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

Annual Report 2003 on the Radiation and Nuclear Safety in the Republic of Slovenia

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Annual Report 2003 on the Radiation and Nuclear Safety in the Republic of Slovenia

July 2004

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

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

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1. Preface

In the areas of protection against ionising radiation and nuclear safety in the Republic of Slovenia the year 2003 went by without significant peculiarities. There were no events that could endanger the population. Intense activities of all stakeholders were under way in order to conform to the provisions of the new Act on Protection against Ionising Radiation and Nuclear Safety (ZVISJV), which was enacted in October 2002. Likewise the preparation of decrees and regulations based on the Act continued. By completing this activity the nuclear legislation will be harmonised with the European Union Acquis.

In the areas of nuclear and radiation safety, ZVISJV recognises two competent authorities, the Ministry of the Environment, Spatial Planning and Energy and the Ministry of Health. When pursuant to this Act the competence is with the Ministry of the Environment, Spatial Planning and Energy, the decision on administrative matters is made by the regulatory authority within this ministry, i.e. the Slovenian Nuclear Safety Administration (SNSA). When the competence is with the Ministry of Health, the decision on administrative matters is made by the regulatory authority within this ministry, i.e. the Slovenian Radiation Protection Administration.

The biggest nuclear facility in Slovenia, the Nuclear Power Plant Krško (NEK), operated without any event having impact on the environment. In autumn 2003 the operation of NEK was thoroughly reviewed by the International Atomic Energy Agency's OSART Mission, which found no serious deficiencies or deviations from world standards. NEK, however, experienced two automatic reactor scrams actuated by the reactor protection system. The first scram was due to a technical fault on one of the valves, while the second one was triggered by an unusually fast rate of increase of the Sava river flow in the autumn, which resulted in clogging of the piping of the cooling water for the secondary side of the plant. In both cases all the systems and the personnel were performing properly (more details in the next Chapter).

In the spring of 2003 the international contract on the ownership of the company NEK with the neighbouring state Croatia was ratified. This ended the long years of negotiations between the two states. The international commission which was established pursuant to this contract appointed a new Board of Directors of the company and ordered the preparation of a joint programme of decommissioning and disposal of radioactive waste.

At the end of February 2003 the Government of the Republic of Slovenia passed a decision on the establishment, tasks and organization of the Slovenian Radiation Protection Administration (SRPA), which is affiliated to the Ministry of Health.

The SRPA performs technical, administrative, inspection and development tasks in the area of radiation practices and use of radiation sources in health and veterinary care; health protection of people against detrimental effect of ionising radiation; systematic inspection of working and living premises due to exposure of people to natural radiation sources; implementation of monitoring of radioactive contamination of foodstuffs and drinking water; reduction, restriction and prevention of detrimental health effects of non-ionising radiation and assessment of compliance and authorisation of radiation protection experts.

In mid-2003, the Expert Council for Radiation and Nuclear Safety, which has its headquarters in the premises of SNSA, started to work.

This report is a continuation of a practice which was introduced a year ago. This short report provides in a condensed form the essential data on the situation in the country in the areas of radiation protection and nuclear safety, 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 CD or at the homepage of the SNSA: (http://www.gov.si/ursjv/en/por_pris/index.php?page=porocila.php).

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 2003 in Slovenia: the Nuclear Power Plant Krško, the Research reactor TRIGA of the Institute "Jožef Stefan" and the Central Interim Storage for Radioactive Waste in Brinje.

2.1.1 Nuclear Power Plant Krško

2.1.1.1 Operation and Performance Indicators

In 2003, the Nuclear Power Plant Krško (NEK) produced 5,207,278.5 MWh (5.2 TWh) gross electrical energy on the output of the generator, which corresponds to 4,963,337.1 MWh net electrical energy delivered to the grid. The annual production was 2.68 % less than planned and 0.73 % less than planned by the revised plan. The plan was revised because the power plant had to operate on reduced power while the flow of the Sava river was too small and because there is a restriction on the Sava river heatup. The production was below the plan also because of two unplanned automatic fast shutdowns and the dispatcher request for lower power operation. The reactor was critical for 8,113.28 hours or 92.62 % of the total number of hours in this year. The thermal energy production of the reactor in the Nuclear Power Plant Krško was 15,027,822.1 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 2003

Safety and performance indicators	Year 2003	Average 1983-2003
Availability [%]	92.27	83.61
Capacity factor [%]	86.37	80.02
Forced outage factor [%]	0.70	1.29
Realised production [GWh]	5,207	4,603
Fast shutdowns - automatic [Number of shutdowns]	2	3.16
Fast shutdowns - manual [Number of shutdowns]	0	0.4
Unplanned normal shutdowns [Number of shutdowns]	0	1.09
Planned normal shutdowns [Number of shutdowns]	1	0.83
Event reports [Number of reports]	5	3.95
Refueling outage duration [Days]	25.7	52.8
Fuel reliability indicator (FRI)[GBq/m^3]	$5.14 \cdot 10^{-5}$	$9.65 \cdot 10^{-2}$

Figure 1 shows the operating diagram of the Krško NPP for the year 2003. As the diagram shows, the power plant operated on reduced power in June, July, August and September because of the Sava river heatup restriction. In August there was an automatic plant shutdown due to inadvertent closure of the main steam isolation valve. And at the end of November, an automatic plant shutdown occurred due to a loss of condenser cooling.

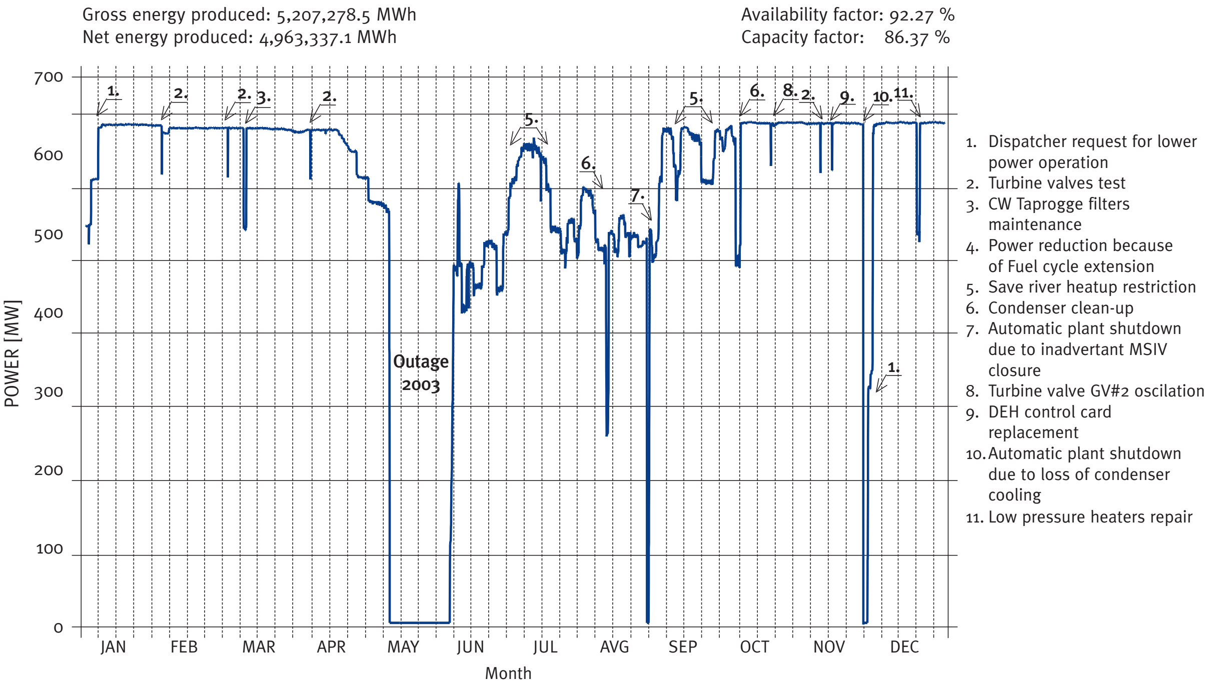

Figure 1: Operating power diagram for the Krško NPP in 2003

In Figure 2, the production of electric energy is presented for the years of commercial operation. In 2003, the production was lower than the year before, when it reached its highest level in the operating history of the NPP. However, the production in 2003 was still above the average value over all operation years. The reasons for smaller production were the dryness period during the summer season (June, July, August and September) when the power plant operated at reduced power, and the forced shutdowns of the power plant in August and November 2003.

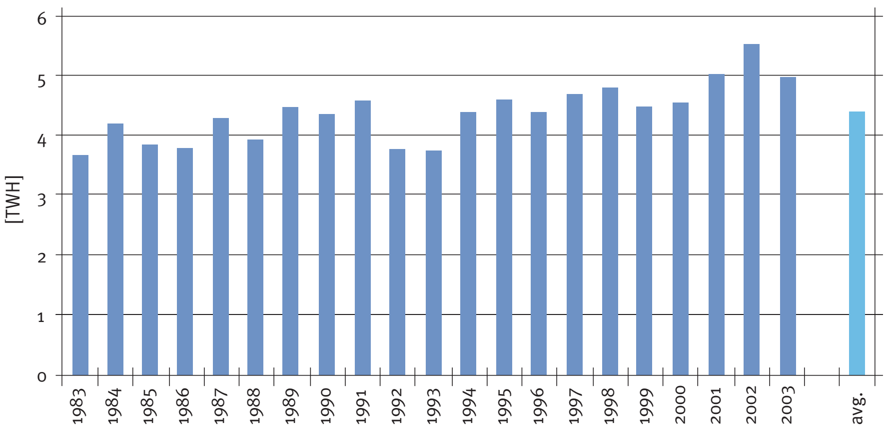

Figure 2: Production of electricity in the Krško NPP

In Figure 3, the capacity factor is presented. In 2003 it amounted to 86.37 % and was lower than in the years 2001 and 2002 but still above the average value. The capacity factor is used world-wide as the main indicator of successful operation of the power plant. For comparison, the association WANO (World Association of Nuclear Operators) calculated, for the year 2002, the average capacity factor for 417 power plants, and it was 85.8 %.

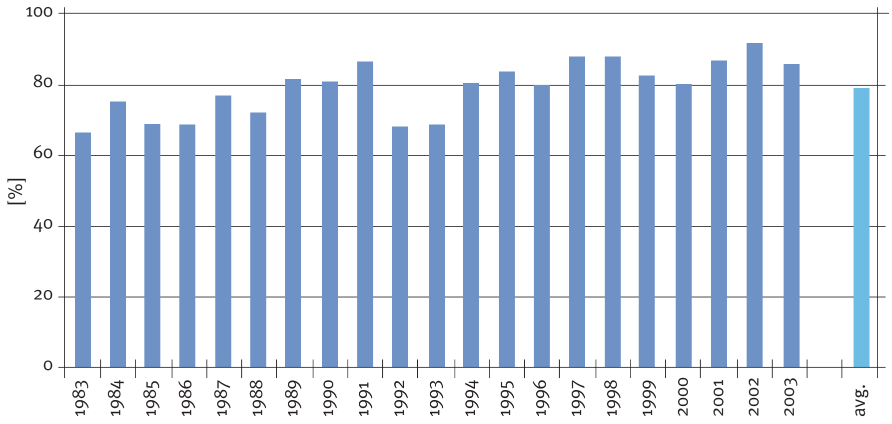

Figure 3: Capacity factor at the Krško NPP

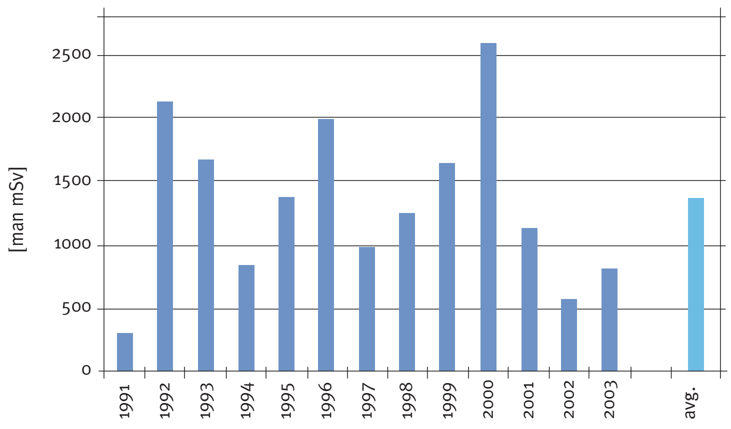

Figure 4: Collective exposure to radiation in the Krško NPP

The collective exposure to radiation, shown in Figure 4, is a little higher than the year before but still under the average value. The main reasons for the higher value of this factor were the unpredictable difficulties during the examination of the reactor vessel head and the larger extent of maintenance work for one reactor pump motor, and during the review of snubbers in the building. The value of the collective dose factor for the year 2003 was 799 man mSv (the goal value was 800 mSv).

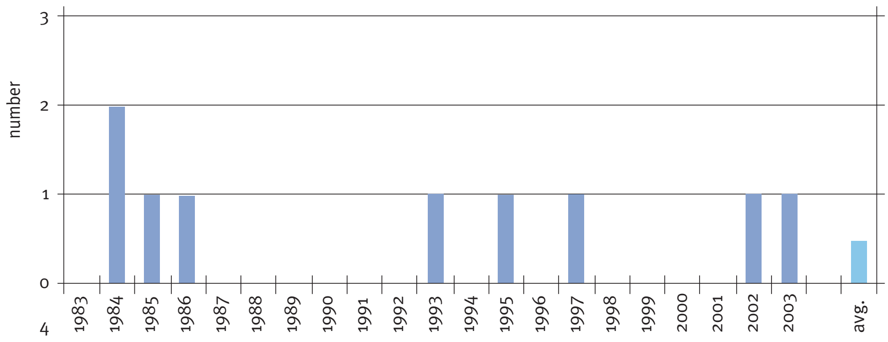

Figure 5: Number of unplanned actuations of the safety injection system in the Krško NPP

Figure 5 shows the number of unplanned actuations of the safety injection system. In the year 2003 there was one unplanned actuation, which occurred during the regular three-monthly testing of the main steam isolation valve.

