have been no data on radioactivity of lake waters until now, since regular environmental monitoring of radioactivity does not foresee such measurements. The research performed by the Jožef Stefan Institute comprised 19 lakes, including glacier lakes (Bohinj and Bled), a tourist lake (Jezersko), swamp lakes (Podpeč and Ribnica na Pohorju), industrial lakes (Velenje and Kočevje), periodic lakes (Cerknica and Idrija), an artificial littoral lake with fresh water (Fiesa), and agricultural lakes (Pernica, Ledava stream, Slivnica, Braslovče, Šmartno near Celje). Concentrations of the Chernobyl radionuclide ^{137}Cs and natural radionuclides ^{3}H, ^{7}Be, ^{210}Pb, ^{226}Ra, ^{228}Th and ^{238}U were determined in lake water.

By far the highest concentration of the fission product ^{137}Cs was measured in the Ribnica Lake (Pohorje), namely 34 Bq/m^3 (the derived/permissible concentration for drinking water is 10.000 Bq/m^3). The shallow swamp lake lies on impermeable ground which prevents further migration of radionuclides. The second highest concentration was found in the Alpine lakes and the Velenje lake, with 0.8 Bq/m^3. The remaining lakes contain only 0.3 Bq/m^3 of this radioisotope or even less.

With regard to natural radionuclides, the highest concentrations were measured for those two radionuclides that are steadily washed out from the atmosphere, i.e. ^{7}Be and ^{210}Pb. The highest value of ^{7}Be was measured in the Ribnica lake (Pohorje), namely 200 Bq/m³ (the derived/permissible concentration for drinking water is 5 MBq/m³), and the smallest one in the periodic lakes of Idrija (Divje jezero) and Cerknica (3 Bq/m³). The maximum concentration of ^{210}Pb was found in the Ribnica lake (15 Bq/m³), followed by the industrial lakes of Velenje and Kočevje with 8 Bq/m³, while the remaining lakes have concentrations of about 2 Bq/m³. The derived/permissible concentration for drinking water is 200 Bq/m³.

In the scope of the ecological monitoring of the Šoštanj thermal power plant the ERICo institute Velenje measured high concentrations of 40K in the Velenje Lake - of about 1000-2000 Bq/m³ (only 92 Bq/m³ in this research); this is the usual indication that coal ash is present. A rather high value was found for the artificial littoral lake in Fiesa (540 Bq/m³), probably due to the mixing of fresh lake water with the sea water. Typical values in the rest of the lakes are lower, reaching 10-30 Bq/m³. The derived/permissible concentration for drinking water is 22,000 Bq/m³.

Radionuclide ^{226}Ra reaches the highest concentration in both industrial lakes (Kočevje with 24 Bq/m³; Velenje with 29-44 Bq/m³, in this study only 11 Bq/m³) and in Fiesa (17 Bq/m³). The derived/permissible concentration for drinking water is 480 Bq/m³. In other lakes the measured levels were between 2 and 5 Bq/m³. Most of uranium in dissolved form was found in the Kočevje lake (^{238}U: 94 Bq/m³), while in other lakes only a few Bq/m³ (the derived/permissible concentration for drinking water is 3000 Bq/m³). Tritium concentrations (^{3}H) are similar in all lakes: deviations from the average value of 1400 Bq/m³ are small. Similar ^{3}H levels were found also in surface waters and in precipitation. The derived/permissible concentration for drinking water is 7.4 MBq/m³.

The results obtained in this research represent the most complete data collection on radioactivity of lake waters in Slovenia. Radioactivity of the majority of lakes is higher than in surface running waters; this holds especially for concentrations of natural and artificial radionuclides in industrial lakes, in the swamp lake at Pohorje, and in the littoral lake at Fiesa. All values are far bellow the derived concentrations for drinking water as prescribed by the regulations on limit values.

3.5.3. Identification of the TENORM due to past and present activities in Slovenia

Technologically modified materials, containing natural radioactive substances in enhanced concentrations (abbreviation TENORM) drew much attention among the professionals and competent authorities in the last years. Also in the new Act on radiation protection and nuclear safety this issue is considered with great attention.

The researchers (Jožef Stefan Institute) collected a great deal of data on radioactivity of technological and raw materials from the available reports on research works and studies related to this field. They also used historical written documents on the former mining and industrial activities, tried to find relevant locations in the field, took samples and performed analyses. The data related to the deposited materials from the past industrial activities are presented in the report, namely on residues of the processed mercury ore in Idrija, phosphates at Hrastnik, coal at Kočevje and Kanižarica, uranium tailings at Žirovski vrh, red mud from bauxite processing at Kidričevo, slag from iron factories at Jesenice and Ravne, and tube scales of crude oil at Lendava; the present activities are also reported, such as coal ash production at the thermal power plants at Šoštanj, Trbovlje and in Ljubljana, and TiO^2 production at Celje. Within this set of present activities with materials containing enhanced natural radioactivity in the country, the use of zircon minerals (coating in ceramic industry and in production of dishes, coating of melting ovens) and the use of welding electrodes with addition of thorium were identified.

Identification and making an inventory of TENORM provided a precise delimitation of old burdens from the past activities and materials with technologically enhanced natural radioactivity still produced nowadays. In Slovenia most of such deposited waste material consists of deposited coal ash (about 30 million tonnes), red mud (6.5 million tonnes) and iron slag and mercury ore residues (1.5 million tonnes and 1 million tonnes respectively). As regards the mass amount of deposited radioactive material, also uranium mine waste from Žirovski vrh (3.5 million tonnes) can be classified into this category. The highest content of radionuclide ^{226}Ra is contained in the uranium tailings (8600 Bq/kg) and, in spots, in coal ash from Kočevje and Kanižarica (up to more than 2000 Bq/kg), while other materials are much less radioactive (mostly about 400 Bq/kg of ^{226}Ra). Some TENORM are deposited in the controlled area of an enterprise and others on areas accessible to the public.

If we compare the radionuclide contents in our TENORM to the levels elsewhere in Europe or in the world, we find that radioactivity of our materials is mostly lower, with the possible exception of coal ashes from the south of Slovenia and mercury ore residues at Idrija. This study provided the input data for model studies in order to evaluate the radiological impacts to workers and to the public. The present rough estimates show a small probability that population exposure due to TENORM exceeds the value of 10 μSv per year.

4. Radiation Protection of Workers and Medical Exposures

4.1. Occupational exposure to ionising radiation

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

4.1.1. Individual exposures

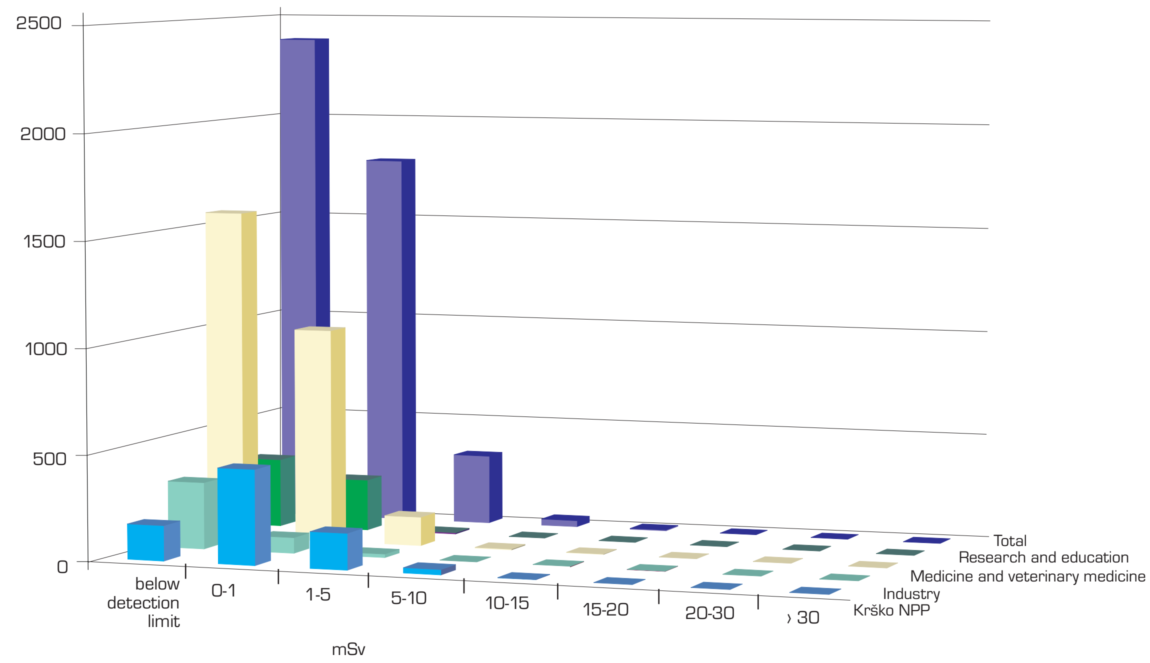
The Slovenian Radiation Protection Administration (SRPA) manages the central register of individual exposures to radiation. All approved dosimetry services regularly report to this register for all exposed workers on external exposure on a monthly basis and for internal exposures due to radon semi-annually and annually.

The approved dosimetry services are the Institute of Occupational Health (ZVD) and the Jožef Stefan Institute (JSI). Limited approvals were granted to the Krško Nuclear Power Plant (only for external radiation) and to the Žirovski vrh mine (internal dosimetry for workplaces in mines). Currently 6,350 persons have their records in the central register, including those who stopped using sources of ionising radiation in previous years. In 2004, the dosimetric service at the ZVD performed measurements of individual exposures for 3,200 workers employed at around 700 enterprises. The Jožef Stefan Institute monitored the exposures of 542 radiation workers. The average annual effective dose was the highest at workers with industrial radiography, namely 1.21 mSv, while the employees in medicine received on average 0.45 mSv. The largest values for these, 0.94 mSv, were recorded at brachytherapy workers. The Krško NPP performed dosimetric control only for their staff and for outside workers, i.e. altogether for 815 workers, where the average annual effective dose was 1.06 mSv.