2.1.1.2 Reports of abnormal events in the Krško NPP

In 2003, the Krško NPP reported five abnormal events, during which the nuclear and radiological safety was not threatened. These events were the following:

1. Leakage of the reactor cooling water under the temperature switch of the diesel generator.
2. Difficulties during the start of the diesel generator.
3. Activation of safety injection on the signal of low pressure in the main steam supply and automatic fast reactor shutdown during the testing of the main steam isolation valve.
4. Deviation of the negative pressure in containment, and
5. Loss of turbine on the signal of low vacuum in the condenser due to debris on the cleaning devices of the condenser cooling system, and automatic plant shutdown due to the loss of condenser cooling.

Both fast shutdowns are described below.

Automatic shutdown due to error on valve on 27 August 2003
On 27 August 2003 at 9:15 during the regular testing of the main steam isolation valves, the steam supply isolation valve No. 2 closed fast, causing the steam flow to rise and the pressure on steam supply header No. 1 to fall. Because of that the safety injection and the reactor shut down were activated and both main steam supply headers were isolated.

The test runs as follows: a valve has to close for 10 %, and then it has to open fully. The isolation valve B, after its full opening, did not touch the final switcher. Due to that the isolation valve automatically closed after five seconds. Afterwards it was found out that the final switcher was set so that it just touched when the valve was fully opened. Opening and closing of the valve at such setting is not continuous and due to that the opening time was longer.

It was found out that the main reason for the event was a fault in the procedures for setting the final switcher. These procedures were therefore properly modified.

During the event there was no influence on the environment and no damage to the other systems, and the following day at 4:12 the plant was synchronised with the grid. Because, the safety systems during the shutdown of the power plant operated correctly, the event was classified, according to the International Nuclear Event Scale (INES), as an event of level 0 - i.e. as unimportant for nuclear safety.

Automatic shutdown due to the rising level of the Sava river on 27 November 2003
On 27 November 2003, very early in the morning, due to heavy rain and operational procedures of the hydro power plant Vrhovo, the flow of the river Sava suddenly rose. Intensive rinsing of the fallen leaves and other alluvial material in the riverbed of the Sava clogged the cleaning devices at the inlet of the condenser cooling system in the Krško NPP. Because of that, the pipes of the heat exchanger at the condenser partly clogged, which actuated an automatic shutdown of the turbine and the reactor.

The Krško NPP expected the rising of the flow of the Sava river and alluvium of debris, but it was not informed about the operational manipulation of the hydro power plant Vrhovo. On 27. 11. 2003 at 3:20 in the morning operators at the NPP started with the preparation of the planned putting in operation of the cooling towers, in order to obtain cleaner water at the inlet of the condenser cooling system. Similar actions, also foreseen in the operational procedures of the NPP, had already been successfully taken by the NPP in the past. At 5:20 all the conditions to put the cooling towers in operation were fulfilled except the conditions on the Sava river. The cooling towers were started only at 6.38, which was too late because of the intermediate quick rising of the Sava. At about seven o'clock in the morning the soiled water started to fill the condenser pipes, and at 7:26 the operators started to reduce the power of the reactor, but the event already reached a point at which automatic protection of the turbine and the reactor was activated and the reactor was automatically shutdown at 7:35.

During the shutdown of the power plant the operation of the safety system was correct. According to the International Nuclear Event Scale (INES), the event was classified at level 0 - unimportant for nuclear safety. On 1st December 2003 at 10:40 the Krško NPP again started to operate at full power.

The Krško NPP and SNSA analysed the above mentioned event separately. There was no trespassing of regulation procedures of the technical specifications. In the future, however, it should be possible to avoid such unpleasant events by faster action of the operators and especially by better communication between operators of the NPP and the hydro power plant Vrhovo.

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 on the basis of world practice and the newest 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 is one of the most important activities which can influence nuclear safety. Because of that all modifications have to be under rigorous control and properly documented.

Following proper administrative procedures, SNSA approved 12 modifications on the facility, and gave agreement to 17 other modifications. For 12 modifications, the Krško NPP found during the preliminary safety evaluation that there was no open safety issue, so it only informed SNSA about them. In the year 2003 SNSA also approved 5 changes of conditions and limits for operation which were the consequence of modifications in the power plant. SNSA also approved one temporary modification because of the high temperature of the Sava river.

In year 2003 NEK issued the 10th revision of the Updated Safety Analysis Report in which all modifications confirmed until November 2003 were considered.

2.1.1.4 Control of penetrations on the head of the reactor vessel

On the basis of the information of US regulatory body for nuclear safety, SNSA, already before the 2003 outage, summoned the Krško NPP to examine the penetrations (the places at which auxiliary pipes - the guides of the regulations rods - penetrate the vessel) of the reactor vessel head. The reason for this was the fact that in the Davis Besse power plant (USA), in March 2002, larger damages were discovered at similar penetrations, caused by the leakage of primary cooling water from the reactor vessel.

The Krško NPP visually examined 14 of the 40 penetrations during the outage in year 2002. The penetrations, which were not examined in outage 2002, were examined during the 2003 outage. On the outside surfaces of the reactor vessel head penetrations there were no traces of the boron crystal which would indicate leakage of the reactor cooling water. Also eddy current examination of the welds gave no negative results. On the basis of these results it could be concluded that in the Krško NPP there were no problems similar to the ones in the above mentioned power plant in the USA.

2.1.1.5 Higher temperature of the Sava river

In 2003 the air temperature during the summer was very high and due to that the temperature of the Sava river has almost reached 26.7°C, which is the highest allowed temperature as prescribed by the operational limits of the facility. Thus on 23rd and 24th of June 2003 the temperature of the Sava river came to 26.3°C. If the temperature increased by a further 0.4°C, operation of the Krško NPP should therefore be stopped. It has been proved by analysis, however, that due to recent improvements on the cooling systems, warmer inlet water would be compensated by more effective heat exchange, because of the enlargement of flow-through pumps of the essential service water system and daily cleaning of the component cooling system heat exchanger in the Krško NPP. Because of that there are no safety related issues in this regard and SNSA has temporarily approved an increase in the highest permitted average temperature of the Sava river on the suction side of the essential service water system in the Krško NPP, changing the limit from 26.7°C to 27.4°C until the end of the outage in the year 2006.

2.1.1.6 Periodic safety review in the Krško NPP

In the year 2002, the periodic safety review became a regulatory obligation in Slovenian legislation. It 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 on the environment, treatment of radioactive waste and compliance with requirements of the operational licence. An important point of view is review and comparison of up-to-date safety standards with the actual conditions in the power plant, and based on that important improvements for safety can be proposed. The review includes all processes in the power plant, such as operation, testing, and maintenance of equipment.

Already in 2001, the Krško NPP presented an outline of the project Periodic Safety Review, which was examined by the mission of the International Atomic Energy Agency. On July 2001, SNSA issued a decision requiring implementation of the project, and work on this started at the beginning of 2002. In 2003 the Krško NPP sent 64 reports for review. Some of them have already been revised on the basis of commentaries and remarks of SNSA. In December 2003 the Krško NPP delivered a final report which gives a summary of the review of the conditions in the power plant and all recommendations resulting from the periodic safety review for improving the safety of the power plant. The final report and the recommended changes in the power plant and in the documentation of the plant, which will results from the review, will be examined by the technical support organization already before the final approval.

According to the final report there are no major safety deficiencies. The areas are defined where improvements are possible, especially with regard to testing and maintenance procedures, control and supervision of safety important systems, probability safety analyses and supervision of materials ageing. The results of the review will be used in the planning and implementation of safety improvements in the Krško NPP. Some of the determined deficiencies have already been removed, and the rest will be included in the action plan according to their importance and contribution to safety.

2.1.1.7 Operational Safety Assessment Mission at the Krško NPP (OSART)

In the year 2003, the International Atomic Energy Agency carried out a mission for the review and estimation of operational safety of the Krško NPP (OSART - Operational Safety Assessment Review Team). This was already the third visit of OSART mission in Slovenia. The first two took place in 1984 and 1993.

Thirteen experts from different countries reviewed the operational safety of the Krško NPP in the fields of management, professional qualification, management of operations, maintenance, technical support, protection against radiation, preparedness for emergency and safety culture. The mission found that the power plant is well managed and comparable with the best similar power plants in the world. They expressed approval of several good solutions that are not used elsewhere. However, they also pointed to areas where improvements are still possible. The most important of these areas are: work safety, more consistent application of maintenance procedures, more independent quality assurance service and improvements in dealing with low-level radioactive waste. In the following years the Krško NPP will gradually carry out the recommended improvements.

The Slovenian Nuclear Safety Administration found that the number of recommendations was considerably smaller than during the same mission in 1993, and also the number of recommended improvements resulting from these recommendations was lower than in 1993.

2.1.1.8 Inspections

In the Krško NPP 65 planned inspections were carried out, two unplanned inspections and two inspection visits for both of which only formal notes were written.

Unplanned inspections were carried out immediately after the automatic shutdowns on 27 August 2003 (closing of the main steam isolation valve and activation of safety injection) and 27 November 2003 (loss of vacuum in the condenser). None of the two automatic shutdowns had any major influence on nuclear safety.

The inspection visits of which formal notes have been written were carried out in connection with arrival and transporting of fresh nuclear fuel to the Krško NPP (44 new fuel elements) and unannounced exercise of emergency preparedness at the Krško NPP - 2003.

Inspections were continuously present during the outage which lasted 25 days and 16 hours from 10 May till 4 June 2003.

In the year 2003 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 Institute “Jožef Stefan” operated as a neutron source for experiments, for the production of radioactive isotopes and for education and training. In 2003 it operated 180 days and released 258 MWh of heat. 568 samples were irradiated in the carrousel and F-channels and 714 samples in the old pneumatic post. The reactor mostly operated in stationary mode and just once (9 May 2003) in pulse mode, when 10 pulses were performed. For the requirements of experiments, six core design changes were performed, as well as fuel shuffling in the core. In the year 2003 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 Institute “Jožef Stefan”. Also 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 500 pupils from elementary and secondary schools also visited the reactor.

In 2003, there were 160 planned and 19 automatic shutdowns. The number of automatic shutdowns increased by 10 in comparison with the year 2002. Most of the unplanned shutdowns occurred due to a local controller failure. It was afterwards replaced. Another shutdown was caused by a cut of the electric power circuit and irradiation of samples at small power. Nuclear safety was not threatened by these automatic shutdowns. There were no unusual events in the year 2003.

2.1.2.2 Inspections

Two planned inspections were carried out which were examined the condition of the reactor hall and auxiliary rooms, the status of the project of establishing a fast pneumatic post for the transmission of short lived isotopes (from the reactor core to a neighbouring building), reactor equipment as well as its surveillance and maintenance, the activities planned for the year 2003, measuring of radioactivity in the surroundings of the reactor's infrastructure centre, emergency preparedness and training of the employees.

The inspections found no irregularities that would require taking additional measures.

2.1.3 The Central Interim Storage for Radioactive Waste in Brinje

In the year 2003 the Agency for Radioactive Waste Management (ARAO) got the permission for the reconstruction of the Central Interim Storage for Radioactive Waste in Brinje (CISRW) and also carried out the reconstruction. This comprised repairing a small damage of the object, repairing the water supply and the sewer system, and renovation of electric installation, assuring fire protection and setting up of a ventilation device. The reconstruction will be finished in year 2004.

In the year 2003 ARAO received in the CISRW radioactive waste from 20 users. Accepted were 55 sealed sources of radiation, 625 fire detectors and one special waste. Two accepted items were connected with findings of used sources among wasted material earmarked for recycling.

Regarding the arrangement of the inventory in CISRW, the Institute "Jožef Stefan", on the basis of a contract with ARAO and the required permission, carried out repackaging of cobalt sources. At the same time the cobalt sources of small users responding to ARAO's request to give away disused sources to the storage, were repacked. The major part of repackaging was carried out from January till the end of February 2003. The sources were repackaged into two new barrels secured by concrete wainscot. The administrative control over the empty protective containers was abandoned because there was no need to treat them as radioactive material. Due to their removal from storage, the weight of protection packaging in CISRW was reduced by nine tons.

At the end of the year 2003, there were 256 storing barrels with radioactive waste, 247 sealed sources, 140 pieces of special waste and 30 pieces of unspecified radioactive waste in CISRW. The total activity of all waste amounted to 2.7 TBq.

2.1.3.1 Inspections

Through four planned inspections inspectors of SNSA dealt with activities of ARAO with regard to performing their duty of dealing with radioactive waste, documentation in connection with storage activities, training of employees for working in storage, emergency preparedness and review of control of radioactivity of storage surroundings, and other aspects of their radiation practices in connection with the reconstruction of CISRW. Each time an inspection of storage was also performed. One inspection was carried out also by the Slovenian Radiation Protection Administration.

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, among them reporting an intention to carry out practices involving radiation and 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 employer, who is obliged to consult an approved expert in protection against radiation. If the employer has insufficient knowledge and experiences related to the field of radiation protection, the evaluation can be prepared by an authorised expert in this field. For the time being two authorised institutions exist in Slovenia: "Jožef Stefan" Institute and the Institute of Occupational Safety. In 2003 the Slovenian Radiation Protection Administration approved 64 evaluations, 11 of them related to medicine and veterinary medicine, 21 to nuclear and radiation facilities and 32 to other kinds of practices.

2.2.1 Use of ionising sources in industry and research

The above mentioned legislation policy caused some difficulties to applicants. The intention of SNSA was to minimise difficulties of applicants regarding fulfilment of the Act on Protection against Ionising Radiation and Nuclear Safety. In addition, care for the economic interest of organizations was taken into account, as well as care for radiation protection of the population and workers. SNSA issued a circular letter to inform users of ionising sources and of legislative requirements. The majority of the users responded to the circular letter. They 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.

In 2003, 33 permits to carry out practices involving radiation were issued, 4 permits to use a radiation source and 17 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 2003, 55 organizations in the Republic of Slovenia used approximately 170 X-ray devices in industry and research, most of them for industrial radiography and for cargo and luggage control. Approximately 400 sealed sources were used in 120 organizations, the majority of them were used in industrial radiography or for measurement of different parameters like thickness, density or moisture. Due to the delay in the reconstruction of the Central Interim Storage for Radioactive Waste at Brinje the unused ionising sources are accumulated at the user's storehouses.

The Institute of Occupational Safety performed in industry and medicine 1,012 surveys in 2003. The number of surveys is almost the same as the number of surveys in the year 2002 (1,011). “Jožef Stefan” Institute performed surveys of 29 radioactive sources in industry. In addition, this institute also surveyed two radioactive sources and three accelerators in medicine, four laboratories dealing with open radioactive sources and six X-ray devices.

2.2.1.1 Interventions due to discovery of ionising sources

Slovenia established quite an efficient system of alarming and acting in the case of discovery of radioactive sources in the country in the previous years. In this system, the customs, police, steel companies, waste disposals, SNSA, ARAO and technical support organizations co-operate closely. If one of the above mentioned institution measures an increase of radiation, SNSA is promptly informed. SNSA also co-ordinates the whole process. As a rule, on the same day or the day after the event the inspectors of SNSA inspect the site, as well as a representative of a technical support organization and a representative of ARAO, which is responsible for carrying out the public service of radioactive waste management. Within a few hours the source is safely transported to the Central Interim Storage for Radioactive Waste at Brinje.

Three emergency interventions were carried out in the year 2003.

Vrtojba Border Crossing: On 31 July 2003 the Italian customs office at Vrtojba border crossing rejected a truck with a consignment of scrap metal due to higher levels of radiation at the truck site measured during the regular inspection. The consignment was returned to the owner, Remats, d.o.o. A ^{137}Cs source, with activity of about 2.4 GBq, was found within the scrap. Emergency intervention was carried out and the source was accepted to the Central Interim Storage for Radioactive Waste at Brinje due to urgent conditions. At the same time an investigation concerning the origin of the source was carried out. The source probably came to Slovenia from eastern countries in scrap material.

Selška Dolina Valley Alpine Club: The Selška Dolina Valley Alpine Club improperly stored a steel rope containing two ^{60}Co sources. The total activity of both sources was estimated to be below 2 MBq. The rope was used in a telpher line in the past. On 29 August 2003 both parts of the rope containing the source were cut. These parts, around 30 cm in length each, were delivered to the Agency for Radioactive Waste and stored in the Central Interim Storage for Radioactive Waste at Brinje.

The Slovenian Steelworks - Acroni Jesenice: On 28 October 2003, a portal monitor at the Slovenian Steelworks - Acroni Jesenice detected a higher level of radiation at a carriage containing a scrap metal. The consignor of the carriage was Remats, d. o. o. The scrap metal from the carriage was displaced and inspected. A contaminated piece of a pipe containing radium was found and transported to the Central Interim Storage for Radioactive Waste at Brinje.

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 SRPA, 717 X-ray devices were used in medicine and veterinary medicine at the end of 2003. 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 in 2002	New	Written-off	Status in 2003
Dental	353	27	23	357
Diagnostic	259	9	10	258
Therapeutic	4	1	1	4
Simulator	2	0	0	2
Mammography	29	2	0	31
Computer Tomography CT	18	3	3	18
Densitometers	23	2	1	24
Veterinary	24	2	3	23
Total	**712**	**46**	**41**	**717**

Nine permits to carry out a practice involving radiation were issued in 2003. In addition 32 permits to use X-ray devices were granted, 26 to hospitals and public institutions, 5 to a private dispensary and one to a veterinary medicine institution. Seven confirmations of evaluation of the protection of exposed workers against radiation were issued, 6 to hospitals and public institutions and one to a private dispensary.

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: 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. No emergency events were reported to SRPA in 2003. The nuclear medicine departments are inspected twice per year by the Jožef Stefan Institute or the Institute of Occupational Safety, and up to now no major deficiencies have been found.

3. Radioactivity in the Environment

3.1 Monitoring of environmental radioactivity

Monitoring of the global radioactive contamination in Slovenia has been carried out for more than four decades. Above all, two long-lived fission radionuclides have been followed, namely ^{137}Cs and ^{90}Sr, which are the consequence of nuclear bomb tests and of the Chernobyl accident. They are measured in atmosphere, water, soil and in the food chain.

Results for 2003 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 in 1986. Only specific area activity of ^{137}Cs in the upper layer of uncultivated soil is still enhanced: at the time of the Chernobyl accident approximately five times higher contamination (20-25 kBq/m^2) was measured compared to the contribution of all nuclear bomb tests in the past. The biggest contribution to radiation exposure of the public comes from external radiation and from ingestion. In 2003 the effective dose from external radiation of ^{137}Cs was estimated to be 6.5 µSv, which is a little less than in the year before (2002: 6.8 µSv). The annual dose from ingestion (food consumption) was 2.1 µSv; the radionuclide ^{90}Sr accounted for 78 % to the dose, while the contribution of ^{137}Cs was 22 %. The annual contribution due to inhalation of both radionuclides is negligible if compared with radiation exposure from other transfer pathways. In 2003, 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 8.6 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).

Table 3: Radiation exposure of population in Slovenia due to global contamination of the environment in 2003

Transfer pathway	**Effective dose [µSv/year]**
Inhalation (^{137}Cs, ^{90}Sr)	< 0.01
Ingestion -food (^{137}Cs, ^{90}Sr) -drinking water (^{137}Cs, ^{90}Sr; tap water Ljubljana, 2 L daily)	 2.1 0.02
External radiation	6.5
Total in 2003 (rounded)	**8.6**

The Institute of Occupational Safety measured also radioactive contamination of imported and exported food samples. Altogether about 200 measurements of specific activities of radionuclides were performed.

Measurements of iodine concentrations in the transboundary rivers Drava and Mura.
From Austrian annual reports on radioactivity measurements in the environment it can be seen that in previous years occasionally the concentrations of radioactive iodine ^{131}I in the Drava and Mura rivers were considerable. This radionuclide is used in nuclear medicine for the treatment of patients suffering from thyroid malfunctions. A part of the administered activity is transferred to the sewage systems and further to surface waters. Sometimes concentrations up to 100 Bq/m^3 were measured before the exit to Austria. The Institute of Occupational Safety in 2003 examined if in the two rivers within Slovenia the concentrations actually reach such relatively high values. River water was sampled at Petanjci (Mura) and at Dravograd (Drava). Weekly measurements in daily samples did not confirm high levels - the values in the Mura were in the range of 0.6 to 1.7 Bq/m^3 and in the Drava from 1.0 to 7.3 Bq/m^3. This is much less than, for instance, concentrations in the Sava river, which is contaminated by radioiodine from Slovenian hospitals.

3.2 Operational monitoring

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. The measured values of environmental samples are usually considerably lower than the detection limits of analytic procedures. The impacts of the nuclear power plant is therefore 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.

Atmospheric discharges differ with regard to how specific groups of radionuclides contribute to the exposure of population:

- isotopes of noble gases Ar, Kr and Xe may significantly contribute to the external exposure during passage of a radioactive cloud,
- radionuclides tritium and ^{14}C, are biologically important as internal irradiators when built in an organism,
- beta and gamma emitters in particulates (isotopes Co, Cs, Sr) have an impact to the exposure through inhalation and due to the fallout during the cloud passage,
- intake of iodine isotopes in the form of several chemical compounds is responsible for the inhalation dose during the cloud passage and the dose due to the ingestion of milk.

In liquid discharges from the nuclear power plant to the Sava river the activity of tritium (in the form of water HTO) is dominant. In 2003 the total discharged activity of beta/gamma emitters (fission and activation products) was several orders of magnitude lower than in 2002.

Environmental monitoring of radioactivity as a consequence of gaseous and liquid discharges comprised the following measurements:

- concentrations of radionuclides in the air (aerosols and iodine),
- radionuclides in dry and wet fallout,
- content of radionuclides in food of agricultural and animal origin, including milk,

- content of radionuclides in soil on cultivated and uncultivated areas,
- dose of external radiation at several locations,
- contents of radionuclides in river water, sediments and water biota (fish),
- concentrations of radionuclides in tap water (Krško and Brežice), water captures and underground water.

None of the environmental measurements showed the presence of radionuclides that could be attributed to atmospheric discharges from the nuclear power plant. A direct impact of liquid discharges was indicated as higher concentrations of tritium downstream the power plant at Brežice and Jesenice na Dolenjskem (2.0 kBq/m^3 upstream the plant and 3.0 kBq/m^3 downstream; the permissible value - derived limit concentration for drinking water - is 60 MBq/m^3). Concentrations of other artificial radionuclides discharged to the Sava river (^{58}Co, ^{60}Co, and others) were measured below the detection limits. The concentrations of radioisotope ^{131}I in the Sava river were caused by discharges from the clinics of nuclear medicine in Ljubljana and Celje, and releases of patients treated with radioiodine, not by the Krško nuclear power plant operation. In tap waters and water captures no impacts due to the nuclear power plant were detected.

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 ^{14}C as the most important exposure pathways. Exposure of population is relatively low. The highest dose is received due to ^{14}C intake with milk ingestion (children) and cereals (other age groups). Also the calculation on liquid discharges showed a low contribution to the population dose: in 2003 it was only 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 0.01 µSv per year). This estimation is much lower than in previous years but it is based on more realistic data.

From Table 4 it is clear that the total effective dose for an individual living in the surroundings of the nuclear power plant does not exceed the value of 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 previous years due to more realistic dose assessment of external radiation. It represents 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: Modelled exposure assessment of population due to radioactive discharges from the Krško NPP in 2003

Type of exposure	Transfer pathway	Most important radionuclides	Effective dose [µSv/year]
External radiation	Radiation from a cloud (immersion) Radiation from deposition	^{135}Xe, ^{131m}Xe Particulates (^{58}Co, ^{60}Co, ^{137}Cs ...)	max. 0,015 < 0,02
Inhalation	Cloud	^{3}H, ^{14}C	max. 0,18
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 at Brinje

Environmental monitoring of the research reactor TRIGA comprises measurements of discharges (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 external radiation and radioactivity in air, underground water, soil and river sediments.

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 Department of Environmental Sciences at the Jožef Stefan Institute, the exposure of population was estimated to be lower than in the previous year. The external immersion dose due to ^{41}Ar discharges to the atmosphere was estimated using a model calculation to approximately to 0.24 µSv per year. A very 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 about 0.03 µSv. The total annual dose (0.27µSv) to the individual is negligible compared to the general dose limit (1000 µSv) or to the dose due to natural background radiation in Slovenia (about 2500-2800 µSv).

Monitoring of environmental radioactivity of the Central storage of radioactive waste at Brinje included control measurements of radioactive atmospheric discharges (radon and its short-lived progeny from the storage as the consequence of stored ^{226}Ra sources) and liquid discharges (joint liquid effluents from the storage and from the laboratories of Environmental Sciences Department of the JSI), and dose rate measurements on external parts of the storage. Measurements of environmental radioactivity comprise underground water (from the well), sediments of the Sava river and external radiation at some selected distances from the storage.

Enhanced concentrations of radon ^{222}Rn in the vicinity of the storage were estimated by a model. According to this estimate radon concentrations at the fence are on average by 3 Bq/m^3 higher than the natural background. In underground water none of the radionuclides was detected that could be attributed to the storage operation. In the river sediments, besides ^{137}Cs as a remnant of Chernobyl contamination, ^{131}I was detected in traces, coming from sewage discharges as a consequence of patient treatment with high administered activities of this radionuclide in the nuclear medicine clinics in Ljubljana.

For dose assessment only inhalation of radon decay products and direct external radiation were taken into account. The total dose received by the individual (not a radiation worker from the reactor centre) in 2003 was 7.7 µSv, while the annual dose at the fence of the reactor site controlled area was estimated to be about 0.3 µSv. This value equals 0.03 % of the general limit or about 0.01 % of the natural radiation background.

3.2.3 Žirovski vrh uranium mine

The monitoring programme of environmental radioactivity of the former uranium mine at Žirovski Vrh - the mine is currently in the closing phase - consists of measurements of specific activities of long-lived radionuclides uranium-radium decay chain in the environment, measurements of radon and its decay products in the air, and external radiation. Mainly the settled areas located in the valley, up to 3 km from the existing radiation sources are controlled. Impacts of the former mining and milling have to be evaluated as regards the reference measurements carried out at relevant locations outside the influence of the mine.