In 2004, no worker received an effective dose above the limit value of 20 mSv. The distribution of workers in different branches is shown in Figure 6.

The highest collective dose received by radiation workers employed in the Krško NPP and in medical institutions was 0.688 and 0.524 manSv, respectively. Exposures in industry and research are lower for an order of magnitude, i.e. 0.106 and 0.034 manSv, respectively.

Figure 11: Number of workers in different branches distributed according to dose intervals



At the Žirovski vrh Mine the largest annual individual dose was 5.93 mSv, and the average for a group of 102 workers was 2.1 mSv. The collective dose was 0.215 manSv.

The SRPA regularly controls occupational exposure to radon also in other mines and tourist caves.

In the Postojna cave, in 2004, 25 workers (out of 91 in total) received an effective dose above 6 mSv. The collective and average doses were 0.353 manSv and 3.9 mSv, respectively.

In the lead and zinc mine at Mežica the maximum effective dose received in 2004 by a single worker was 3.6 mSv. The average individual dose of 0.76 mSv was calculated for a group of 24 workers.

In the Idria mercury mine in closure there were 43 exposed workers in 2004. Eight of them received an effective dose above 1 mSv; however, no dose above 5 mSv was recorded. The collective and average doses were 0.028 manSv and 0.65 mSv, respectively.

4.1.2. Training

On 27 February 2004 a Regulation on Responsibilities of Organisations Carrying Out Radiation Practice and Users of Sources of Ionising Radiation (Off. Gaz. RS 13/2004) was put into force.

The Regulation determines the education required for exposed workers depending on the level of difficulty of the practice, and the extent and frequency of training in ionising radiation protection. Education of workers using sources of radiation is in accordance with regulations. Training of radiation workers is carried out by the approved technical support organizations, namely the Institute of Occupational Health and the Jožef Stefan Institute.

In 2004 two certificates were issued for programmes of training in ionising radiation protection at Krško NPP. Altogether 930 participants attended courses in ionising radiation protection.

4.1.3. Medical surveillance

Medical surveillance of radiation workers in 2004 was performed by five approved occupational health institutions: the Clinical Institute of Occupational, Traffic and Sports Medicine, Ljubljana, the Institute of Occupational Safety, Ljubljana, Aristotel Llc., Krško, the Health Centre Krško, and the Health Centre Škofja Loka. Altogether 2,872 medical examinations were carried out.

4.2. Medical exposures

Protection against radiation, besides occupational exposure of workers and individuals, covers also a third major group of population. These are numerous patients subject to X-ray and radioisotope medical investigations for diagnostic purposes.

In 2004 SRPA continued a project of setting up a system of diagnostic reference levels at standard diagnostic radiological procedures. The aim of the radiological procedure programmes is to improve the medical exposure control of patients and the quality of radiological procedures. Besides this, SPRA has carried out a comparison of classical and digital radiography in order to improve quality assurance when using digital radiography.

Diagnostic radiology is the main reason for the high exposure of population to artificial sources of ionising radiation. About 15% of the total dose received by an average European is due to medical use of ionising radiation. Leaving aside the natural sources, diagnostic radiology contributes almost 90% to the collective dose of the public. In Slovenia the data on medical exposure of patients are incomplete. To overcome this deficiency, SRPA in 2003 funded the setting up of a programme of radiological procedures. In 2004 continuation of the programme took place to enable radiation dose assessment for the population due to medical examinations at specific institutions.

Digital radiography in comparison to classical radiography offers numerous advantages and possibilities for optimisation of procedures. However, in the course of transfer from classical to digital techniques the radiation burden has slightly increased. With digital radiography the computerised analysis of gathered data provides optimal image contrast, so the image quality is improved at higher doses due to reduced noise background. The increase of radiation burden stems from a larger number of inspections performed (regardless of the method used). With the comparison of both X-ray diagnostic techniques an optimisation of procedures of digital radiography is expected and it is being introduced in our country in order to reduce the radiation burden of patients at diagnostic procedures.

5. Control over Radiation and Nuclear Safety

5.1. Legislation

The most important legal instrument in the area of nuclear and radiation safety in the Republic of Slovenia is the Act on Protection against Ionising Radiation and Nuclear Safety (ZVISJV, Off. Gaz. RS, 67/2002).

The Act, which was first amended in 2003 (Off. Gaz. RS, 24/2003), was amended in 2004 for the second time (Off. Gaz. RS, 46/2004). Besides some minor adjustments it was amended mostly in the part which relates to shipments of nuclear and radiation sources and radioactive waste into and out of the Member States of the European Union and their import, export and transit, as well as to the part which relates to administrative offences.

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

Based on the ZVISJV five implementing regulations were adopted in 2003, namely one governmental decree, one regulation issued by the minister of environment and three regulations issued by the minister of health.

In 2004 the adoption of implementing regulations expedited and the following regulations and decrees were issued:

- Regulation on health surveillance of exposed workers (Off. Gaz. RS, 2/2004),
- Regulation on the obligations of the persons carrying out radiation practices and persons possessing ionizing radiation sources (Off. Gaz. RS, 13/2004),
- Regulation on approving of experts performing professional tasks in the field of ionising radiation (Off. Gaz. RS, 18/2004),
- Regulation on the method of keeping records of personal doses due to exposure to ionizing radiation (Off. Gaz. RS, 33/2004),
- Decree on the areas of limited use of space due to a nuclear facility and the conditions of facility construction in these areas (Off. Gaz. RS, 36/2004),
- Decree on activites involving radiation (Off. Gaz. RS, 48/2004),
- Decree on dose limits, radioactive contamination and interevention levels (Off. Gaz. RS, 49/2004),
- Regulation on inputs from and outputs in the EU member states and on import and export of radioactive waste (Off. gaz. RS, 60/2004),
- Regulation on the conditions to be met by primary health care centres for breast (Off. Gaz.

RS, 110/2004),
- Regulation on the use of potassium iodine (Off. Gaz. RS, 142/2004).

Several other decrees and regulations were in the process of preparation and reconciliation in 2004.

5.2. Slovenian Nuclear Safety Administration

Regulation on Organizations within the Ministries (Off. Gaz. RS, 58/2003) provides that the Slovenian Nuclear Safety Administration performs specialized technical and developmental administrative tasks and tasks of inspection in the areas of:

- radiation and nuclear safety,
- carrying out practices involving radiation and use of radiation sources, except in medicine or veterinary medicine,
- protection of environment against ionising radiation,
- physical protection of nuclear materials and facilities,
- non-proliferation of nuclear materials and safeguards,
- radiation monitoring, and
- liability for nuclear damage.

The legal basis for the administrative and professional tasks in the field of nuclear and radiation safety as well as inspection in this field are the Act on Protection against Ionising Radiation and Nuclear Safety (Off. Gaz. RS, 102/2004, OCT-2), Act on Third Party Liability for Nuclear Damage (Off. Gaz. SFRY, 22/78 and 34/79), Act on Transport of Dangerous Goods (Off. Gaz. RS,79/99, 96/02 and 2/2004), Act on Control of Dual Use Goods Export (Off. Gaz. RS, 37/2004), Decree on Implementing Control of Dual Use Goods (Off. Gaz. RS, 46/2004) and regulations issued on the basis of these acts. The legal basis are also acts and decrees for the ratification of international agreements in the field of nuclear energy and nuclear and radiation safety.

The web pages of the Slovenian Nuclear Safety Administration (http://www.gov.si/ursjv) offer general information about the SNSA, information to the public, legislation, agreements and standards in this field, annual and other reports, information on meetings, workshops, projects and invitations for tenders co-financed by the International Atomic Energy Agency, data on the radiation monitoring, INES events, data on the outage in the Krško NPP, information of the internal library and links to the web pages of other regulatory authorities, organizations and research centres. At the end of 2004 the SNSA issued on its web pages all relevant information required by the Act on Access to Information of Public Nature.

5.2.1. Expert Council for Radiation and Nuclear Safety

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

The Expert Council met four times in 2004. It took an expert standpoint on seven regulations. At each meeting the council got acquainted with the present nuclear safety situation in the country. It started comprehensive analyses for assuring state nuclear safety in the long-term. It has issued documents with recommendations for the minister of the environment and spatial planning for further discussion.

5.2.2. Expert Commission for Testing the Krško NPP Operators Qualifications

In 2004, the Expert Commission for Examination of the Krško NPP Operators Qualifications, nominated by the SNSA, held eight sessions. The first session was devoted to the organizational problems in the preparation for carrying out the examinations of the Krško NPP operators qualifications. The remaining seven sessions were related to the performance of the examinations of the Krško NPP Operators. One of these sessions was devoted to the first examination of the qualifications of the candidates for the Reactor Operator while the remainder of the sessions dealt with the examinations of the qualifications for the extension of the licenses for the Senior Reactor Operator and the Reactor Operator.

In November and December 2004 the Commission organized seven examinations for altogether 29 candidates. Seven candidates successfully passed the initial examination of qualification for the Reactor Operator and three were successful for the Senior Reactor Operator. 14 candidates successfully acquired extension of the Senior Reactor Operator license and five candidates acquired the extension of the Reactor Operator license.

The candidates who successfully passed the initial examinations for the Senior Reactor Operator or the Reactor Operator got from the SNSA, upon the proposal of the Commission, the licenses with the validity of one year. One candidate got from the SNSA the extension of the license with the validity of two years.

The rest of the candidates were awarded the extension of the Senior Reactor Operator or Reactor Operator licenses with the validity of four years.