Concentrations of radionuclides in some environmental media have been partially decreased. The differences are the most evident in lower values of long-lived radionuclides in air, radon and surface water radioactivity. 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 of natural background concentration which is about 20 Bq/m^3 in this region. 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). In 2003 radon concentrations near the mine remained the same, but the levels of radon measured at the reference point (approximation for the background) were lower than before. This apparently means a higher contribution of radon sources of the mine and leads also to a higher dose assessment for the population. Radioactivity of the surface waters in both streams is slowly but steadily decreasing. This is especially the case with concentrations of ^{226}Ra in the Brebovščica and Todraščica streams, which are very close to the natural background levels.

Calculation of an effective dose takes into account the following exposure pathways: inhalation of long-lived radionuclides, radon an 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 340 µSv in 2003. This value is considerably higher than in the previous two years (230 µSv). The increase could be attributed to the lower measured value of natural radon background. If we take into account long-term average concentrations at the reference point for radon background, the effective dose for the year 2003 would be essentially lower (about 200 µSv, which is similar to the last two years). The most important radioactive contaminant of the mine environment was still radon with its progeny, which contribute almost three quarters of additional exposure (Table 5).

Table 5: Effective dose of population due to radiation sources of the Žirovski Vrh uranium mine in 2003

Transfer pathway	**Detailed description** **Important radionuclides**	**Effective dose** **[µSv/year]**
Inhalation	• aerosols with long-lived radionuclides(U, ^{226}Ra, ^{210}Pb) • only ^{222}Rn • Rn - short-lived progeny	3 6 270*
Ingestion	• drinking water (U, ^{226}Ra, ^{210}Pb, ^{230}Th) • fish (^{226}Ra, ^{210}Pb) • local food (^{226}Ra in ^{210}Pb)	(15) 0,8 < 40
External radiation	• immersion and deposition of radon progeny • deposition of long-lived radionuclides • direct gamma radiation from disposal sites	2 - 2
	Total annual effective dose (rounded):	**340 µSv**

* The natural radon background value determined at the reference point was lower, therefore it could be assumed that the Rn value, indicated in the Table, is too high.

The total effective dose due to contribution of the former uranium mine reached one third of the general limit value for the population in 2003: this figure means about 13 percent of the annual dose due to natural radiation background in Slovenia (2500-2800 µSv).

Measurements of radioactivity in the period of the last years show that the discontinuation of uranium mining and remediation measures carried out so far have considerably reduced the environmental impact.

3.3 Early warning system for monitoring the radioactivity in the environment

A complex automatic early warning system for radioactivity measurements was developed 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. All these different kinds of data will be available, allowing a complex assessment of the radiological situation. The data from 42 automatic measuring stations for external radiation governed 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 are collecting at the SNSA, and they are currently analysed and archived, and are available on the Internet address http://www.gov.si/ursjv/si/avto_mon/siRadMap.php. At any increased measured levels the relevant alarm is triggered.

In 2003, only one alarm (occurring in September 2003) due to increased radiation was recorded. It was found that in the vicinity of a measuring station industrial radiography was applied for a pipe welding control. The sensitive instrument of the early warning system detected radiation from the radiographic source.

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 access to the data 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.

3.4 Radiation exposures of population in Slovenia

Every inhabitant of the world is exposed to radiation due to several radiation sources in the environment:

- natural radiation of terrestrial and cosmic origin,
- nuclear bomb tests and accidents with large amounts of radioactive materials released to the atmosphere,

- human activities carried out in inhabited environment, increasing the concentrations of natural radionuclides

Besides this some population is additionally exposed to the sources of ionising radiation:
- at work if they are dealing with radiation sources or in a radiation field,
- at medical examinations if they are exposed to ionising radiation.

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.

3.4.1 Exposure to natural radiation

Natural exposure is caused by the radioactive rocks on the Earth and radiation coming from space (cosmic rays). According to reports 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 2400 μSv, ranging from 1000 to 10,000 μSv. 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 2500 to 2800 μSv per year. About 50 % of this is due to internal exposure as a consequence of inhalation of radon and its progeny (1200-1500 μSv per year). The amount due to intake of food and water equals to about 400 μSv. The annual effective dose of external radiation originating from soil radioactivity, building material in dwellings and from cosmic rays together was estimated at 800 to 1100 μSv.

3.4.2 Population dose due to global contamination

Particularly people from the Northern Hemisphere are 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 2003 the average individual dose to the population from this source in our country was around 9 μSv. The biggest contribution comes from external radiation, while food and water consumption contribute only 2 μSv.

3.4.3 Population dose due to human activities

Radiation exposures due to the regular operation of nuclear and radiation installations are 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 Table 6 the annual individual doses are given for the reference groups of population living the vicinity of nuclear and radiation installations in Slovenia. These doses include also exposure from global contamination of the environment (nuclear tests and Chernobyl accident). The highest exposures are those of the population living in the surroundings of the former uranium mine at Žirovski vrh (slightly above one tenth of the exposure due to natural sources).

Table 6: Population exposures due to the installations discharging radioactivity to the environment and due to global contamination in 2003 (annual dose limit for the population is 1000 μSv)

	Annual dose [μSv]
Žirovski Vrh uranium mine	340
Chernobyl accident and nuclear bomb tests	8.6
Krško NPP	1
Research reactor TRIGA	0.3
Central storage of radioactive waste	0.3

In Slovenia we have little data on exposures of population from former work activities, related mostly to processing raw material containing admixtures of uranium and thorium (mercury mining and processing, processing of bauxite and phosphates, coal combustion). Only certain data on materials with enhanced contents of natural radionuclides are available, but a comprehensive study of exposures of the population in these environments have never been performed.

3.5 Research studies

3.5.1 Radioactive contamination of the forest ecosystem in Slovenia

In the period between 1945 and 1980, 423 atmospheric nuclear bomb tests were performed which contaminated especially the northern part of the globe. The long lived radionuclides ^{137}Cs in ^{90}Sr due to these tests are nowadays still present in the environment. At the Chernobyl reactor accident on April 26, 1986, about 37 % of radioactive materials from the reactor core were dispersed within Europe outside the former Soviet territory. The most contaminated was the upper layer of soil in forests, partly due to a high content of organic matter in the layer and partly due to the fact that the forest areas are not disturbed by the human cultivation. Although forest areas extend over more than 50 % of the Slovenian territory, little data was available about its radioactivity until the year 2003. Within the frame of the research study samples of soil, grass, forest fruits and mushrooms, game meat and bio-indicators were analysed.

The most important findings of this research study, carried out by the Institute of Occupational Health from Ljubljana, are resumed. The upper layer of forest soil (0-5cm) from the surroundings of Dravograd contains as much as one order of magnitude higher activities of ^{137}Cs (10-40 kBq/m^2) than other uncultivated areas throughout Slovenia. High quantities of this radionuclide were found in blackberries: one kilogramme contains as much as 65 Bq, which equals the average annual intake of ^{137}Cs by a Slovenian inhabitant. The contents of this radionuclide in boletus and chanterelles from this location (100-140 Bq/kg) are up to five times higher than elsewhere in Slovenia. In mushrooms named *Xerocomus badius* ^{137}Cs content exceeds the EC limit for import from third countries (600 Bq/kg) by more than a half. The venison contains up to 20-times higher values of radio-caesium than other meat. In bio-indicators (moss, lichens, dry pine needles) the order of magnitude of ^{137}Cs was 200-500 Bq/kg, while radionuclide ^{134}Cs could be still measured in traces (up to 1 Bq/kg).

The results obtained are a new contribution to the knowledge of radioactivity in specific environments in our country. They show that in environmental surveillance programmes more attention should be paid to certain samples and areas. Due to the ingestion of forest fruits, mushrooms and game some specific groups of population are considerably more exposed to radioactivity through the ingestion pathway. However, this contribution is still considerably below the average exposure due to natural sources. There is therefore no reason for any limitation with regard to the consumption of naturally grown food in forests.

3.5.2 Liquid discharges into the environment due to the Šoštanj thermal power plant operation

The operation of a thermal power plant (TPP) increases environmental radioactivity because of the coal, which usually contains natural radionuclides of the uranium-radium decay series. Besides the atmospheric releases, the plant also discharges some waste waters into the environment. Transport waters from the Šoštanj TPP enable transport of the ash sludge to the disposal site located on the sinking terrain of the coal mine and the Velenje lake. Seepage waters from the fly ash disposal site are channelled to the Družmirje lake. The final recipient of the discharged radioactivity is the Paka river.

The aim of the research study carried out by the ERICO Velenje Institute was to estimate the total radioactivity entering the environment with liquid discharges. The assessment takes into account also natural radioactivity of the incoming streams: this radioactivity was subtracted from the measured activity of the liquid effluents from the TPP entering the lakes.

Waters at all discharge points were sampled, including those that have a direct or indirect link with the deposited coal ash, and the flow rates were monitored. The highest concentrations were measured at the outflow of the Velenje lake (for ^{40}K 1370 and for ^{226}Ra 34 Bq/m^3) and of the Družmirje lake (for ^{40}K 144 Bq/m^3 and for ^{226}Ra 38 Bq/m^3). The total liquid discharges for ^{238}U, ^{226}Ra and ^{40}K are shown in Table 7.

Table 7: Liquid discharges form the Šoštanj thermal power plant in 2003

	Liquid discharges of dissolved radionuclides [MBq/year]		
	^{238}U	^{226}Ra	^{40}K
Total discharged activity	29	137* (25**)	$12 \cdot 10^3$

* *reference values of inflow streams taken from the current year (very dry season)*

** *average reference values from previous years are taken into account*

Discharges of ^{226}Ra to the Paka river are quite comparable to the current discharges from the former uranium mine at Žirovski Vrh (64 MBq), while the total released quantity of uranium was one hundred times lower (2.9 GBq).

These measurements should continue in future to verify if radiation exposure of the public does not exceed the acceptable level.

3.5.3 Impact of TENORM on the radioactivity of underground and surface waters in Slovenia

In Slovenia most of the activities with technologically enhanced natural occurring radioactive materials (TENORM) have been identified by various research studies. Processing of some raw materials creates by-products that have enhanced contents of some radionuclides. These products are usually disposed on sites where they are exposed to leaching of radioactive material into surface water and/or underground water, having a certain impact on the environment. Well-known are disposal sites of coal ash and coal tailings (at Velenje, Trbovlje, Kočevje), the areas of the former disposal of roasted residues of mercury ore in Idrija and the disposal site of red mud from processing of bauxite (Kidričevo). Less known are technologically enhanced radioactivity due to titanium oxide production (Celje) and phosphate processing (phosphogypsum from the Hrastnik chemical factory was deposited for a relatively short period at the Unično site).

The aim of our research study, which was funded by the SNSA and carried out by the Jožef Stefan Institute, was to examine the impacts of TENORM on the radioactivity of the surface waters and the underground water. Four locations were examined, namely Idrija (Hg ore), Velenje (lignite), Celje (ilmenite) and Kidričevo (bauxite, coal). The roasted residues of mercury ore and of lignite contain radioactivity of the uranium-radium chain, while phosphogypsum, waste acid from ilmenite processing and red mud contain mostly elements from the thorium decay series. Only key radionuclides of the U-Ra decay series in water were determined, while radionuclides of the Th-series and potassium - the latter is specific for waters in contact with coal ash - were not analysed. Seepage water from the disposal landfill at Unično, with deposited phosphogypsum totalling 0.2 million tonnes, was not measured due to non-cooperative attitude of the management.

High concentrations of ^{226}Ra and ^{210}Pb were measured in bore holes G-10 at Idrija (37 and 233 Bq/m^3 respectively) and in a bore hole V21 at Kidričevo (19 and 186 Bq/m^3). In underground water at Velenje no enhanced radioactivity was detected but it can be seen from the annual report of the ERICo Institute for the year 2002 that water from the same bore hole (Z-3) contained even 56 Bq/m^3 ^{226}Ra, 37 Bq/m^3 ^{210}Pb and 232 Bq/m^3 ^{40}K. The quoted values of ^{210}Pb at Idrija and Kidričevo exceed the derived limit value (200 Bq/m^3) based on the EC directive for drinking water 98/83/EC. The measurements should be repeated and appropriate measures should be carried out if necessary. The concentrations of ^{226}Ra reach about one tenth of the limit value (500 Bq/m^3), derived from the same limitation.

The research study shows that in future more attention has to be paid to radioactivity caused by TENORM. The future regulations, foreseen by the Act on radiation protection and nuclear safety, are being prepared to cover this subject appropriately.

4. Radiation Protection of Workers and Medical Exposures

4.1 Occupational exposure to ionising radiation

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 dosimetric services are the Institute of Occupational Safety (IOS) 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 6300 persons have their records in the central register. In 2003, the dosimetric service at the IOS performed measurements of individual exposures for about 3100 workers employed at around 700 enterprises. Almost 31,000 TLDs were read-out. The "Jožef Stefan" Institute monitored the exposures of 349 radiation workers. The average annual effective dose was the highest at the Institute of Oncology (930 μSv), while the employees of the JSI received on average only 50 μSv. The Krško NPP performed dosimetric control only for their staff and for outside workers, i.e. altogether for 841 workers.

In 2003, 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 was received by radiation workers employed in the Krško NPP and in medical institutions (0.799 and 0.55 manSv respectively). Exposures in industry and in research are an order of magnitude lower (0.059 and 0.066 manSv respectively).