5.3. Slovenian Radiation Protection Administration

The Slovenian Radiation Protection Administration (SRPA), an agency within the Ministry of Environment and Spatial Planning, performs specialised technical and developmental administrative tasks and tasks of inspection related to carrying out practices involving radiation and use of radiation sources in medicine and veterinary medicine, protection of people against ionising radiation, systematic survey of exposure of both living and working environments to natural radiation sources, monitoring of radioactive contamination of foodstuffs and drinking water, restriction, reduction and prevention of health detriment resulting from non-ionising radiation, and auditing and authorisation of radiation protection experts.

As a special operational unit within the SRPA the Inspectorate for radiation protection is responsible for surveillance of sources of ionising radiation used in medicine and veterinary medicine and for the execution of regulations in the field of protection of population against ionising radiation. In 2004, the SRPA had five employees.

In 2004 the SRPA finished the preparation and adoption of the regulations competent to the Ministry of Health, secondary to The Act on Protection Against Ionising Radiation and Nuclear Safety (Off. Gaz. RS 102/2004).

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

The SRPA continued with monitoring of foodstuff and drinking water and with determination of radon concentrations and gamma radiation levels at workplaces. Two projects were started involving preparation of programmes of radiological interventions and a comparison of classical and digital radiography, respectively.

Within its competencies the SRPA also supervised the Krško NPP and the Agency for Radioactive Waste Management, which operates the Central storage for radioactive waste at Brinje near Ljubljana, and the Žirovski vrh Uranium mine. In the Krško NPP six inspections were performed and one inspection was performed in the Agency for Radwaste Management and at the Žirovski vrh mine. With respect to ensuring radiation safety, no irregularities were found. In medicine and veterinary medicine 11 inspections on radiation protection of exposed workers were performed in total. In four cases small irregularities were discovered and also in four cases a provision to remedy the deficiencies was issued.

Inspection surveillance increased by a factor of 15 when compared to the year 2003 and the number of certificates issued doubled. Appropriate protection was assured in carrying out radiation activities and the use of sources of radiation in medicine and veterinary medicine. The SRPA carried out supervision together with the professional organisations that regularly inspect the status in this work-field. Records of radiation sources used in medicine and veterinary medicine were kept. Development of and input into the central register of personal doses of exposed workers were also performed.

With regard to radon, in 2004 the SRPA supervised the Žirovski vrh Mine in decommissioning, the Mežica Lead and Zinc Mine in closure, the Idrija Mercury Mine in closure, the Postojna Cave and primary schools, kindergartens and hospitals with increased contents of radon.

5.4. Authorized Organizations

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

Authorized radiation protection experts cooperate with the employers in drawing up an assessment of the radiation protection of exposed workers. They give advice on the working conditions of exposed workers, the extent of implementation of radiation protection measures in supervised and controlled areas, the examination of the effectiveness thereof, the regular calibration of measuring equipment, the control of operability of measuring instruments and protective equipment, and perform training of the exposed workers in radiation protection. Authorized radiation protection experts regularly monitor the levels of ionising radiation, contamination of the working environment and working conditions in supervised and controlled areas. Presently the authorisations for authorized radiation protection experts are held by the Jožef Stefan Institute and the Institute of Occupational Health, which acquired the authorisations in accordance with the legislation of 1980.

Authorized dosimetric service performs tasks related to monitoring of the exposure of persons to ionising radiation. The authorisation for measuring of the personal doses with the thermoluminiscent dosimeters is held by the Institute of Occupational health, the Jožef Stefan Institute and the Nuclear Power Plant Krško (for its own and for the contractor's workers). Of the above mentioned institutions the Institute of Occupational health has already acquired an accreditation according to the SIST EN ISO/IEC 17025 standard, while the other two are in the process of accreditation. Authorization for monitoring of the exposure to radon and its daughters is held by the Institute of Occupational health, the Jožef Stefan Institute and the Žirovski vrh mine.

Authorized medical physics experts give advice relating to the optimisation, measurement and evaluation of irradiation of patients, and to the development, planning and use of radiological procedures and equipment, and to ensuring and testing the quality of radiological procedures in medicine. The institution of authorized medical physics experts is a novelty in our legislation, and no experts have been authorized so far in this field. A novelty introduced by this regulation is also the requirement for accreditation of laboratories in compliance with the standards SIST EN ISO/IEC 17025 or SIST EN 45004. The regulation also set the requirement that the authorization in accordance with this regulation should be acquired by the present authorized organisations in 3 years from its coming into force i.e. by 13 March, 2007. Until that date the authorizations issued on the basis of the legislation of 1980 are valid.

Authorised providers of the health surveillance of exposed workers carry out the health surveillance of exposed workers within the framework of the public health service. At present five organisations are authorised: the Clinical Institute for Medicine of Work, Traffic and Sport, the Institute of Occupational Safety, the Community Health Centre Krško (for the Krško NPP employees), the Community Health Centre Škofja Loka (for the Žirovski vrh mine employees) and Aristotel Plc. from Krško. The extent of medical surveillance, the functioning of the authorized institutions and the conditions which must be fulfilled for acquiring the authorization are set in the Regulation on Medical Surveillance of Exposed Workers (Off. Gaz. RS, 2/2004).

Approved experts for radiation and nuclear safety perform assessments and give expert opinion on the activities in the nuclear and radiation facilities.

In 2004 the following 13 organizations held the authorization:

- Milan Vidmar Electric Institute (EIMV), Ljubljana,
- ENCONET Consulting, Vienna, Austria,
- Faculty of Electrical Engineering and Computing, University of Zagreb, Croatia,
- Faculty of Mechanical Engineering, University of Ljubljana,
- IBE Consulting Engineers (IBE), Ljubljana,
- Jožef Stefan Institute (IJS), Ljubljana,
- Energy Institute (IE), Zagreb, Croatia,
- Institute for Energy and Environment Protection (EKONERG), Zagreb, Croatia,
- Institute of Metals and Technologies (IMT), Ljubljana,
- Institute of Metal Constructions (IMK), Ljubljana,
- Welding Institute (ZAVAR), Ljubljana,
- Izolirka, Fire Engineering, Radovljica,
- Slovenian National Building and Civil Engineering Institute (ZAG), Ljubljana.

Based on the yearly reports of the authorized organizations, the main conclusion was that there were no major changes in their performance in comparison with previous years. In the field of staffing the authorized organizations maintain their competence; however, there is no noticeable recruitment of new young engineers. The equipment used in their professional work has been well maintained and updated. The organizations have established the Quality Management Programmes, and some of them even obtained or renewed the Quality Certificate in compliance with ISO 9001:2000.

The most extensive professional task of these organizations in 2004 was independent surveillance of activities in the Krško NPP related to nuclear and radiation safety during its yearly outage, and provision of the Joint Expert Assessment Report on the Outage Activities to the SNSA. The authorized organizations kept providing professional support to the Krško NPP by preparation of expertises and safety analyses; they also trained the plant's personnel in various professional areas. An important part of their work focused on making an independent evaluation of the periodic safety review. They also offered professional support to the Žirovski vrh mine and to the Agency for Radwaste Management. An important part of their activities consisted of research and development activities. Some organizations very successfully participated in the 6th framework programme of the EU research.

5.5. The Fund for Decommissioning of the Krško NPP

The fund for Decommissioning of the Krško NPP is collecting financial resources from the Slovenian owner of the plant. In 2004 the Krško NPP delivered one half of the electric power to Slovenian and one to the Croatian economy. ELES GEN, Llc. was liable for payment of regular levy to the Fund in 2004 in the amount of 0.462 SIT for every kWh of electric power received from the NPP. By the end of the year the total amount of 1,207.6 million tolars was paid. This is 30% less than the amount paid in 2003. At the end of the year 2004 the Fund successfully managed the financial portfolio of 27,392 million SIT.

The total income in 2004 was 8% higher than originally planned and amounted to 2,801.6 million SIT. The expenses in 2004 were 23% lower than planned and amounted to 727 million SIT. The Fund Portfolio is designed according to guidelines of investment policy for 2004 and assures a long-term stable income. The value of the financial portfolio in 2004 increased by 10%. Successful investment resulted in the annual portfolio yield of 7.6% per EURO and exceeded the plans.

In 2004 the Fund acted in accordance with the valid legislation and realised all the goals which had been set.

1.977 million SIT of income was provided with financing. The year 2004 was therefore a successful one for the NPP Fund. The regular levy for 2004 according to the Fund Act was covered in total. The collected funds were economically managed and exceeded the planned results. Good organisational structure and rational spending resulted in lower outcomes compared to the planned outcomes.

In 2004 the Programme of decommissioning of the Krško NPP and disposal of low and intermediate level radioactive waste and spent nuclear fuel was completed. The Government carried out a resolution by which ELES GEN, Llc., became liable for paying in the Fund 0.30 eurocent for every delivered kWh of electric energy produced in the Krško NPP upon corroboration of the Programme of Decommissioning at the Bilateral Commission for controlling transactions of the Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia. By the end of 2004 the Bilateral Commission did not confirm the Programme of Decommissioning yet.

5.6. Nuclear Pool GIZ

The pool for the insurance and reinsurance of nuclear risks GIZ (in short: Nuclear Pool GIZ) is a special type of insurance company dealing with insurance and reinsurance of nuclear risks. The

Nuclear Pool GIZ has been operating since 1994 and at the moment includes eight members.

The Insurance Company Triglav, Ltd., and the Reinsurance Company Sava, Ltd. have the largest shares in the Pool. The Nuclear Pool GIZ has its headquarters at the premises of the Insurance Company Triglav, Ltd., Miklošičeva street 19, Ljubljana.

The Krško NPP third party liability cover is insured by the Nuclear Pool GIZ in the amount of SDR (special drawing rights) 150 million or approximately USD 221 million, which is in accordance with the Decree on Establishment of the Amount of Operator's Limited Liability and the Corresponding Amount of Insurance for Nuclear Damage. The share retained by the Slovenian Pool is 1.30%, while the rest of the risk is reinsured by 17 foreign pools, the most important being British, Japanese, German, French and Swedish.