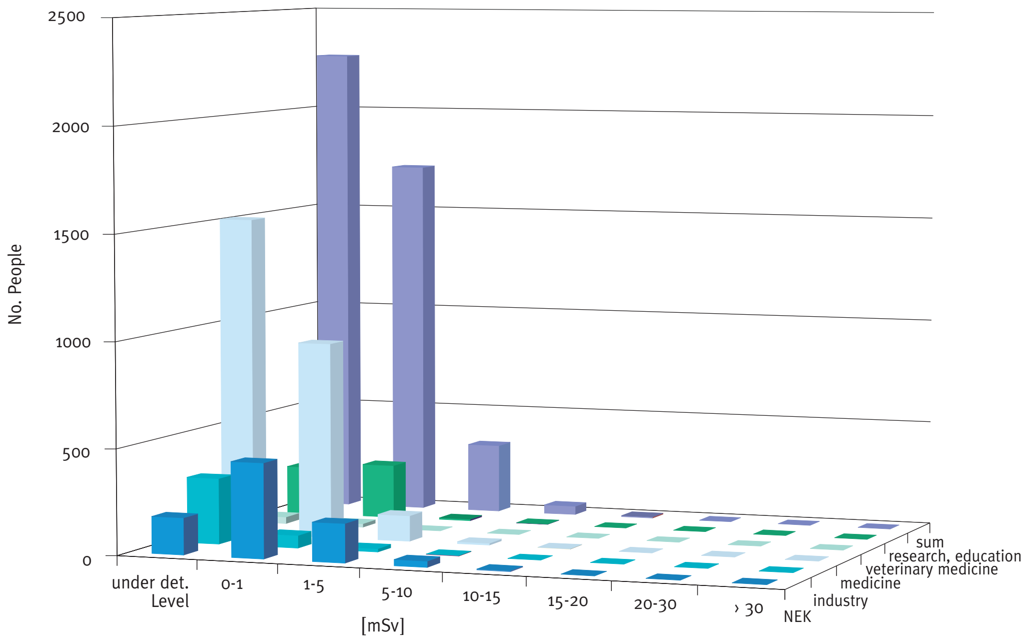

Figure 6: Number of workers in different branches distributed according to dose intervals

The SRPA regularly controls occupational exposure to radon in mines and tourist caves. In the lead and zinc mine at Mežica the maximum effective dose received by a single worker was 2300 μSv. The average individual dose of 870 μSv was calculated for a group of 13 workers. At the Žirovski vrh Mine the maximal individual dose was 5400 μSv, and the average for a group of 40 workers was 2370 μSv.

4.1.2 Training

Training of radiation workers is carried out by the approved technical support organizations, namely the Institute of Occupational Safety and the Jožef Stefan Institute. The Institute of Occupational Safety organized several training courses on radiation protection, three of which were general courses on radiation protection and the rest were courses adjusted to the needs of users of radiation sources. Altogether 348 participants attended these courses, 216 from industry and 132 from medical, research and educational institutions. In 2003, the Nuclear Training Centre at the Jožef Stefan Institute organized five training courses for users of radiation sources in industry and research.

4.1.3 Medical surveillance

Medical surveillance of radiation workers in 2003 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 Ltd., Krško, Health Centre Krško, and Health Centre Škofja Loka. Altogether 1855 medical examinations were carried out.

4.2 Medical exposures

In 2003, SRPA started a project of sample programmes of radiological procedures for the most frequent medical activities. This project will help medical practitioners to prepare relevant programmes of quality control and to perform intercomparison runs for radionuclide measuring devices in nuclear medicine. The aim of the radiological procedure programmes is to improve the medical exposure control of patients and the quality of radiological procedures, while the intercomparison runs will systematically examine the accuracy of radionuclide monitors by the use of the reference radiation monitor that is traceable to the primary standards.

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. It comprises restoration of diagnostic reference levels for patient exposures. In a few years this will enable radiation dose assessment for the population due to medical examinations.

5. Control Over the Radiation and Nuclear Safety

5.1 Legislation

The Act on Protection against Ionising Radiation and Nuclear Safety was amended in 2003. The amendments provide that the Slovenian Government shall prepare an amendment of the National Programme for the Protection of the Environment as regards radioactive waste and spent fuel management by the end of 2004 and submit it to the Parliament for adoption. The site for a low- and intermediate-level waste repository must be approved by 2008 and it is to be licensed for operation by 2013.

Some regulations necessary for the implementation of the Act were adopted:

- Regulation on the Expert Council for Radiation and Nuclear Safety (Off. Gaz. RS, 35/2003),
- Regulation on the Expert Council on Issues Relating to Protection of People Against Ionizing Radiation, to Radiological Procedures and to the Use of Radiation Sources in Health and Veterinary Care (Off. Gaz. RS, 62/2003),
- Regulation on the Conditions for the Use of Radiation Sources in Health Care (Off. Gaz. RS, 111/2003),
- Regulation on Conditions and Methodology of Assessment of Doses for the Protection of Workers and the Population Against Ionizing Radiation (Off. Gaz. RS, 115/2003),
- Decree on the Criteria for Determining the Amount of Compensation due to the Limited Use of Land in the Area of a Nuclear Facility (Off. Gaz. RS, 134/2003).

Several other decrees and regulations were in the process of preparation and reconciliation in 2003 to be adopted 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, 50/2003, OCT-1[1]), 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 Export of Dual Use Goods (Off. Gaz. RS, 31/2000), Decree on Export and Import Regime of Specific Goods (Off. Gaz. RS, 111/2001, 20/2002 64/2002, 116/2002, 37/2003, 54/2003 and 129/2003) and regulations, issued on the basis of this 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.

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, Spatial Planning and Energy 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, mitigation of the consequences of emergencies, and use of radiation sources other than those used in health and veterinary care. Based on Article 5 of the Act on Protection against Ionising Radiation and Nuclear Safety the minister of the Environment, Spatial Planning and Energy appointed the chairman and four members of the expert council.

The Expert Council met four times in 2003. The Expert Council Rules of Procedure were adopted. In addition to the standard issue, i.e. “safety of nuclear facilities operation in the period after the last meeting”, the Expert Council also discussed and issued its opinions on:

- Draft Decree on Dose Limits, Radioactive Contamination and Intervention Levels (UV 2),
- Draft Regulation on Conditions Governing Imports, Exports and Transit of Radioactive Waste or Spent Fuel (JV 11),
- Draft Regulation on Conditions for Workers Performing Activities Related to Safety in Nuclear or Radiation Facilities (JV 4),
- Draft Decree on Practices Involving Radiation (UV 1),
- Draft Regulation on Conditions Governing Imports, Exports and Transit of Radioactive or Nuclear Substances (JV 12) and
- Draft Regulation on Use of a Radiation Source and on Radiation Practice (JV2/SV2).

[1] *OCT - Official Consolidated Text*

5.2.2 Expert Commission for Testing the Krško NPP Operators Qualifications

The Expert Commission for Testing the Krško NPP Operators Qualifications met seven times in 2003. In November and December 2003 the Commission organized six examinations for altogether 22 candidates. All candidates passed the exams.

One candidate passed the examination for the Senior Reactor Operator for the first time. 16 candidates acquired the extension of the Senior Reactor Operator license and five candidates acquired the extension of the Reactor Operator license.

The candidate who passed the examinations for the first time got from the SNSA the license for one year, while the others, based on the proposal of the Commission, got the licenses for four years.

5.3 Slovenian Radiation Protection Administration

The Slovenian Radiation Protection Administration (SRPA), established in 2003, performs specialized technical and developmental administrative tasks and tasks of inspection related to carrying out practices involving radiation and use of radiation sources in medicine and veterinary medicine, protection of people against 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, diminishing and prevention of health detriment resulting from non-ionising radiation, and auditing and authorisation of radiation protection experts.

In 2003 the SRSA was mainly preparing and adopting the regulations. It continued the monitoring of radioactive contamination of foodstuffs and drinking water and started two new projects related to the preparation of programmes of radiological procedures and intercomparison measurements in nuclear medicine. Because of these activities supervision of the protection of people against ionising radiation was reduced in comparison with 2002. In spite of that, adequate safety in carrying out practices involving radiation and use of radiation sources in medicine and veterinary medicine was maintained. The SRSA carried out the supervision together with expert organizations, which regularly supervise the situation in this area. The SRSA kept the records of radiation sources used in medicine and veterinary medicine and developed and filled the central record on personal doses of exposed workers.

Within its competencies the SRPA supervised in 2003 the Krško NPP and the Agency for Radioactive Waste Management, which operates the Central storage for radioactive waste in Brinje near Ljubljana. In the Krško NPP five inspections were performed and one inspection was performed in the Agency for Radioactive Waste Management. With regard to carrying out the radiation safety no irregularities were found, only the measured collective dose during the outage in the Krško NPP was higher than planned due to unforeseen problems related to the reactor vessel head penetrations inspection, more extensive activities related to the maintenance of the primary reactor coolant pump motor, to the inspection of snubbers and to the opening and closing of the reactor vessel.

With regard to radon, the SRPA supervised in 2003 the Žirovski Vrh Uranium Mine in decommissioning, the Mežica Lead and Zinc Mine in decommissioning, the Postojna Cave and primary schools, kindergartens and hospitals with increased contents of radon.

5.4 Technical Support Organizations

In Slovenia two organizations, namely the "Jožef Stefan" Institute and the Institute of Occupational Safety, have acquired authorisation for monitoring radioactive contamination, for measuring the exposure of workers to ionising radiation, for periodic monitoring of levels of exposure in the working environment, for the control of operability of measuring instruments and protective equipment, for the decontamination of the working and living environment, and for training of radiation workers. The Žirovski vrh Mine has been authorized for performing measurements of ionising radiation in mines.

For the implementation of active medical protection, the following institutions are authorized: the Clinical Institute for Medicine of Work, Traffic and Sport, the Institute of Occupational Safety, the Community Health Centre Krško (for the Krško NPP employees) the Community Health Centre Škofja Loka (for Žirovski vrh Mine employees) and Aristotel Llc. from Krško. The most extensive professional tasks performed by these organizations in the year 2003 were monitoring of exposure in the working environment and radiation exposure of workers, training of radiation workers, preparation and presentation of an expertise in the field of radiation protection and assessment of radiation protection measures, surveillance measurements of radioactivity in the environment, assessment of the impact of the nuclear facilities to the environment, and a review examination of radiation sources. The authorized public health organizations were monitoring the health conditions of the radiation workers.

According to Article 14 of the Act on Implementing Protection against Ionising Radiation and Measures for the Safety of Nuclear Facilities, technical and research organizations were authorized for performing certain tasks in the field of nuclear safety and radiation protection on the Slovenian territory.

In 2003 the following 13 organizations held the authorisation:

- 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 applied the Quality Management Programmes, and some of them even obtained or renewed Quality Certificate.

The most extensive professional task of these organizations in 2003 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 attention was focused on making an independent evaluation of the periodic safety review. A significant part of their activities consisted of research and development activities. Some organizations very successfully co-operated in the 6th framework programme of the EU researches.

In Articles 28 and 29, the Act on Protection against Ionising Radiation and Nuclear Safety determines the tasks of approved radiation protection experts, while the provisions of Articles 58 and 59 of the Act regulate the work of the approved experts for radiation and nuclear safety. Special regulations, which shall be issued on the basis of Articles 28 and 59, shall define in detail the records of approved experts, the format and extent of regular and exceptional reports and other conditions which approved radiation protection experts and approved experts for radiation and nuclear safety for individual fields of radiation protection or radiation and nuclear safety must fulfil.

5.5 The Fund for Decommissioning of the Krško NPP

The Fund was established by Law at the end of the year 1994 with an intention to assure the financial resources for the decommissioning and disposal of radioactive waste and spent fuel originated from the Krško NPP. The Fund's mission was to provide sufficient financial resources to cover all costs associated with the decommissioning and disposal of radioactive waste and spent fuel from the Krško NPP.

Due to shared ownership the levy on kWh was paid into the Fund by the Krško NPP only for the electric energy delivered to Slovenia. In March 2003, a bilateral treaty between the Government of Republic of Slovenia and the Government of Republic of Croatia concerning the Krško NPP was ratified. The treaty, among other, defines that the Krško NPP is owned by two states in equal shares. Each country must have its own Fund for collecting the financial resources for decommissioning and disposal of radioactive waste and spent for a safe decommissioning and radioactive waste management.

The Krško NPP had to contribute a levy of 0.61 Slovenian Tolars (SIT)/kWh into the Fund until March 2003. Since then, the ELES GEN, Plc, a company representing the interest of Slovenian owner of the Krško NPP, is obligated to pay the levy per kWh from the half of generated electricity in the Krško NPP in the amount of 0.462 SIT/kWh.

In the first quarter of 2003 the Krško NPP contributed to the Fund 965 mio SIT. For the rest of the year ELES GEN, Plc contributed a total amount of 774.7 mio SIT. Total payments from both the Krško NPP and ELES GEN, Plc. In 2003 were 1,739.8 mio SIT. With this the financial liabilities toward the Fund were completely covered.

For the sake of safety of investment, the Fund constantly holds at least 30% of all financial investment in stocks issued or guarantied by the Republic of Slovenia. At the end of 2003 the Fund had 24,924 mio SIT of financial investment, 33 % of them have been placed in large Slovenian banks, 49 % in national bonds (domestic bonds and bonds in EURO) and 13 % in other bonds, almost 3 % in mutual funds and investment societies and 2 % in stocks of Slovenian "blue chips" companies. Investments in deposits were dispersed in nine commercial banks and the investments in the national bonds were dispersed in 19 issues. The real yield of the Fund's portfolio for the year 2003 was 9.66 % in EURO.

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. In 2003 the Pool raised its capacities, compared to 2002, i.e. to the amount of USD 7,613,000 for domestic risks and to the amount of USD 6,854,000 for foreign risks.

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 190 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 0.84 %, 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.