In accordance with the Decree, the Nuclear Pool GIZ also insured the third party liability of the Krško NPP during the transport of nuclear fuel.

In 2004 two minor damages were reported by the NPP Krško to the Nuclear Pool GIZ, with respect to third party general (not nuclear) liability insurance.

Also the Jožef Stefan Institute's TRIGA type Research Reactor third party liability cover is insured by the Nuclear Pool GIZ in Slovenian tolars, which equals to the amount of SDR (special drawing rights) 5 million.

5.7. Implementation of the International Agreement on the Krško NPP

At the presentation of the Decommissioning Programme held on 1 March, 2004 in the premises of NPP Krško, the two expert organisations introduced scenarios for the decommissioning of the nuclear power plant and for the management of the low and intermediate level waste and spent nuclear fuel, and recommended the most probable scenario. The Decommissioning Programme was on 9 March, 2004 handed over to the Ministers of the Republic of Slovenia and the Republic of Croatia competent for energy. On the fifth session of the Bilateral Commission held on 1 April, 2004 the representatives of the Agency for Radwaste Management of Slovenia and the Croatian Agency for Special Waste presented the Decommissioning Programme and the optimal scenario of decommissioning and of management of the low and intermediate level waste and spent nuclear fuel. The Bilateral Commission authorized the NPP Krško to assure an independent international review of the Decommissioning Programme by 15 May, 2004, at the latest.

The sixth session of the Bilateral Commission was held on 23 June 2004. The international review of the Decommissioning Programme was presented to the Commission. The review was performed by the French Company Electricité de France, which was contracted by the NPP Krško. The Bilateral Commission established that the review was positive and that it confirmed the items and conclusions of the Decommissioning Programme. It was also decided that both delegations submit to the competent authorities the Decommissioning Programme for its endorsement, which would fulfil all the prerequisites for its approval at the next session of the Bilateral Commission,. The Government of the Republic of Slovenia approved the Programme and defined the new contribution rate to the Decommissioning Fund. The Government of the Republic of Croatia approved the Programme on 4 August 2004. The approval was later confirmed by Croatian Parliament on 8 December 2004.

The Assembly of the Company NPP Krško, meeting on 15 April 2004, endorsed the Annual Report for 2003. The Assembly concluded that a high degree of responsibility and cooperation on the management level was achieved. In 2003 the investment into the technological infrastructure amounted to 4 billion of Slovenian Tolars (SIT), which assured greater safety, stability and economically sound operation. The realised profit from the regular operation in 2003 was SIT 1.647 billion. The competitive position of the owners improved. Expenses for material use were 18 index points lower than in 2002.

5.8. Nuclear and Radiation Emergency Preparedness

The emergency response, which would be activated in the case of a substantial release of radioactivity to the environment, is an important element of the national comprehensive system of nuclear and radiation safety.

5.8.1. The Administration for Civil Protection and Disaster Relief in Slovenia

After the revised National Radiological Emergency Plan was adopted by the Government, the Administration for Civil Protection and Disaster Relief of Republic of Slovenia distributed the Plan to all participating organisations and requested these organisations to harmonize their radiological emergency plans with the National Radiological Emergency Plan or to produce new harmonized radiological emergency plans. The National Radiological Emergency Plan has been published at the web site of the Administration for Civil Protection and Disaster Relief, where also the instructions for the population on how to react in the case of a nuclear emergency are available.

In December 2004 the Ministry of Health published the Regulation on the Use of Potassium Iodide Tablets. This regulation provides a regulatory framework for planning of the distribution of potasium iodide tablets in local communities.

As required by the decisions after the »NEK 2002« exercise, the inter-ministerial working groups continued their work also in 2004. These groups were established to contribute to the appendices to the National Radiological Emergency Plan and worked on informing the public, on notification of the affected population and on communications between the stakeholders.

In 2004 the Administration for Civil Protection and Disaster Relief in co-operation with the min-

istries and governmental services, prepared the National Emergency Plan in the Case of a Terrorist Attack with Weapons of Mass Destruction or with Conventional Weapons. In this plan also the possibility of attack with nuclear and radiological means is considered.
In the Training Centre for Protection and Rescue at Ig, 266 members of Civil Protection, capable of intervening in radiation or nuclear emergencies, were trained.

Under the provisions of the Agreement between the Governments of Croatia and Slovenia on Cooperation in the Protection against Natural and Civilisation Disasters, the meeting of the main commission was organised, while the sub-commission for the harmonisation of emergency plans should meet at the beginning of 2005.

5.8.2. Slovenian Nuclear Safety Administration

By continuous activity on emergency preparedness, the SNSA has maintained an efficient emergency response system which would be activated in the case of nuclear and/or radioactive emergency and release of radioactivity to the environment. During an emergency the SNSA completely transforms its operation structure, follows its own emergency plan and provides professional support to the National Civil Protection Headquarters (Administration for Civil Protection and Disaster Relief, the leading agency for decision making during emergency in Slovenia). During nuclear or radiological emergencies the SNSA prepares expert and competent suggestions for the civil protection in the form of recommendations about protective actions, response and countermeasures (especially in early and intermediate phases of the accident). The emergency plan contains specific procedures for the SNSA preparedness to emergency and for staff activation. Some new procedures have been prepared on the basis of domestic exercises and international experiences and by gathering new knowledge in 2004 and were included in the SNSA emergency plan. The SNSA emergency plan is regularly revised, verified and updated by new procedures. At the moment it is composed of 34 procedures, instructions and guideline for procedure revision.

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

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

In 2004 the "NEK-2004" exercise took place. Besides Krško NPP, also the SNSA emergency team actively participated in this exercise.

5.8.3. The Krško NPP

The activities of the Krško NPP in 2004 concerning emergency planning were directed to the maintenance of the existing preparedness, especially to increasing the training and skills of the Krško NPP emergency personnel and to implementing the tasks and recommendations assigned within the frame of the annual emergency preparedness action plan. In this context, priority was given to the staff's professional training and informing of the emergency plan, and on the preparation and implementation of the "NEK 2004" exercise.

Throughout the year, Krško NPP maintained the operability of emergency centers and equipment, updated emergency documentation and performed systematic monthly communication testing and checking of emergency personnel response. It carried out a revision of information material for the visitors and of the outage manual relating to emergency planning and response. The internal instruction "Measures in the case of emergency" was prepared and placed on the building walls in accordance with OSART 2003 mission recommendations.

5.8.3.1. "NEK-2004" Exercise

The announced annual internal exercise, called "NEK-2004", took place on 30 November 2004. The course of the accident was simulated on the Krško NPP simulator and besides the plant the SNSA, the National Notification Centre and the Regional Krško Notification Centre were also involved.

The progressive accident scenario envisaged an increasing emergency classification from alert to general emergency and the corresponding Krško NPP emergency staff and centers activation. During the exercise the real meteorological data were considered. The anticipated radiological conditions required protective measures (evacuation inside the plant area) and the usage of protective equipment. On the basis of potential radiological jeopardy the protective countermeasures for the endangered population were anticipated.

The results of the exercise were positive. The response of the Krško NPP emergency organisation and the equipment in the emergency centres were appropriate. Some minor equipment deficiency and non-compliance in intervention countermeasures realisation in the Krško NPP annual plan for the year 2005 will be corrected.

5.8.4. Ecological Laboratory with a Mobile Unit (ELME)

In 2004 the Radiation Unit of the Mobile Laboratory ELME had two interventions. The first intervention started with a message from the police regional communication centre that an elevated radiation level was measured in the vicinity of a truck which came from Italy and was loaded with 18 ton of zirconium sillicate. The radiation levels were too low to consider the cargo as a radioactive material. The second intervention was at Ljubljana cemetery, where a lightning rod was presumably radioactive. The measurements revealed no radioactivity and the rod was safely removed. In November 2004 the Mobile Laboratory received from the Administration for Civil

Protection and Disaster Relief a new vehicle to replace the old one which was worn out.

5.8.5. International Activities in the Area of Emergency Preparedness

In January 2004 a co-ordination meeting within the project »Strengthening of Regional Emergency Preparedness« took place in Vienna.

In the framework of the Phare project, the workshop »Assessment of the Off-Site Impact after a Radiological Release« was held in Cologne and Neckarwestheim in May 2004. Two representatives of the SNSA took part in the workshop, which was organised to provide an insight into the German emergency preparedness, communication means, response and monitoring of radiological situation in the case of an emergency in Germany or abroad.

In May 2004 the United Kingdom Ministry of Trade and Industry organised a visit for three SNSA experts to the UK Department of Environment, Food and Rural Affairs and the National Radiological Protection Board. The visit was focused on the organisation of emergency preparedness in the UK, notification of an accident and strategy of radiological monitoring during an emergency in Great Britain.

The second meeting of the National Competent Authorities Co-ordinating Group in relation with the Convention on Early Notification and Assistance took place in June 2004 at the International Atomic Energy Agency in Vienna. The purpose of the meeting was to maintain contacts between the National Competent Authorities in the period between the two biennial meetings of the National Competent Authorities representatives. The National Competent Authorities Co-ordinating Group meeting dealt with the organisation of work after the Action Plan for Strengthening the International Preparedness and the Response System for Nuclear and Radiological Emergencies was adopted.

The meeting of the United Kingdom Ministry of Trade and Industry Assistance Recipient Countries was organised in September 2004 in Moscow. Slovenia sent a representative to the meeting and all the participants, regardless of their being actual or potential assistance recipients, were informed about the projects of the United Kingdom Ministry of Trade and Industry.

6. Radioactive Waste Management and Management of Nuclear and Radioactive Materials

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

6.1. Technical groundwork for the national program of management with radioactive waste

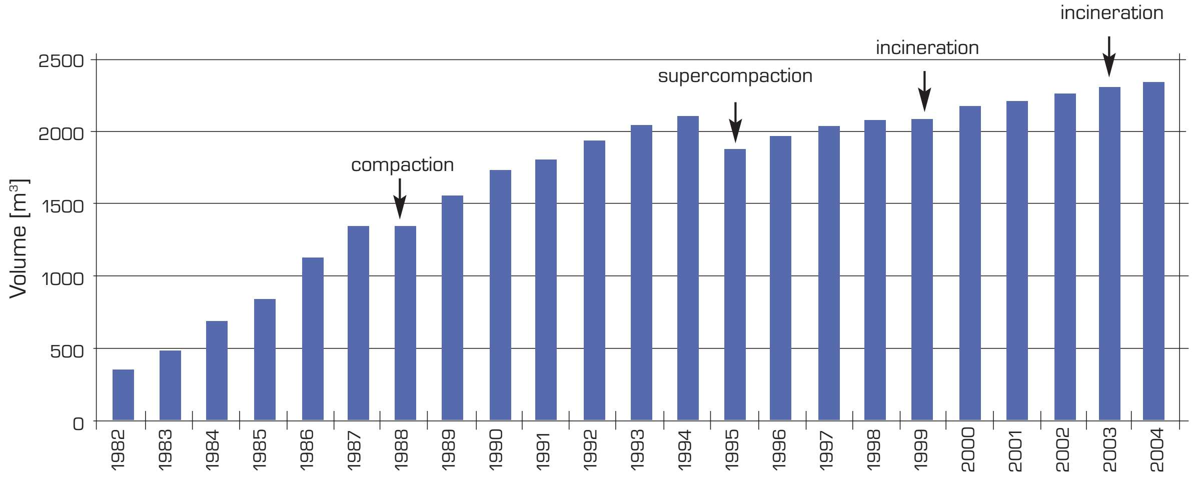
In 2004 the Agency for Radwaste Management (ARAO) prepared the technical groundwork for the national program of management with radioactive waste (RW) and spent nuclear fuel (SF). On this basis a National program of management with RW and SF will be made in accordance with the National programme of environment protection. The technical groundwork contains details on measures that should be taken for the reduction of RW production, their handling and disposal, as well as measures for handling and disposal of SF. The facilities, included in the study, are those at which waste is either produced or stored: the Krško NPP, the central interim storage at Brinje, TRIGA research reactor, other storages at user's locations (Institute of Oncology, Clinic of nuclear medicine), and former Žirovski vrh uranium mine. A special section is dedicated to the waste which is typically not considered radioactive but contains naturally occurring radionuclides. The technical groundwork also lists the current amounts of RW and SF, and specifies the existing and planned procedures of treatment of waste, the estimated amount by 2014, and financial evaluations with the corresponding time schedule. The operational programme of waste management is included for the period form 2005 till 2008, and from 2008 till 2014, respectively.

6.2. Radioactive waste and irradiated fuel at the Krško NPP

In the past several years the volume of low and intermediate level radioactive waste (LILW) radioactive waste was reduced by means of compression, super-compaction, drying and incineration, so that their total volume at the end of 2004 amounted to 2,289 m^3 (Figure 7). In 2004, there were 159 standard drums containing solid waste, 33 of which were inserted in 13 TTC containers. The total gamma and alpha activity stored were $1.93 \cdot 10^{12}$ Bq and $1.50 \cdot 10^{9}$ Bq, respectively.

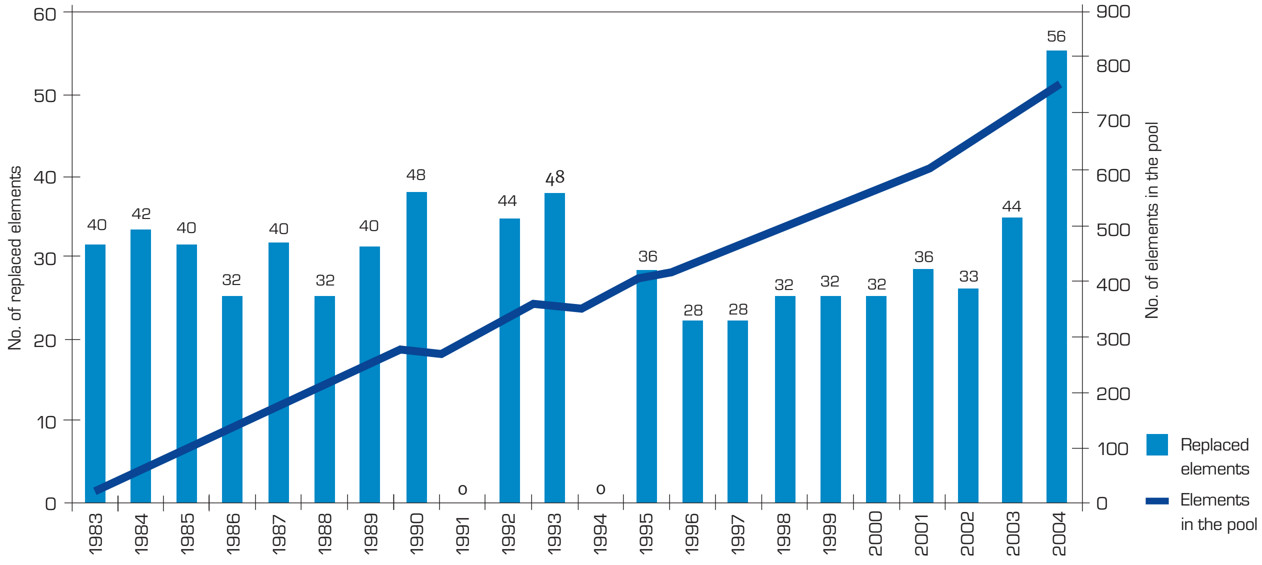
In 2004 the Krško NPP performed decontamination of 30 drums of different contaminated waste oils. By the end of 2004 the oil was stored in standard drums inserted in spill-safe containers (EKO type). Works were carried out from October till December 2004. 3,727 litres of contaminated oil was treated. Oil with addition of water and solvents was separated by the gravitational method and solidified in the system for liquid waste treatment.

Figure 12: The volume of low and intermediate level radioactive waste in the Krško NPP



All spent nuclear fuel at the Krško NPP is stored in a pool with a capacity of 1,694 storage cells (828 before re-racking). During the 2004 regular outage 56 spent fuel elements were removed from the reactor core. At the end of 2004 altogether 763 spent fuel elements were stored in the spent fuel pool. Figure 8 shows the accumulation of spent fuel at the Krško NPP. The Krško NPP has now started an 18-months fuel cycle, so that in 2005 no outage of nuclear fuel is expected.

Figure 13: The annual discharges of spent fuel assemblies and accumulation of spent fuel assemblies in the Krško NPP spent fuel pool



6.3. Radioactive Waste at the Jožef Stefan Institute

In 2004, approximately 0.05 m^3 of low and intermediate level radioactive waste was produced at the Reactor infrastructure centre of the Jožef Stefan Institute. At the end of 2004, approximately 2.75 m^3 of radioactive waste was accumulated, with total activity of $3.7 \cdot 10^{+7}$ Bq. The waste is temporarily stored in the reactor hall and in the hot cell, and is ready for transfer to the Central Interim Storage for Radioactive Waste at Brinje.

6.4. Radioactive Waste in Medicine

The Oncological Institute Ljubljana, as the biggest user of radioactive iodine ^{131}I, has appropriate hold-up tanks to facilitate decrease of activity waste liquids through decay. The tanks are emptied every four or more months. Before the discharge, measurements of specific activity are performed by the authorized organisations. Discharge is realised if the limit values are not exceeded.

The Clinic for Nuclear Medicine of the Clinical Centre of Ljubljana has not built the system for holding-up of liquid waste yet, in spite of the issued written order which requires this.

6.5. Activities of the Agency for Radwaste Management

The Agency for Radwaste Management is responsible for carrying out the public service of radioactive waste management. Among other things, it covers the operation of the Central Interim Storage for Radioactive Waste at Brinje, receipt of radioactive waste from small producers, siting and construction of a repository for low and intermediate level radioactive waste and preparation of planning documents for radioactive waste management (the National programme for the management of radioactive waste). Because of the delay in refurbishment of the Central Interim Storage for Radioactive Waste at Brinje, the public service of radioactive waste management is practically performed only in emergency cases.

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

Slovenia is one of the few European countries with a nuclear power facility without a repository for the disposal of low and intermediate radioactive waste. Since its foundation in 1991, the Agency has been putting significant effort in its siting. In February 2003, amendments to the Act on Protection against Ionising Radiation and Nuclear Safety were adopted. One of the amendments set the priorities and the deadlines for the siting and operation of the repository for the disposal of low and intermediate level radioactive waste. According to these provisions the repository site shall be approved by 2008 and the repository shall acquire a licence for operation by 2013.

Due to demanding and intertwined procedures of planning the repository for low and intermediate radioactive waste, most of the effort in 2004 was dedicated to appropriate incorporation of the site selection process in the legal framework in accordance with the Spatial Planning Act, taking into account the features of the disposal facilities.

In June 2004 the Agency forwarded a proposal to the Ministry of Environment, Spatial Planning and Energy to start the procedure of issuing a Detailed Plan of National Importance for the repository of low and intermediate radioactive waste. On its basis an initiative to the Office for spatial development was given by the minister of environment, spatial planning and energy to actuate the procedure. A draft programme of preparation of the Detailed Plan for the repository was prepared in October.

Prior to acceptance of the programme, the first public hearing was convened in order to assure public involvement in the decision-making. The purpose of the hearing was to obtain references, guidance, and legitimate public interest regarding the preparation of the Detailed Plan and activities of the foreseen spatial arrangements. Additionally, the public was acquainted with the site selection procedure and its involvement in the process. Representatives of Slovene municipalities, spatial planning stakeholders, industry representatives, interested associations and the general public were invited to take part. There were 43 attendees, 17 of which were representatives of municipalities.