5.7 Implementation of the International Agreement on the Krško NPP

At the Set-up Assembly on 5 April 2003, the new management of the Krško NPP was appointed and the supervisory board was constituted. The Assembly also appointed an ad hoc business and technical arbitration board as provided in the contract of partnership. The supervisory board confirmed the estimated price and other conditions of supply of electric energy for both partners (Eles Gen, Llc. and Hrvatska elektroprivreda, Ltd.) in 2003. The price of electric energy was formed in a way to cover all costs of operation, including inter alia also the costs of amortisation in the amount which guaranties the realisation of long-term investments and investments into technical improvements related to the safety and economic efficiency of the NPP.

The Croatian partner started to receive the electric energy from the Krško NPP on 19 April 2003.

The Government of the Republic of Slovenia appointed on its session on 9^{th} May 2003 the Agency for Radioactive Waste Management to prepare a programme of decommissioning and managing of low and intermediate radioactive waste and spent nuclear fuel of the Krško NPP, while the Government of the Republic of Croatia appointed on 22 March 2003 the Agency for Special Waste.

On 15 May 2003 the Government of the Republic of Slovenia established an international commission to survey the implementation of the international agreement and appointed its members and chairman. The chairman of the Slovenian part of the international commission is the minister competent for energy. The Government of the Republic of Croatia also appointed the members of the international commission, which is also chaired by the Croatian minister competent for energy.

The international commission met for the first time on 10 June 2003 and entrusted the Krško NPP a task to prepare, together with the above mentioned Agencies, a decommissioning plan by the end of June 2003. At its second meeting the international commission determined the deadline for preparing the decommissioning plan, namely 11 March 2004.

On 9 December 2003 the supervisory board of the Krško NPP confirmed a long-term plan of investments for the technical upgrade of the Krško NPP for the next five-year period. The supervisory board also agreed with the business plan for 2004 and in this way determined the price of electric energy.

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 a comprehensive system of nuclear and radiation safety.

The Administration for Civil Protection and Disaster Relief of RS

In 2003 the activities of the Administration for Civil Protection and Disaster Relief of RS, which is the organization within the Ministry of Defence accountable for administrative and technical tasks relating to protection, rescue and assistance in the system of protection against natural and other disasters, were mostly directed to the analysis of the »NEK 2002« exercise and the preparation of a new version of the National Radiological Emergency Plan.

In February 2003 the Government of RS approved the »NEK-2002« Exercise Report. Besides the recommendations to improve the nuclear emergency preparedness, which mainly address the communications, transfer of measured data and implementation of protective actions, the Government of RS also requested from the ministries which did not contribute to the National Radiological Emergency Plan to provide their inputs as soon as possible.

To improve the National Radiological Emergency Plan some inter-ministerial working groups were established for communications, radiological monitoring, informing the public and implementation of protective actions. Some of the proposals prepared by the working groups were incorporated into the new version of the National Radiological Emergency Plan, while most of them will be included in the appendices to this plan.

In the second half of 2003 all the activities were focused into the revision of the National Radiological Emergency Plan. Version 2.0 was produced, which was harmonized with the new legislation in the area of emergency planning. In addition, the experience gained during exercises and the recommendations of international organizations were also taken into account. The chapters on the scope of planning and resources needed were fully rewritten. When adopting the new National Radiological Emergency Plan, the Government of RS passed a decision which requires all involved organizations to harmonize their radiological emergency plans with the National Plan. These new harmonized plans shall be sent to the Administration for Civil Protection and Disaster Relief of RS within three months after being adopted.

In the Training Centre for Protection and Rescue at Ig, 149 members of Civil Protection, capable of intervening in radiation or nuclear emergencies, were trained. The training was conducted in accordance with additional, introductory and fundamental training programmes for Civil Protection members.

Considering the Agreement between the Governments of Croatia and Slovenia on Co-operation in the Protection against Natural and Civilisation Disasters the sub-commission for the harmonisation of emergency plans continued its work. The sub-commission members were informed about the experiences gained during the “NEK-2002” exercise, and with the planned changes in the National Radiological Emergency Plan.

Slovenian Nuclear Safety Administration

During an emergency SNSA follows its own emergency plan, which defines its response during the event and contains the procedures for the maintenance of emergency preparedness. In 2003 there were produced new nine procedures, which represent approximately one quarter of all procedures (the total number of procedures is 34).

The Emergency Preparedness Unit, which is directly subordinated to the SNSA Director, carried out the following tasks:

- Revision of all procedures of the SNSA Emergency Plan in accordance with the findings and the report made by SNSA participants in the »NEK-2002« exercise,
- Implementation of systematic monthly communication testing, emergency premises walk-down (twice per month), testing of the emergency diesel generator,

- General one-day training for all emergency organization staff,
- Special two-day training for each expert group separately,
- Exercise planning,
- Exercise analysis (collecting and classification of remarks, production of the action plan, correction of procedures, equipment procurement).

In 2003 the lists of expert group members were updated and the tasks of individual emergency organization positions were defined in more detail. A table was produced which relates the emergency procedures and individual positions in the emergency organization.

The Krško NPP

The activities of the Nuclear Power Plant Krško in 2003 concerning emergency planning were directed to the maintenance of the existing preparedness, especially to increasing the training and skills of the Krško NPP emergency organization and to implement the tasks and recommendations assigned within the frame of the annual emergency preparedness action plan. In this context, priority was given to the harmonisation of nuclear emergency plans of all levels and the preparation for the OSART mission, as well as support during its implementation.

The Krško NPP in 2003 carried out a revision of information material for the visitors and of the outage manual. The Krško NPP visitors and excursions were informed about the emergency planning. The new programme for the assessment of radiological consequences was put in trial operation.

"NEK-2003" Exercise

The unannounced exercise, named "NEK-2003", took place in the afternoon and evening of 8 October 2003. It was carried out by the the Krško NPP, the National Notification Centre and SNSA. During the exercise, activation of the nuclear power plant and the SNSA emergency organization were tested. The following elements of emergency response were implemented and tested: declaration of emergency, assessment of situation and emergency classification, activation and functioning of the emergency centres, functioning of equipment and communications, decision making about protective actions, evacuation of the NPP, security service response, assessment of radiological consequences in the environment, notification of authorities and public information.

The overall outcome of the exercise was positive, the equipment in the emergency centres and the response of the emergency organization were satisfactory.

Ecological Laboratory with Mobile Unit (ELME)

The Radiation Unit of the Mobile Laboratory ELME made no interventions in the year 2003. Three regular drills in the vicinity of the Nuclear Power Plant Krško were performed.

International activities in the area of emergency preparedness management

Within the project of strengthening the regional emergency preparedness the IAEA held the Area Coordination Group Meeting of the participating states in Vienna from 29 to 30 May 2003.

From 2 to 6 June 2003 the Second Meeting of Representatives of National Competent Authorities to the Convention on Early Notification of a Nuclear Accident (the early notification convention) and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (the Assistance Convention) took place in Vienna. The agenda included the presentation of work carried out by three committees between two meetings (the first one was held in June 2001). The committees were as follows: Long-term Sustainability of the International Emergency Preparedness and Response System, System of International Assistance and Strengthening International Emergency Communication. The draft final report was formed as an action plan.

During 3 and 4 July 2004, DSSNET (Decision Support System NETwork) Meeting took place in Krakow. Around 60 participants presented their contributions to three systems of support to decision-making (European RODOS, Danish ARGOS and Russian RECASS). DSSNET works under the EU Fifth Framework Programme. The main purpose of the meeting was to convene the annual meeting of representatives of organizations taking part in DSSNET. The meeting representatives reviewed the work already carried out and set guidelines for the next period.

The symposium on Off-Site Nuclear Emergency Management, organized by Austria, Germany, EU and US DoE, was held in Salzburg from 29 September to 3 October 2003. There were over 180 participants. The main purpose of the symposium was an overall presentation of the status of emergency preparedness in a particular country. The review comprised trends in organizational development of emergency preparedness, information technology, communication support and systems for support of decision-making during radiological emergency. The emphasis of the last part of the symposium was on finding solutions to the problems presented at the symposium.

Within the PHARE project Installation of RODOS System in Slovenia two procurements were launched. Following the evaluation of tenders and granting of the selection procedure, a contract was concluded with Enconet Consulting GmbH/STUK in October 2003.

In 2003 the SNSA started sending daily radiological data in new EURDEP 2.0 form via computer to EU JRC in Ispra (Italy). In relation to that, SNSA took part in an international exercise to test overall transmission of data to JRC Ispra during an emergency. Exchange of these data with the neighbouring Austria continued.

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

In Slovenia the 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 uranium production and 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 in Brinje.

6.1 Radioactive waste and irradiated fuel at the Krško NPP

In the past several years the volume of LILW radioactive waste was reduced by means of compression, super-compaction, drying and incineration, so that their total volume at the end of 2003 was 2253 m^3 (Figure 7). 161 standard drums containing solid waste with total gamma activity of 1.10E+12 Bq and total alpha activity of 3.35E+8 Bq were stored in 2003. The majority of the above mentioned activity arises from 36 stored drums, which contain spent demineralizer from the primary coolant circuit. They were temporarily stored in the tank before their treatment in 2002. The incineration products of the radioactive waste which was sent to Sweden in 2002 have not been returned to the Krško NPP by the end of 2003.

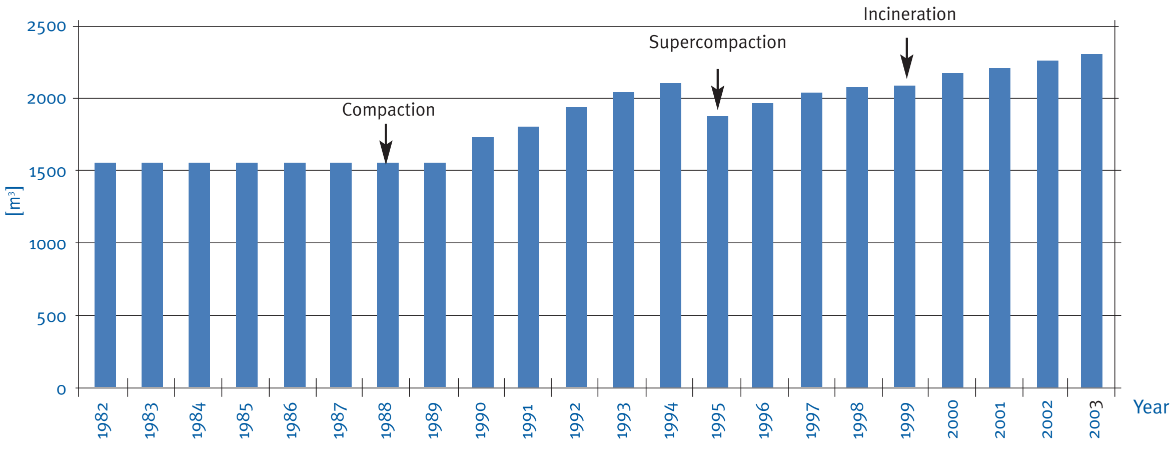

Figure 7: The volume of low and intermediate level radioactive waste in the Krško NPP

All spent nuclear fuel at the Krško NPP is stored in a pool. The capacity after its reracking is 1694 storage cells (before 828). During the 2003 regular outage 44 spent fuel elements were removed from the reactor core. At the end of 2003 altogether 707 spent fuel elements were stored in the spent fuel pool, containing approximately 275 t of irradiated uranium. Figure 8 shows accumulation of spent fuel at the Krško NPP.

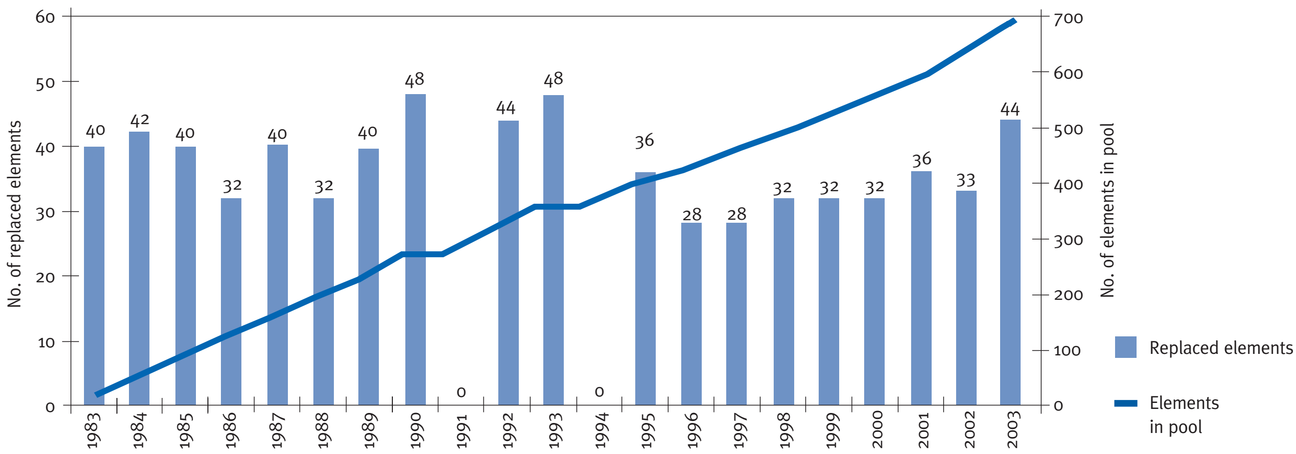

Figure 8: The annual discharges of spent fuel assemblies and accumulation of spent fuel assemblies in the Krško NPP spent fuel pool

6.2 Radioactive Waste at the "Jožef Stefan" Institute

In 2003, approximately 0.5 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 2003, approximately 2.7 m^3 of radioactive waste was accumulated, with total activity of $3.7 \cdot 10^7$ Bq, ready for transfer to the Central Interim Storage for Radioactive Waste in Brinje. Due to the reconstruction of the Central Interim Storage for Radioactive Waste in Brinje this radioactive waste is temporarily stored at the Reactor infrastructure centre of the "Jožef Stefan" Institute.