With the acceptance of the programme of Detailed Plan of National Importance for the repository preparation in November, the Agency for Radwaste Management was able to start the activities of inclusion of the local communities in the site selection procedure and to enable the planned terrain exploration at the potential locations. An invitation was sent in December to all municipalities to participate, and applications were due to be sent by the end of March 2005.

In order to follow the response of the local communities and support the procedure of collecting their applications, an appropriate database was created. This was also the basis for activities of the mediator. The Agency started acquiring geological and general spatial planning data to assess the suitability of the locations offered by the local communities.

Acquisition of official offers is expected in 2005. A Decree on Measures for Determining the Amount of Indemnities for Limited Land Use at Nuclear Facility (Off. Gaz. RS, No. 134/03) determines the financial compensation to the local communities which are candidates in the investigation phase and the community which will be selected to host the low and intermediate radioactive waste repository. For the procedure of site selection and acquisition of offers, adoption of the Decree was of utmost importance.

6.6. Reclamation of consequences of uranium mining at Žirovski vrh

The reclamation of uranium mining at the Žirovski vrh mine has been in progress since the foundation of the public enterprise Rudnik Žirovski vrh in 1992. Since then, the uranium processing plant, together with the accompanying objects, has been successfully decommissioned and demolished. In 2004 activities were mainly performed in the mineshaft in connection with the removal of the temporary mill tailings depository and regular maintenance of facilities and both depositories, Jazbec and Boršt respectively.

Works in the shaft and on the surface were carried out without any special technical complications. During the activities, the weather was moderate, without any extremes that would present an additional burden of radiation or release of chemical substances from the mine to the environment. By the end of 2004 at the Jazbec 1,876,000 tons of mill tailings with average U_3O_8/t content of 67 g were deposited. The total mass of U_3O_8 amounts to126 tons.

The Safety Analysis Report for Jazbec was in preparation according to the guidelines given by the SNSA.

At the Boršt depository of uranium mill tailings regular maintenance of facilities and the surface took place in 2004. Occasionally, the condition of the drainage channel beneath the depository was inspected. No maintenance work took place in the channel. Moreover, works to put in order the western and eastern streams have been finished.

6.7. Transport and Transit of Radioactive and Nuclear Materials

In accordance with the Law for Transportation of Dangerous Goods, the SNSA issued one permit for import of nuclear material, namely for 56 fresh fuel assemblies for the Krško NPP. The fuel arrived in April 2004 by sea from the USA to the Port of Koper, wherefrom it was transported by trucks to the Krško NPP.

For the transport of radioactive materials two permits were issued to the Institute for Occupational Health. Both of them were used for the transport of spent sealed sources between different companies and the Central Interim Storage for Radioactive Waste at Brinje.

6.8. Import and Export of Radioactive and Nuclear Materials

The SNSA issues permits for import and export of radioactive and nuclear materials, with the exception of medical appliances, which are regulated by the Ministry of Health - the Slovenian Radiation Protection Administration (SRPA). On 1 May 2004 Slovenia became a member of the European Union. Therefore import and export of radioactive materials from the EU became subject to the Council Directive (Euratom) No. 1493/93 of 8 June 1993 on the shipments of radioactive substances between Member States. In accordance with the Directive both regulatory bodies validated 113 declarations of consignees, where each isotope at the same consignee from one holder is counted separately. This standard document of declaration is valid for a period of not more than three years.

Besides imports and exports from the Member States, in 2004, the SNSA and SRPA issued 51 permits, 43 permits for import and 8 for export. The biggest importers were Biomedis Llc., Karanta Ljubljana Llc., Genos Llc., Krško NPP, Temat Llc., Kemofarmacija Inc. and IMP Promont kontrolor NDT Črnuče. Other companies only carry out occasional imports of radiation sources.

6.9. Programme of Decommissioning of the Krško NPP

Obligations towards the decommissioning of the Krško NPP are determined by the treaty between the Slovenian and Croatian Governments on solving statutory and other legal relations related to the investment into the Krško NPP, its exploitation and decommissioning. The treaty determines, inter alia, that the decommissioning of the Krško NPP and the disposal of radioactive waste are joint responsibilities of both contractors. A Programme of Decommissioning was prepared, which is to be revised at least every five years. The purpose of the Programme was to estimate the costs of decommissioning and to determine the corresponding amount of regular levy liable for payment for every kWh of electric power delivered from the NPP.

The Programme of Decommissioning was reviewed by the SNSA. It was established that until the next revision the proposed solutions represent a good basis for preliminary cost estimates of decommissioning of the Krško NPP and management with its radioactive waste and spent nuclear fuel. Due to the complexity of the plan which would accurately elaborate the technical solutions of the planned decommissioning actions and consequently specify their exact costs, an initiative for immediate work on the revision of the Programme was given to the Krško NPP and the group that prepared the first edition. The legally binding deadlines for the construction of the low and intermediate radioactive waste repository should be taken into account.

As a result of the Programme, a motion was put forward that after confirmation of the Programme by the Bilatereal Commission under the Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia, ELES GEN, Llc. becomes liable for payment of a regular levy to the Fund in 2004 in the amount of 0.3 eurocent for every kWh of electric power delivered from the NPP.

The Croatian party must, in accordance with the interstate treaty, start collecting financial resources for the decommissioning of the Krško NPP in its own fund, which has not yet been established. Therefore, the Croatian regular levy for every kWh of delivered electric power will be substantially bigger than that of Slovenia.

7. Nuclear Non-proliferation

Nuclear non-proliferation is an activity preventing the development and production of nuclear weapons in the countries which are formally not nuclear weapons states. Nuclear weapons states are the USA, Russia, the United Kingdom, France and China. Since the Gulf crisis, the discovery of clandestine activities in North Korea, nuclear weapon tests in India and Pakistan and since the terrorist attacks on 11 September in 2001, the international community has been devoting a lot of attention to this issue. Slovenia completely fulfils its obligations which derive from the adopted international agreements and treaties. Slovenia supports all efforts of the International Atomic Energy Agency (IAEA), which inter alia issued a Code of Conduct on the Safety and Security of Radioactive Sources. Particular intention is paid to high-activity sources with the biggest potential risk and consequences.

7.1. Safeguards agreement

In Slovenia, all nuclear material (fresh and spent fuel) at the Krško NPP and at the Research reactor TRIGA (which is operated by the Jožef Stefan Institute) is under the International Atomic Energy Agency supervision. There were seven IAEA inspections during 2004 and no anomalies were detected. The SNSA reported to the IAEA in due time and in accordance with the Safeguards agreement. On 1 May 2004 Slovenia became a member of the European Union, hence the organisations that possess nuclear materials are liable to the regulations within the Euratom legislation. There were three Euratom inspections in 2004 and no anomalies were detected.

7.2. Additional protocol to the Safeguards agreement

The Additional protocol was signed in 1998 and ratified and entered into force in 2000. The SNSA prepared the initial report and sent it to the IAEA in 2001. Since then annual updates have been prepared. The last one was sent to IAEA in May 2004. The update mainly referred to Article 2.a (iii) of the Additional protocol, which addresses the description of changes of the Krško NPP site. The changes concerned the facility modifications carried out at the Krško NPP site. IAEA inspectors carried out two inspections under the Additional protocol and no anomalies were discovered.

7.3. Comprehensive Nuclear Test-Ban Treaty

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

Regarding activities of the Republic of Slovenia, an initiative from the Jožef Stefan Institute is worth mentioning. One of their laboratories has started the accreditation procedure to meet the CTBT standards.

The CTBT Director General, Mr. Wolfgang Hoffman, visited Slovenia in April 2004.

7.4. Export Controls of Dual-Use Goods

In the scope of international activities in this area Slovenia is participating in the work of the Nuclear Suppliers Group (NSG) and the Zangger Committee. In accordance with the established rules and procedures, the SNSA reported regularly to both organisations also in 2004.

Since 1 May 2004 a new Act on Export Controls of Dual-Use Goods is in use. A special Commission for Export Controls of Dual-Use Goods was established. Representatives of the Ministry of Economy, the Ministry of Foreign Affairs, the Ministry of Defence, the Ministry of the Interior, Customs Administration, SNSA, Slovene Intelligence and Security Agency and the National Chemicals Bureau constitute the Commission.

An exporter of dual-use goods must obtain a permit from the Ministry of Economy, which is issued upon expert findings of the Commission for Export Controls of Dual-Use Goods. In 2004 the Commission mainly dealt with chemicals and machine tools. Some machine tools were indeed from the list of nuclear goods of dual-use.

7.5. Physical Protection of Nuclear Material and Facilities

Physical protection of nuclear facilities and material at the Krško NPP and the research reactor TRIGA, and of the radioactive waste in the Central Low and Intermediate Waste Storage at Brinje, is conveyed by joint inspections of the Ministry of the Interior and of the SNSA. At the Ministry of the Interior a Commission has been established for tasks related to physical protection of nuclear material and facilities. On the basis of information provided by the police, intelligence services, the SNSA and nuclear facility operators, the commission reviewed the design basis threat for each nuclear facility in Slovenia. The revised design basis threat was issued by the Director General of the Police in 2004.

7.6. Illicit Trafficking of Nuclear and Radioactive Materials

In order to prevent illicit trafficking with nuclear and radioactive material a great number of actions have been organised primarily through international organisations such as the International Atomic Energy Agency and the European Commission. Besides this there are also bilateral activities, mainly with the USA. In the beginning of 2004, some Slovenian institutions received from the US Government equipment for the detection, identification and analysis of radioactive and nuclear material.