6.3 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. Unless the technical support organization determines that the specific activity exceeds the limits for drinking water, the tanks are emptied every five or more months.

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.

6.4 Operation of RAO Agency

The RAO Agency is responsible for carrying out the public service of radioactive waste management. Among other things, it also covers the operation of the Central Interim Storage for Radioactive Waste in 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 in Brinje, the public service of radioactive waste management is practically not performed or is performed only in emergency cases.

6.4.1 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. One of the main reasons for the failure of this effort has been the low public acceptance of such a repository. Consequently, the RAO Agency oriented its efforts into communication with the public and developed a special methodology for this purpose. The process of site selection was presented to the general public at some press conferences and through the mass media. In addition, a special workshop was organized for the representatives of Slovenian local municipalities. The key role in this process was given to a mediator, who presented the process to municipal councils, the media and the political parties in the parliament. The actual work related to the construction of the repository was limited to the production of studies, a conceptual design and education of the staff. 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.

In 2003 the RAO Agency evaluated in greater detail within suitable regions the natural conditions for the siting of a repository for low and intermediate level radioactive waste from the geological point of view. The Agency is planning to receive official offers for the site from local municipalities in 2004. The adoption of the Decree on the Criteria for the Determination of the Amount of Compensation Due to the Limited Use of Land in the Area of a Nuclear Facility (Off. Gaz. RS, 134/2003) is extremely important for the involvement of the public and their acceptance of the site. The draft of the decree was prepared by the RAO Agency.

6.5 Reclamation of Uranium Mining at Žirovski Vrh Mine

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 accompanying objects, has been successfully demolished. At present the reclamation of the mine is still going on. The biggest remaining problem is reclamation of the tailings Jazbec and Boršt. For these disposal sites the Ministry of the Environment, Spatial Planning and Energy issued a supplement to the site permit in 2003. Therefore, preparation of reclamation at both sites is still in progress.

The most problematic is reclamation of Boršt where the uranium mill tailings are deposited. The results of field tests on this disposal site showed that the uranium mill tailing has poor geomechanical characteristics. For this reason, a special expert council was established in 2003 with the objective to prepare terms of reference for a comprehensive technical solution for a permanent reclamation of the Boršt uranium mill tailings site. The proposal of such terms of reference was not prepared by the end of 2003.

The Žirovski vrh mine is requested to harmonize the results of the expert council with the contents of the supplement to the site permit and it also has to obtain a permit for the planned works. In 2003, SNSA defined the content of the safety analysis report, which should be prepared and submitted for approval to SNSA.

6.6 The First Slovenian Report under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

Slovenia as a Contracting Party to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, prepared the first comprehensive national report in 2003. In this report, details on radioactive waste management in Slovenia are presented. The Slovenian delegation participated in the first Review Meeting which took place at the IAEA headquarters in Vienna from 3 to 14 November 2003, where the parties to the convention reviewed the national reports.

The Slovenian report and its presentation were favourably received by the other parties, in particular with regard to its initiative on a regional solution regarding the disposal of high level waste.

6.7 The initiative on a regional solution for the disposal of high level waste

After preliminary discussion with the directors of nuclear regulatory bodies of the Czech Republic, Slovakia and Hungary, the director of SNSA proposed the formation of an international group with the task of seeking a solution for the regional disposal of high level waste. The first meeting of the informal group was held in Ljubljana on 2 December 2003. There where representatives of the Czech Republic, Slovakia, Hungary, Bulgaria, Croatia and Austria. Romania expressed its interest but was not present. Although all counterparts were aware that a final solution is a time-consuming process, they accepted the initiative as a possible solution to the problem. It was concluded that the members of the group would examine the possibilities for such solution in their own countries and would meet again in 2004.

The initiative received a warm acceptance in the international arena. It was obvious that many countries and international organizations share the opinion that high level radioactive waste should preferably be stored at very few, safe and well-guarded locations around the world. Slovenia considers this option as a possible future solution to this important problem.

6.8 Transport and Transit of Radioactive and Nuclear Materials

In accordance with the Law for Transportation of Dangerous Goods, SNSA issued one permit for import of nuclear material, namely for the 44 fresh fuel assemblies for the Krško NPP. The fuel arrived in April 2003 by the sea into the Port of Koper, wherefrom it was transported by trucks to the Krško NPP.

For the transport of radioactive materials nine permits were issued to the Institute for Occupational Safety. Most of them were used for transport of spent sealed sources between different companies and the Central Interim Storage for Radioactive Waste in Brinje. Slovenian and foreign carriers also conveyed a transit of isotopes to Hungary and Croatia.

6.9 Import and Export of Radioactive and Nuclear Materials

SNSA issues permits for import and export of radioactive and nuclear materials, with the exception of medical appliances, which are regulated by the Ministry of Health - the Slovenian Radiation Protection Administration (SRPA).

In 2003, SNSA and SRPA issued 88 permits (Figure 9), 82 permits for import and 6 for export. The biggest importers were Biomedis d.o.o., Karanta Ljubljana d.o.o., Genos d.o.o., Krško NPP, Temat d.o.o., Kemofarmacija d.d. and IMP Promont kontrolor NDT Črnuče.

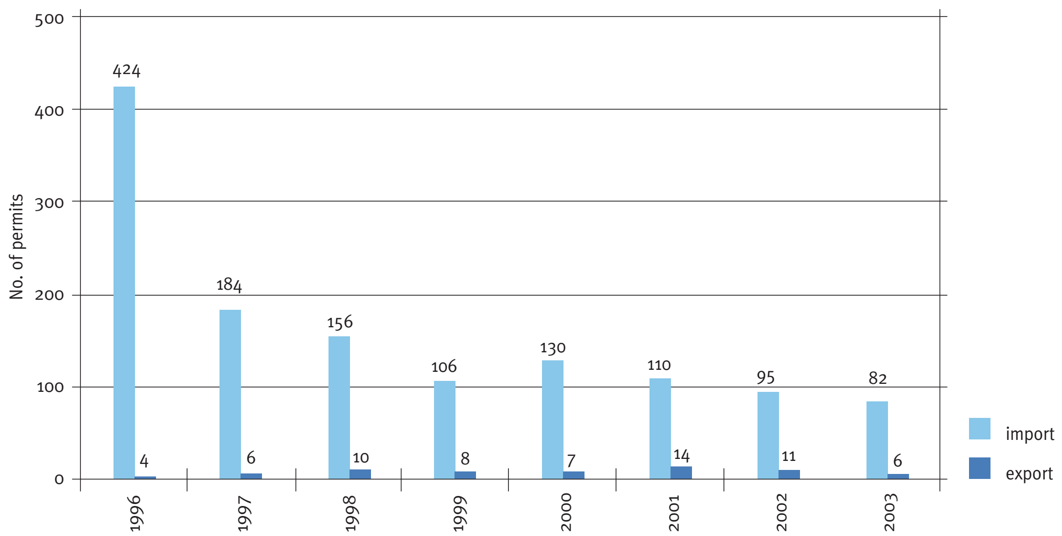

Figure 9: Number of import and export permits of nuclear and radioactive materials by year

6.10 Decommissioning of nuclear facilities

In Slovenia, there are two nuclear facilities that, after their closure, are subject to decommissioning. With regard to the financial and technical aspects, decommissioning of the Krško NPP, including the removal of low, intermediate and high level radioactive waste, is a very demanding process. Therefore, it is necessary to timely ensure the necessary financial resources and skilled technical an labour infrastructure. For this purpose, the Law on the Fund for Financing the Decommissioning of the Nuclear Power Plant Krško and for the Disposal of Radioactive Waste from the Nuclear Power Plant Krško was adopted. The Law governs the collection of financial resources and their management. This law and the responsibilities for decommissioning of the Krško NPP have been changed after the treaty between the Slovenian and Croatian Governments on solving statutory and other legal relations, related to the depositions 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 parties. They will prepare a decommissioning programme, which will be revised at least every five years.

In 2003, the Agency for Radwaste Management and the Croatian partner APO d.o.o. started preparing the decommissioning programme, which has not been finished by the end of 2003 yet. The programme will be approved by a bilateral commission and then approved by SNSA.

The research reactor TRIGA of the "Jožef Stefan" Institute has been in operation for 37 years and has an operating license without time limitations. The decommissioning plan for this reactor has not been made yet. The costs and technical requirements for this research reactor are smaller in comparison with the decommissioning of the Krško NPP. The biggest problem and costs are envisaged in relation to spent fuel management and its disposal.

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 September 11, 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.

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 2003 and no anomalies were detected. SNSA reported to IAEA in due time, in accordance with the Safeguards agreement. SNSA and the organizations that possess nuclear materials worked on preparation for of the changes concerning this reporting after the accession to the European Union.

7.2 Additional protocol to the Safeguards agreement

The Additional protocol was signed in 1998, ratified and entered into force in 2000. SNSA prepared the initial report and sent it in 2001 to IAEA. Since then annual updates were prepared. The last one was sent to IAEA in May 2003. 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 newly built regional switchyard next to the Krško NPP site. IAEA inspectors carried out two inspections under the Additional protocol and no anomalies were discovered.

With reference to the obligations under the Additional protocol, we should mention the speech of the US State Secretary Colin Powell in the Security Council of the United Nations, in which he was justifying reasons for the military intervention in Iraq. He claimed, among other things, that Iraq had tried to acquire nuclear technology also from Slovenia. This information got a lot of attention in domestic media and politics.

With regard to this issue, IAEA representatives showed a strong interest in a Slovenian company producing industrial magnets. Slovenian authorities examined the case and through an interview with the director of the company revealed that in a business contact interest for magnet production technology transfer had been expressed, but this never materialized. This information was given to IAEA representatives during their visit relating to Slovenian commitments on nuclear non-proliferation.

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. Slovenia signed the treaty on September 24, 1996 and ratified it on August 31, 1999.

Slovenia, its state institutions and other organizations (Slovenian Agency for the Environment, Geological Survey of Slovenia, "Jožef Stefan" Institute and Institute of Occupational Health) did not have any significant activity in this area.

7.4 Export Controls of Dual-Use Goods

There are several state institutions which have their roles and competencies in this area: Ministry of Economy, Ministry of Foreign Affairs, Ministry of the Interior, Ministry of Defence, Customs Administration, National Chemicals Bureau and SNSA. Their work is being co-ordinated by a commission (Inter-agency working group for monitoring and co-ordination of control on export of dual-use goods) established by the Government in 2002.

In the scope of international activities in this area Slovenia is participating in the work of the Nuclear Suppliers Group (NSG) and Zangger Committee. In accordance with the established rules and procedures, SNSA reported regularly to both organizations also in 2003. In response to a Slovenian application, the technical co-ordinator of the NGS set-up a direct, protected, electronic connection between SNSA and the Japanese mission in Vienna serving as a point of contact for NSG.

The is practically no export of nuclear-related dual-use goods from Slovenia. In 2003 SNSA did not receive any request for opinion on export of such goods.

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 in Brinje, is supervised by joint inspections of the Ministry of the Interior and of 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, 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 July 2003.

In 2003, the NPP accomplished the refurbishment of its technical system for physical protection. In the scope of refurbishment of the Central Interim Storage for Radioactive Waste in Brinje, the Agency for Radwaste Management prepared a physical protection plan that was approved by the Ministry of the Interior.

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 organized primarily through international organizations such as the International Atomic Energy Agency and the European Commission. The latter in particular is striving to achieve the same level of control in the candidate countries as in the EU Member States. Besides this there are also bilateral activities with the USA and to some extent with German and Austrian state institutions. In April and May 2003, 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, 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 organized two consultative meetings in May and October 2003. Their objective was to analyse the status and to coordinate activities. For the purpose of consultation, SNSA provided to the other organizations the phone number of a 24 hours on-duty officer of the radiological monitoring. There were 10 calls in 2003. Two of them required interventions because of discovery of a Cs-137 source in a scrap material shipment to Italy and discovery of a Ra-contaminated (NORM) scrap material shipment. Police representatives visited several Slovenian companies possessing radioactive sources presenting a greater potential risk in case of unauthorised use and they conveyed some informative discussions.

In 2003, Slovenia reported on one occasion to the IAEA Illicit Trafficking Database. It reported the discovery of the Cs-137 source in the shipment of a scrap material to Italy. In 2003, IAEA received more than 465 reports of similar events throughout the world. They were characterized as a theft, loss, discovery or unauthorised transfer of radioactive sources.

8. International Co-operation

8.1 Co-operation with other International Organizations

In the year 2003, 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 (15 - 19 September 2003), the following should be mentioned:

- Within the programme of technical co-operation in 2003 Slovenia received 35 applications for training of foreign experts in our country. 7 of these applications were implemented in the same year as well as 8 applications from 2002. All other applications approved by our country will be implemented in 2004.
- Within technical co-operation in 2003 there were 9 research contracts going on which had been signed in the previous years. 5 research contracts were completed in 2003, while 4 new research contract proposals were submitted, of which 2 were approved by the Agency.
- Technical assistance projects are the most extensive form of co-operation between Slovenia and the International Atomic Energy Agency. This is due to the large amount of resources, engagement of experts and also to the fact that projects of this type usually last for several years. In December 2003, Slovenia submitted 5 new technical assistance project proposals for the cycle 2005-2006, which will be decided upon in the year 2004. The International Atomic Energy Agency approved 2 project proposals for the years 2003 and 2004 and extension of a project that has been going on since 2001.
- In 2003, the International Atomic Energy Agency implemented three missions in Slovenia:
    - Operational Safety Assessment Review Team Mission - OSART
    - Mission on the Combined Use of Deterministic and Probabilistic Methods to Enhance the Event Investigation Process at Nuclear Power Plants, and
    - In-service Inspection Programme Mission.