In the area of combating illicit trafficking, the SNSA together with the Ministry of the Interior, the Administration for Civil Protection and Disaster Relief of the Republic of Slovenia, the Slovenian Radiation Protection Administration, the Customs Administration, the Agency for Radwaste Management, Jožef Stefan Institute and the Institute of Occupational Health organised two consultative meetings in May and November 2004. Their objective was to analyse the status and to co-ordinate their activities. For the purpose of consultation, the SNSA provided to the other organisations the phone number of a 24-hour on-duty officer. There were 6 calls in 2004, two of which required interventions.

In October 2004 the SNSA, together with the Institute of Occupational Health, organised a one-day seminar for collectors and refabricators of scrap materials where they got acquainted with the problem of orphan sources found in scrap metal and their potential consequences.

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

In 2004, Slovenia reported on two occasions to the IAEA Illicit Trafficking Database. It reported the discovery of a Co-60 source in a shipment of scrap metal in Ravne Steelworks and the rejection of a truck loaded with Eu-152/154 (lightning rods) at the Gruškovje border crossing. From 1993 until the end of 2004, IAEA received more than 600 reports of similar events throughout the world. They were characterised as theft, loss, discovery, and unauthorised transfer of radioactive sources respectively.

Negotiations between Slovenia and the USA on an agreement on the setting of several radiation portal monitors at the Port of Koper and other border crossings are still under way.

8. International Co-operation

8.1. Co-operation with International Organizations

In the year 2004, the successful co-operation with the International Atomic Energy Agency continued. Besides attendance of the Slovenian delegation at the regular session of the General Conference (20 - 24 September 2004), the following should be mentioned:

- Within the programme of technical co-operation in 2004 Slovenia received 15 applications for training of foreign experts in Slovenia. 7 of these applications were implemented in the same year as well as 16 applications from 2003. All other applications approved by Slovenia will be implemented in 2005.

- Within technical co-operation in 2004 there were 7 research contracts going on which had been signed in the previous years. 1 research contract was finished in 2004, while 4 new research contract proposals were submitted, of which 3 were approved by the International Atomic Energy Agency.

- Technical assistance projects are the most extensive form of co-operation between Slovenia and the International Atomic Energy Agency. This is due to the large amount of resources, engagement of experts and also to the fact that projects of this type usually last for several years. In December 2003, Slovenia submitted 5 new technical assistance project proposals for the cycle 2005-2006, which were decided upon during the November session of the Board of Governors. The International Atomic Energy Agency approved 2 project proposals for the years 2005 and 2006 and extension of 2 projects that have been in progress since the 2003-2004 cycle. One project is awaiting for financial support by interested organizations.

- In 2004, the International Atomic Energy Agency implemented a mission in Slovenia. The mission took place at the Jožef Stefan Institute, from 27 to 29 September 2004 with a view of examining the commercial capabilities from a management perspective and of providing appropriate recommendations for sustainable preservation.

- Slovenia continues with its active policy of being a host of activities organized by IAEA. In 2004, Slovenia hosted 6 regional workshops, training courses and seminars.

It should be emphasized that Slovenia timely settled all its financial obligations to the International Atomic Energy Agency, i.e. the contribution to the Regular Budget as well as the contribution to the Technical Co-operation Fund.

In the year 2004, co-operation with the Nuclear Energy Agency (NEA) within the Organization for Economic Co-operation and Development continued. In 2001, Slovenia was awarded the status of an observer country for a two year cycle, which was in 2003 extended for another two year period. Within the framework of NEA there are seven standing committees to which Slovenian experts were designated by the Slovenian Government. The committees are:

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

8.2. Co-operation with the EU

8.2.1. Adoption of the Acquis and Co-operation with the EU

The most important event in the area of international co-operation in 2004 was formal accession of Slovenia to the EU on 1st May 2004. Until this date Slovenia had to notify to the EU all legal documents which witness that Slovenian legislation had been harmonised with the EU acquis. Before the notification Slovenia produced the last version of Tables of Concordance which describe harmonisation of legislation in detail. The questionnaires on implementation of EU regulations were also updated and sent to the European Commission.

In the Atomic Questions Group, the consultative body of the Council of the EU, important activities took place in relation to the "nuclear package" (two drafts of directives considering nuclear safety of installations and radioactive waste management). Under the Irish Presidency in the first half of 2004 the goal was to reach consensus about the "nuclear package" before 1st May 2004, i.e. before the accession of the new Member States to the EU. Irish presidency as the priority activity set also the adoption of Euratom Safeguards Regulation and its implementation guidelines. In the area of international co-operation, priority was given to the negotiations of agreement with the Russian Federation on the trade of nuclear materials. The workplan of the Commission for 2004 comprised four topics: (a) political priorities, (b) inspections and nuclear safeguards, (c) conditions for sustainable growth of European economy, (d) international relations (update of the existing directive on shipment of radioactive waste, agreement with the Russian Federation on the trade of nuclear materials, conclusion of negotiations with China and Japan). After extensive discussions in the first quarter and after the meeting of the Atomic Questions Group on 31 March 2004, the Council of the EU prepared a non-paper which proposed a final version for both draft directives of the "nuclear package". The non-paper considered only the articles which were tabled during the 31 March 2004 Atomic Questions Group meeting, and on those articles which were commented in written form. Slovenia supported the legally binding option, i.e. the adoption of both directives. During the COREPER II Meeting on 13 May

2004 it was stated that there was no qualified majority for the adoption of “nuclear package” directives. The Presidency did not want the 18-month long work to remain without a conclusion and it proposed a working group to prepare for the Council of the EU conclusions on the above issues.

On 4 June 2004 the Council of the EU published draft “Conclusions of the Council of the EU on Nuclear Package”, which stated that the consideration of the nuclear package had ended, expresses concern about nuclear safety in the light of documents produced by different fora (WENRA, NRWG) and returns the nuclear package back to the Commission for further elaboration. On 29 September 2004 the Council’s Atomic Questions Group for the first time considered the so-called second nuclear package. The discussion ended in a few minutes, because it became clear to the Presidency that the Member States had not changed their position with regard to the first nuclear package, and thus there was no necessary qualified majority for the adoption of the package.

During the Dutch Presidency the main activities of the Atomic Questions Group focused on international agreements with China, Japan and Kazakhstan, with the accession proposal of the Euratom to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, with the proposals on Council Decisions with regard to the Convention on Early Notification of a Nuclear Accident and Convention on Assistance in the Case of Nuclear Accident or Radiological Emergency, with the new draft directive on shipment of radioactive waste and with the proposals on financing the decommissioning of Ignalina NPP and of Bohunice V1 NPP.

In 2004 the Slovenian Nuclear Safety Administration became a consortium member for the implementation of EURANOS Integrated Project, which was co-financed from the 6th Framework Programme. The project is aimed at research, demonstration activities and testing of decision support tools in case of an emergency. Since 2004 the system ECURIE (European Commission Urgent Radiological Information Exchange) for exchange of information in case of a nuclear or radiological emergency has been operational.

8.2.2. Phare Projects in 2004

In 2004 extensive work was carried out within the projects »Assistance to the Slovenian Regulatory Body - Transfer of Western Methodology« and »Installation of RODOS in Slovenia«. Both projects were successfully concluded in December 2004.

For the project Support to the SNSA in Upgrading and Modernization of the National Early Warning System, the tender dossier including technical specifications was prepared in April 2004. In May 2004 the European Commission approved the tender dossier. Due to accession of Slovenia to the EU, the financial control and the approval of the project were transferred to the Ministry of Finance, which became accredited in fall 2004. In the meantime the rules about the tender dossier were amended and changed, and thus the tender dossier needed to be adapted accordingly. In December 2004 the new tender dossier was approved and the invitation to tender was published in the Official Journal of the EU and the Official Gazette of the Republic of Slovenia.

For the project Characterization of Low and Intermediate Level Radioactive Waste Currently Stored in the Central Facility Brinje four potential tenderers were selected in April 2004. All four of them received the tender dossier. In July 2004 evaluation of the received tenders took place and until the end of 2004 the contract with the winning tenderer was signed.

In 2004 the work on preparation of the tender dossier for the project "Hot cells" Facility Renovation and Modernization was carried out.

8.2.3. WENRA

WENRA is an informal association of European nuclear regulators (Western European Nuclear Regulators' Association), whose members are regulators of the new EU Member States and Switzerland. The work of the association is devoted to reference safety levels and to the evaluation of how the requirements of these reference safety levels have been met by a particular member of the association. Two working committees prepare the documents, one committee in the area of reactor safety and the other in the area of radioactive waste and decommissioning of nuclear objects. Reference safety levels should be prepared by the end of 2005, and the members will try to transpose these levels into the national legislation by 2010.

8.2.4. Co-operation with Other Associations

On 1 January 2004 prof. dr. Peter Grilc (Law Faculty of University in Ljubljana) started his two-year term of the Managing Board Chairman of the International Nuclear Law Association (INLA). In 2004 the preparatory activities for the International Nuclear Law Association Congress in 2005 in Portorož were carried out.

In 2004 the annual meeting of the Network of Regulators of Countries with Small Nuclear Programmes (NERS) was organised along with the IAEA General Conference. The following topics were considered: independence of the regulatory body, knowledge management in regulatory bodies, discussion on establishing a network of non-destructive testing experts and the follow-up of activities after the event in the Paks NPP in 2003.

It is worth mentioning that Slovenia is eager to co-operate in the above and other associations, although this means a lot of expenses and takes a lot of time.

8.2.5. Co-operation in the Context of International Agreements

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

In February 2004 a Slovenian delegation participated in a conference on the revision of the Paris

Convention on Third Party Liability in the Field of Nuclear Energy and Brussels Supplementary Convention.

In 2004 Slovenian experts closely monitored all proposals for changes and supplements to the Convention on Physical Protection of Nuclear Material. These activities were, in fact, preparation for the conference on examination and adoption of the proposed amendments to the Convention on Physical Protection of Nuclear Material, which will be held in July 2005.

In September 2004 a Slovenian delegation took part in the Organisational Meeting for the Third Review Meeting of the Contracting Parties of the Convention on Nuclear Safety. The Third Review Meeting will take place in April 2005 in Vienna.