Slovenia continues with its active politics of being a host of activities organized by IAEA. In 2003, Slovenia hosted 11 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 2003, 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 EU

8.2.1 Adoption of the acquis and co-operation with EU

The 4th meeting of the EU-Slovenian sub-committee for transport, energy, environment and trans-European networks was postponed from December 2002 to January 2003. The main topic discussed in the area of nuclear safety was independence of the Slovenian regulatory body from the energy sector, since SNSA falls under the Ministry of the Environment, Spatial Planning and Energy. In July 2003, the 5th meeting of the Accession Committee EU-Slovenia took place. With the accession both the committee and the sub-committee will cease to exist.

In April 2003, Jaime Garcia Lombardero, chief negotiator of the European Commission with Slovenia, sent a letter with a request to update the Slovenian position concerning compliance with recommendations set out in the Council's Report on the Evaluation of Nuclear Safety in the Context of Enlargement (ref. 9181/01), elaborated in 2001. The Slovenian side responded that all the recommendations set out in the report were successfully met. Special attention was given to the recommendation on independence of the regulatory body (i.e. SNSA) from promoting of nuclear energy, and to the seismic safety of the Krško NPP, also due to the fact that these two recommendations were emphasized also in the Peer Review Status Report concerning the fulfilment of recommendations given in the Council's Report on the Evaluation of Nuclear Safety in the Context of Enlargement. The Status Report was prepared at the end of the Spanish Presidency in June 2002. Slovenian position is that the present legal basis and the organizational framework within the Ministry of the Environment, Spatial Planning and Energy are sufficient for independent functioning of the Slovenian regulatory body for nuclear safety. Seismic characterization of the Krško NPP area is linked to the elaboration of a new seismotectonic model which will be included in the new revision of the updated safety analysis report.

Signing the Accession Agreement in Athens in April 2003, Slovenia was given the status of an observer state in organizations and bodies of the EU. In the field of nuclear safety, a representative of the Mission of the Republic of Slovenia to the European Union in Brussels attended the meetings of the Atomic Question Group. The main discussion in the AQG was on the subject of the so-called nuclear package composed of two proposals for Council Directives (Euratom, COM(2003)32): setting out basic obligations and general principles on the safety of nuclear installations and on the management of spent nuclear fuel and radioactive waste. Both proposals were prepared at the end of 2002, during the Danish Presidency. During the Italian Presidency (the second half of 2003) two groups were formed on the given question: supporters and opponents of the Directives. Supporters of the Directives claimed that it was due time to adopt a binding document regulating nuclear security and radioactive waste management. The emphasis was on international significance of nuclear safety and the need for common standards, which would mean a sound basis for further harmonization of nuclear safety. The circle of opponents of the Directives comprised Great Britain, Germany, Finland and Sweden; they argued that in the first stage of convergence to common standards a recommendation or a resolution should be sufficient. They also claimed that the Directives were too incomplete, which could lead to a situation where the Court of Justice of the European Community should decide on nuclear safety. In the field of radwaste it was said that decisions on a geological repository of radioactive waste were premature. The question of a binding or non-binding mode was raised in the Committee of Permanent Representatives (COREPER). COREPER proposed that under the Irish Presidency in the first half of 2004 an action in the direction of Directives should be resumed. The Annual Regular Report on Slovenia's Progress Toward Accession was in 2003 substituted by a Comprehensive Monitoring Report on Slovenia's Preparation for Membership, stating that Slovenia is fully able to assume the obligations of membership in EU. The Report also mentions that in June 2003 Slovenia presented to the European Commission additional data on progress made in meeting the priorities stated in the Council's Report on the Evaluation of Nuclear Safety in the Context of Enlargement and on independence of the regulatory body. The Report stimulates Slovenia to further strengthen the Agency for Radwaste Management and mentions a few deficiencies in legislation in the field of radiation safety which were to be transposed by the time of accession to EU. Since it is believed that administrative capacity is on a reasonable level no special emphasis was given to this.

In December 2003, two acts were adopted: Council Directive 2003/122/EURATOM of 22 December 2003 on the control of high-activity sealed radioactive sources and orphan sources and Commission Recommendation of 18 December 2003 on standardised information on radioactive airborne and liquid discharges into the environment from nuclear power reactors and reprocessing plants in normal operation.

8.2.2 PHARE Projects approved in 2003

In January 2003 the Financial Memorandum for the PHARE Nuclear Safety 2002 projects was signed. These projects are:

- Upgrading and Modernization of the National Early Warning System,
- "Hot cells" Facility Renovation and Modernization,
- Characterization of Low and Intermediate Level Radioactive Waste Currently Stored in a Central Facility.

CONCERT GROUP

23rd Meeting of the CONCERT Group took place during 5 to 7 May 2003 in Prague. The main part of the meeting was devoted to a regulatory approach to safe closure and decommissioning of NPPs. The next meeting took place from 11 to 12 December 2003 in Brussels. The purpose of the meeting was mutual exchange of information of representatives of regulatory bodies in the field of nuclear safety, review and opinion of the CONCERT Group on the situation in particular fields interesting to all of the participants and strengthening of informal contacts between regulatory bodies. Besides that, EU representatives presented a few other areas: status of PHARE projects in particular states in projects, EURATOM research projects in the field of nuclear safety (i.e. general approach, vision, needs and common instruments), and a plan of the consortium of ten states in the field of development of new concepts of reactors.

8.2.3 Co-operation with Other Associations

In the field of nuclear and radiation safety representatives of Slovenia co-operate with other international associations like: Western European Nuclear Regulators' Association (WENRA), Network of Regulators of Countries with Small Nuclear Programmes (NERS), International Nuclear Law Association (INLA), association in the field of dual use goods (Zangger Committee and Nuclear Suppliers Group - NSG), Decision Support System Network (DSSNET), European Commission for Urgent Radiological Information Exchange (ECURIE), International System on Occupational Exposure (ISOE), etc.

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 time.

8.2.4 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 2003, representatives of Slovenia participated in a group of experts who prepared a text for amendment of the Paris Convention on Third Party Liability in the Field of Nuclear Energy and Brussels Supplementary Convention. Both will be ready for signing in February 2004.

Representatives of Slovenia also took part in a working group of legal and technical experts preparing a proposal for the Director General of IAEA. The proposal should consist of co-ordinated suggestions of changes and supplements to the Convention on Physical Protection of Nuclear Material. The working group did not succeed in finishing the proposal in the given mandate, therefore informal consultations will continue in 2004.

During 3 and 14 November 2003 the Slovenian delegation took part in the first review meeting of parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (details in chapter 6.6).

Besides co-operation in multilateral agreements, SNSA continued to co-operate with representatives of related regulatory bodies in the scope of bilateral agreements (with Austria, the Czech Republic, the Slovak Republic and Hungary).

8.3 Use of Nuclear Energy World-wide

According to information provided by international organizations (International Atomic Energy Agency, British Petroleum, World Energy Congress) nuclear energy still represents an important source of electrical energy in the world as it satisfies approx. 16 to 17 % of the consumption. In the EU countries about one third of the produced electricity comes from the nuclear power plants and its share is not diminishing.

In 2003 the 32 years old nuclear power plant Stade in Germany and four smaller units in the United Kingdom were permanently shut down. Construction of a fifth reactor started in Finland which is the first newly ordered nuclear unit in Europe after more than two decades. A similar construction is foreseen in France at the end of 2004 or in 2005, while in the US by the end of 2003 operating life of more than 20 reactors was extended from 40 to 60 years. Moreover, construction of new nuclear power plants is continuing in Asian countries: China, Japan, the Republic of Korea and India.

Table 8: Number and Installed Power of Operational, Shut-down and Under-construction Reactors by Country at the end of 2003

	Operational		Shut down		Construction	
	No. of Units	Total MW (e)	No. of Units	Total MW (e)	No. of Units	Total MW (e)
			Europe			
Belgium	7	5.712	1	11		
Bulgaria	4	2.722	2	816		
Czech Republic	5	2.560			1	912
Finland	4	2.310			1	1.600
France	59	63.293	12	3.719		
Germany	18	20.432	18	5.605		
Hungary	4	1.731				
Italy			3	1.163		
Lithuania	2	2.370				
Netherlands	1	452	1	55		
Romania	1	650			1	650
Russian Federation	30	20.739	5	786	6	5.125
Slovak Republic	6	2.408	1	110		
Slovenia	1	676				
Spain	9	7.460	1	480		
Sweden	11	9.401	2	610		
Switzerland	5	2.985	1	9		
Ukraine	13	11.358	4	3.317	2	1.950
United Kingdom	27	11.992	18	2.254		
Total Europe:	**207**	**169.251**	**69**	**18.935**	**11**	**10.237**
			Asia			
Armenia	1	376	1	376		
China	5	3.636			5	5.001
Dem. P.R. Korea		0			2	2.000
India	14	2.446			9	4.712
Iran		0			2	1.900
Japan	54	44.394	3	320	4	5.062
Kazakhstan		0	1	70		
Korea, Republic of	18	14.890			2	2.000
Pakistan	2	425				
Taiwan	6	4.885			1	1.350
Total Asia:	**100**	**71.052**	**5**	**766**	**25**	**22.025**
			Americas			
Argentina	2	935				
Brasil	2	1.855				
Canada	20	13.601	5	2.016		
Mexico	2	1.308				
USA	104	95.622	24	9.107		
Total Americas:	**130**	**113.321**	**29**	**11.123**		
			Africa			
South Africa	2	1.842				
Total World:	**439**	**355.466**	**103**	**30.824**	**36**	**32.262**

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 four year 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 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 reports of 2003 present the level of radiation protection and nuclear safety world-wide.

Twenty-six INES reports were received by NEWS in 2003. Nine reports were on events in nuclear power plants, the remaining 11 on lost radioactive sources (3 reports), on exceeded dose levels due to use of radioactive sources (4 reports), in 3 cases a spent source was found in a scrap metal intended for recycling, and incidents of radioactivity in consumer products (stainless-steel thermoses, canisters and watch bands) were also reported.

One event in a nuclear power plant was rated as level 3 - *serious incident*, ten as level 2 - *incident*, nine as level 1 - *anomaly* and one as level 0 - *no safety significance*. Among other events eight were rated as level 2 and three as level 1.

The events which were reported to NEWS in 2003 did not have any strong impacts on the environment, nor did they cause any injuries to workers due to radiation. In four cases radiation workers received doses higher than the prescribed limit but this did not result in any lasting health effects. The most serious anomaly in any nuclear power plant in 2003 was the one in Hungary, in the nuclear power plant Paks, where due to negligent handling of the nuclear fuel cleaning process in a special container outside the reactor, cooling of the fuel was interrupted, which resulted in damage of most of the fuel assemblies inside the container. There was no appreciable impact on the environment or workers in the plant; however, the economic damage was high since the plant will not be able to operate for at least two years.

Slovenia reported to NEWS on two events. The first one occurred on 16 July on the border crossing Vrtojba where a radioactive source was found in a container containing a scrap metal. The second report was on an event that occurred in NEK on 27 August. A fast shut down of the plant took place due to a reactor scram caused by the reactor protection signalling an error on the main steam isolation valve. The former was rated as level 1 and the latter as level 0.

9. Appendix: List of Organizations and their Internet Addresses

Organization	Internet address
Agency for Radioactive Waste	http://www.sigov.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, Spatial Planning and Energy	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	N/A at the moment
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/

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2. Letno poročilo NEK 2003, februar 2004.

3. Performance Indicators for the Year 2003, NEK, februar 2004.

4. Dodatno poročilo o varnostnih in obratovalnih kazalcih za leto 2003, dopis ING.NOV-017/2004/2791 z dne 8. 3. 2004.

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8. Dopisi št. ING.DOV-192.03/BF/9718 (3.9.03), ING.DOV-212.03/BF/10536 (30.9.03) in 39000-7/2003/7/0200 (12.9.03) o nenormalnem dogodku št. 3/03: Sproženje varnostnega vbrizgavanja na signal nizkega tlaka glavnega parovoda in samodejna ustavitev reaktorja zaradi napake pri testiranju osamitvenega ventila na glavnem parovodu.

9. Analiza zaustavitve NEK zaradi izgube vakuuma v kondenzatorju, URSJV Sektor za jedrsko varnost, URSJV/DP-065/2004, marec 2004.

10. Poročilo o dejavnostih na področju pripravljenosti NEK za primer izrednega dogodka (NUID) za leto 2003, dopis št. ING.DOV-035.03/BG/2450 z dne 26. 2. 2004.

11. Poročilo za leto 2003, Uprava Republike Slovenije za varstvo pred sevanji, št. 59-4/2004-15-B02.

12. ELME - Poročilo za leto 2003 - Radiološki del, IJS-DP-8913, februar 2004.

13. Radioaktivnost v življenjskem okolju Republike Slovenije za leto 2003, ZVD, št. LMSAR 166/04, Ljubljana, marec 2004.

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15. Nadzor radioaktivnosti v okolju Rudnika urana Žirovski vrh med izvajanjem programa trajnega prenehanja izkoriščanja uranove rude in ocena vplivov na okolje, Poročilo za leto 2003, IJS-DP, št. 8935, Ljubljana, marec 2004.

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