Besides co-operation in multilateral agreements, the SNSA continued to co-operate with representatives of related regulatory bodies in the scope of bilateral agreements. Slovenia held a bilateral meeting with Austria. With the Czech Republic, the Slovak Republic and Hungary, the requirements from bilateral agreements to exchange information were met at the annual quadrilateral meeting in Slavkov, Czech Republic, and at the meeting held during the IAEA General Conference.

8.3. Use of Nuclear Energy World-wide

At the end of 2004 there were 56 countries in the world with research reactors and 31 one countries operating 440 reactors for electricity production. In 2004 four new nuclear power plants with total power of 3510 MW were put in operation, one in China and South Korea and two in Ukraine. In recent years there is a notable increase in efficiency of operation of NPP's. One quarter and almost two thirds of them sustain availability of 90% (Krško NPP among them) and 75%, respectively. By the end of 2004, NPP's around the world accumulated a total of 11,000 working years.

In Europe a new NPP is being built in Finland, while a similar order is expected in 2006 in France. In the European Union approximately one third of electric power is produced in nuclear power plants.

Table 6:Number and Installed Power of Reactors by Countries at the end of 2004

	Operational		Under construction		Planned		Proposed	
	No.	Power [MW]	No.	Power [MW]	No.	Power [MW]	No.	Power [MW]
Belgium	7	5,728	0	0	0	0	0	0
Bolgaria	4	2,722	0	0	0	0	1	1,000
Czech Republic	6	3,472	0	0	0	0	2	1,900
Finland	4	2,656	0	0	1	1,600	0	0
France	59	63,473	0	0	0	0	1	1,600
Germany	18	20,643	0	0	0	0	0	0
Great Britain	23	11,852	0	0	0	0	0	0
Hungary	4	1,755	0	0	0	0	0	0
Lithuania	1	1,185	0	0	0	0	0	0
Netherlands	1	452	0	0	0	0	0	0
Romania	1	655	1	655	0	0	3	1,995
Russia	31	21,743	4	3,600	1	925	8	9,375
Slovakia	6	2,472	0	0	0	0	2	840
Slovenia	1	676	0	0	0	0	0	0
Spain	9	7,584	0	0	0	0	0	0
Sweden	11	9,459	0	0	0	0	0	0
Switzerland	5	3,220	0	0	0	0	0	0
Turkey	0	0	0	0	0	0	3	3,450
Velika Britanija	15	13,168	0	0	1	950	0	0
Europe total:	**206**	**172,915**	**5**	**4,255**	**3**	**3,475**	**20**	**21,210**
Argentina	2	935	0	0	1	692	0	0
Brazil	2	1,901	0	0	1	1,245	0	0
Canada*	17	12,080	1	515	4	2,570	0	0
Mexico	2	1,310	0	0	0	0	0	0
USA	103	97,542	1	1,065	0	0	0	0
America total:	**126**	**113,768**	**2**	**1,580**	**6**	**4,507**	**0**	**0**
Armenia	1	376	0	0	0	0	0	0
China**	15	11,471	4	4,500	8	8,000	19	15,000
Dem. P.R. Korea	0	0	1	950	1	950	0	0
India	14	2,493	9	4,128	0	0	24	13,160
Indonesia	0	0	0	0	0	0	2	2,000
Iran	0	0	1	950	1	950	3	2,850
Israel	0	0	0	0	0	0	1	1,200
Japan	54	46,342	2	2,181	12	14,782	0	0
Korea, Republic of	20	16,840	0	0	8	9,200	0	0
Pakistan	2	425	0	0	1	300	0	0
Vietnam	0	0	0	0	0	0	2	2,000
Asia total:	**106**	**77,947**	**17**	**12,709**	**31**	**34,182**	**51**	**36,210**
Egypt	0	0	0	0	0	0	1	600
South Africa	2	1,842	0	0	0	0	1	125
Africa total:	**2**	**1,842**	**0**	**0**	**0**	**0**	**2**	**725**
World total:	440	366,472	24	18,544	40	42,164	73	58,145

Reference: World Nuclear Association 29. 3. 2005

* In Canada the temporarily stopped reactors at Pickering and two Bruce units are included in 'Planned'

** China: Including 9 operational reactors in the mainland China (6,587 MWe) and 6 in Taiwan (4,884 MWe). In the mainland two new reactors (1,900 MWe) and two in Taiwan (2,600 MWe) are under construction. In the mainland China eight reactors are ordered

8.4. Radiation Protection and Nuclear Safety World-wide

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

It is now five years since the Nuclear Events Web Based System (NEWS) went into operation. NEWS is a partially open communication system providing a fast flow of information between regulatory bodies, operators, technical support organizations, media and the public. The system is jointly managed by IAEA, OECD Nuclear Energy Agency and the World Association of Nuclear Operators. It enables transfer of information on the occurrence of events that would attract the interest of media. The system has different levels of access: for experts from regulatory bodies and nuclear facilities or other users of nuclear energy and also for journalists and members of the public. It is available on the Internet site: http://www-news.iaea.org/news/default.asp.

All the INES reports are simultaneously translated into the Slovenian language and can be browsed on the Internet address: http://www.gov.si/ursjv/si/ines/index.php?page=dogodki.php.

The summary of the reports of 2004 presents the level of radiation protection and nuclear safety world-wide. Thirty one INES reports were received by NEWS in 2004. Ten reports were on events in nuclear power plants, the remaining 21 on lost radioactive sources (5 reports), on exceeded dose levels due to use of radioactive sources (8 reports). In 4 cases spent sources were found in a scrap metal intended for recycling; 1 source was even melted and 3 sources were inadvertently stolen. Three events in a nuclear power plant were rated as level 2 - incident, five as level 1 - anomaly, one as level 0 - no safety significance and one had no rating. Among other events one was level 3, ten were level 2, six level 1, three level 0 and one had no rating. Slovenia did not report any event in 2004.

The most serious accident in a nuclear power plant in 2004 was the one in Japan, in the nuclear power plant Mihama-3 operated by Kansai Electric. On 9 August a leakage of a high temperature non-radioactive steam from a ruptured pipe killed four contractor's workers and injured seven. An investigation determined that the size of the rupture on one of the two condensate pipes made of carbon steel was 500 mm. The outer diameter of the pipe was 560 mm and the thickness of the pipe wall 10 mm. A jet of the steam of the secondary coolant from the rupture had a temperature of approx. 140° C. At the time of the burst 221 contractor's workers were conducting preparatory work, at the 2nd level of the turbine building for the upcoming annual outage planned to start on 14 August. The major cause of the accident was inadequate ageing management of the piping, particularly control of its thinning. Mihama-3 is a 780 MW pressurised water reactor initially synchronised to the grid in 1976.

It is evident from the INES reports, that management and control of irradiation sources, which are widely used in industry in the world, is deficient, resulting in a loss of sources during transport or in their inadvertent theft. The source is sometimes found in a scrap metal or even melted in a smeltery.

The events which were reported to NEWS in 2004 did not have any strong impacts on the environment, nor did they cause any injuries to workers due to radiation. In five cases radiation workers received doses higher than the prescribed limit but this did not result in any lasting health effects. In two other cases workers were potentially overexposed but there was no possibility to confirm their doses by the measurement. There was one case of a potential overexposure of the public when a source was lost and out of control for 36 hours. In the most serious accident in a nuclear power plant, which resulted in four deaths, the cause of the deaths was not radioactivity but the high temperature and blow of the steam.

9. Appendix: List of Organizations and their Internet Addresses

Organization	Internet Address
Agency for Radioactive Waste	http://www.gov.si/arao
Milan Vidmar Electric Institute	http://www.eimv.si
ENCONET Consulting	http://www.enconet.com
Faculty of Electrical Engineering and Computing, University of Zagreb	http://www.fer.hr
Faculty of Mechanical Engineering, University of Ljubljana	http://www.fs.uni-lj.si/
IBE Consulting Engineers	http://www.ibe.si
Jožef Stefan Institute	http://www.ijs.si
Energy Institute	http://www.ie-zagreb.hr
Welding Institute	http://www.zavar.si
Institute of Metals and Technologies	http://www.imt.si
Institute of Metal Constructions	http://www.imk.si
International Atomic Energy Agency	http://www.iaea.org
Ministry of Agriculture, Forestry and Food	http://www.sigov.si/mkgp/
Ministry of the Interior	http://www.mnz.si/
Ministry of the Environment and Spatial Planning	http://http//www.sigov.si/mop/
Ministry of Health	http://www.gov.si/mz/
Krško Nuclear Power Plant	http://www.nek.si
OECD Nuclear Energy Agency	http://www.nea.fr
Žirovski Vrh Uranium Mine	http://www.rudnik-zv.si/
United States Nuclear Regulatory Commission	http:/www.nrc.gov/
Slovenian Nuclear Safety Administration	http://www.gov.si/ursjv/
Slovenian Radiation Protection Administration	http://www2.gov.si/mz/mz-splet.nsf
Administration of RS for Civil Protection and Disaster Relief	http://www.mors.si/urszr/
Slovenian National Building and Civil Engineering Institute	http://www.zag.si/
Institute for Occupational Safety	http://www.zvd.si/

10 Reference

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11. Poročilo o delu Reaktorskega infrastrukturnega centra v letu 2004, Institut "Jožef Stefan", Ljubljana, februar 2005.
12. Letna poročila pooblaščenih organizacij za leto 2004
13. IAEA News System - podatkovna baza INES poročil
14. Letno poročilo ARAO za URSJV (ARAO-SP-4105-1), ARAO.
15. Redna mesečna poročila o skladiščenju trdnih radioaktivnih odpadkov NEK.
16. Letno poročilo o izvajanju varstva pred IO sevanji in o vplivu Rudnika Žirovski vrh na okolje za leto 2004, RŽV.