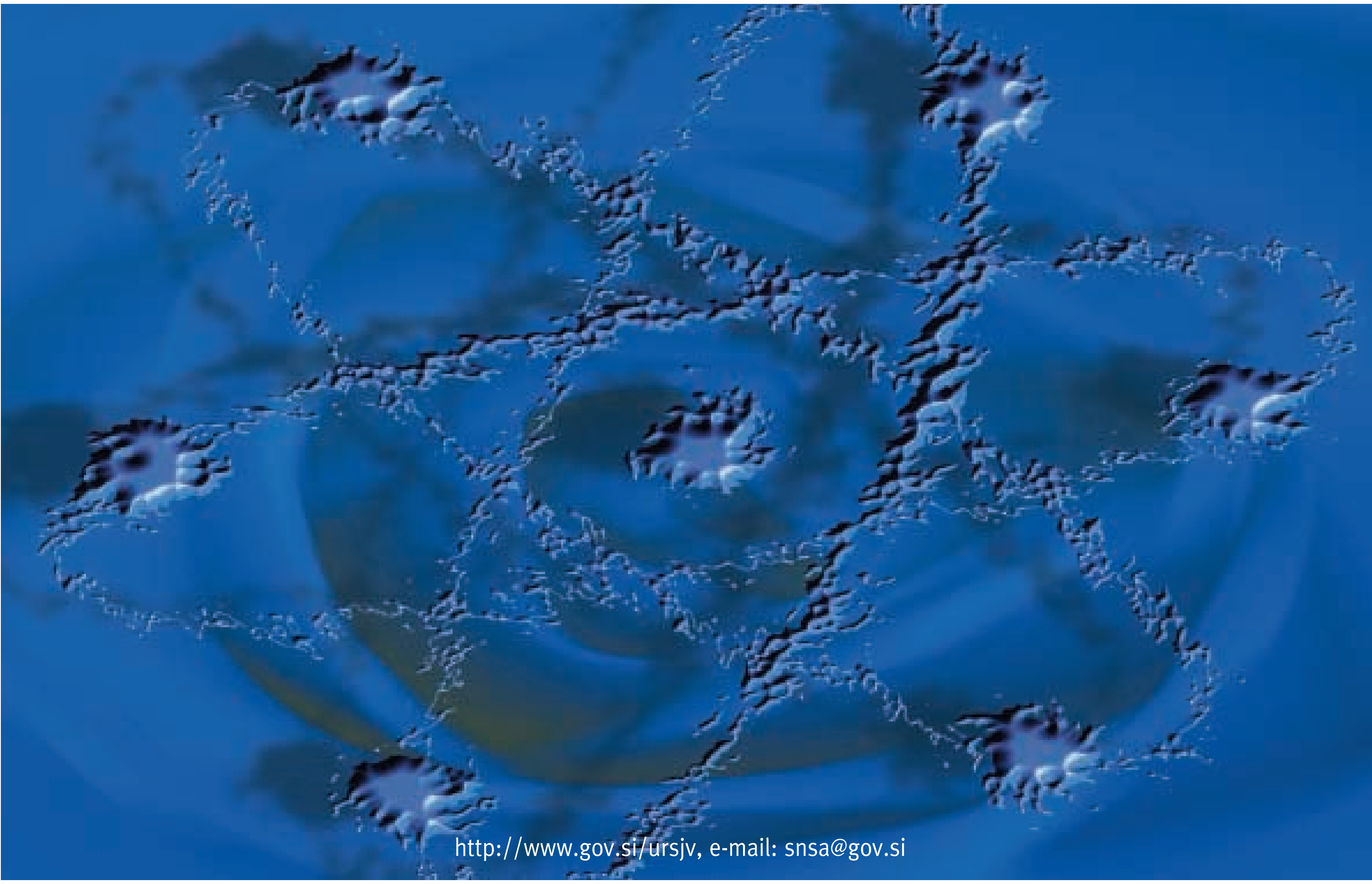
REPUBLIC OF SLOVENIA
MINISTRY OF THE ENVIRONMENT, SPATIAL PLANNING AND ENERGY
SLOVENIAN NUCLEAR SAFETY ADMINISTRATION

Annual Report 2002 on the Radiation and Nuclear Safety in the Republic of Slovenia



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Annual Report 2002 on the Radiation and Nuclear Safety in the Republic of Slovenia

June 2003

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1. Preface

Regarding nuclear and radiation safety, the year 2002 can be characterised as very dynamic, yet at the same time as undisturbed. The latter qualification relates to the number of incidents, which could reflect the radiological risk of the population or the environment. The number of such incidents was very small and none of them was a threat to the population (details are given in the next chapter). The operation of the biggest nuclear facility, the Nuclear Power Plant Krško, was stable and reached the highest production of electrical energy.

The year was very dynamic, on the other hand, regarding updating of the legislation on nuclear and radiation safety, which was mainly based on harmonization of Slovenian legislation to that of the European Union. In spring 2002, a new law, namely the Act on Protection against Ionising Radiation and Nuclear Safety, was passed after several years of preparation and intensive reconciliations in the National Assembly. The law is a big step if we take into account that the old law from the time of former Yugoslavia was replaced and that the general harmonization based on the requirements of the European Union was achieved. The work is not finished yet however, and preparation of the secondary legislation, which will replace the old regulations, is still under way. The new law clearly defines the responsibilities of the ministry which is responsible for the environment and the ministry responsible for health.

This report is different from the previous ones. The main part was shortened so that it can be easily read and understood. All details and numerous data are put into the extended report (Reference 1), which is available in the electronic form on a CD or at the homepage of the Slovenian Nuclear Safety Administration (www.gov.si/ursjv).

Data regarding nuclear facilities, unusual events, radioactive contamination of the environment, the state system of radiation and nuclear safety, emergency preparedness, waste management, nuclear non-proliferation and finally international co-operation in the field of nuclear safety are given in this report.

2. Operation of Nuclear Facilities

A nuclear facility is defined by the Slovenian legislation as *"a facility for the processing or enrichment of nuclear materials or the production of nuclear fuel, a nuclear reactor in critical or sub-critical configuration, a research reactor, a nuclear power-plant and heating plant, a facility for storing, processing, treating or depositing nuclear fuel or highly radioactive waste, and a facility for storing, processing or depositing low or medium radioactive waste"*. Three nuclear facilities operated in 2002 in Slovenia: the Nuclear Power Plant Krško, the Research reactor TRIGA and the Central Interim Storage for Radioactive Waste in Brinje.

2.1. Nuclear Power Plant Krško

2.1.1. Operation and Performance Indicators

The Nuclear Power Plant Krško produced in 2002 5,527,987.5 MWh (5.5 TWh) gross electrical energy on the output of the generator or 5,308,751 MWh (5.3 TWh) net electrical energy that was placed to the grid. This is the highest amount of electrical energy produced in a calendar year in the operating history of the nuclear power plant, and is 3.28% higher than planned. The reactor operated for 8,139.82 hours or 92.92% of the total number of hours in this year. The thermal energy production of the reactor was 15,806,966 MWh. Total electrical energy production in Slovenia has been increasing over the last few years and it reached 13,031.7 GWh in the year 2002. Figure 1 shows the electric power production of the Nuclear Power Plant Krško in the year 2002.

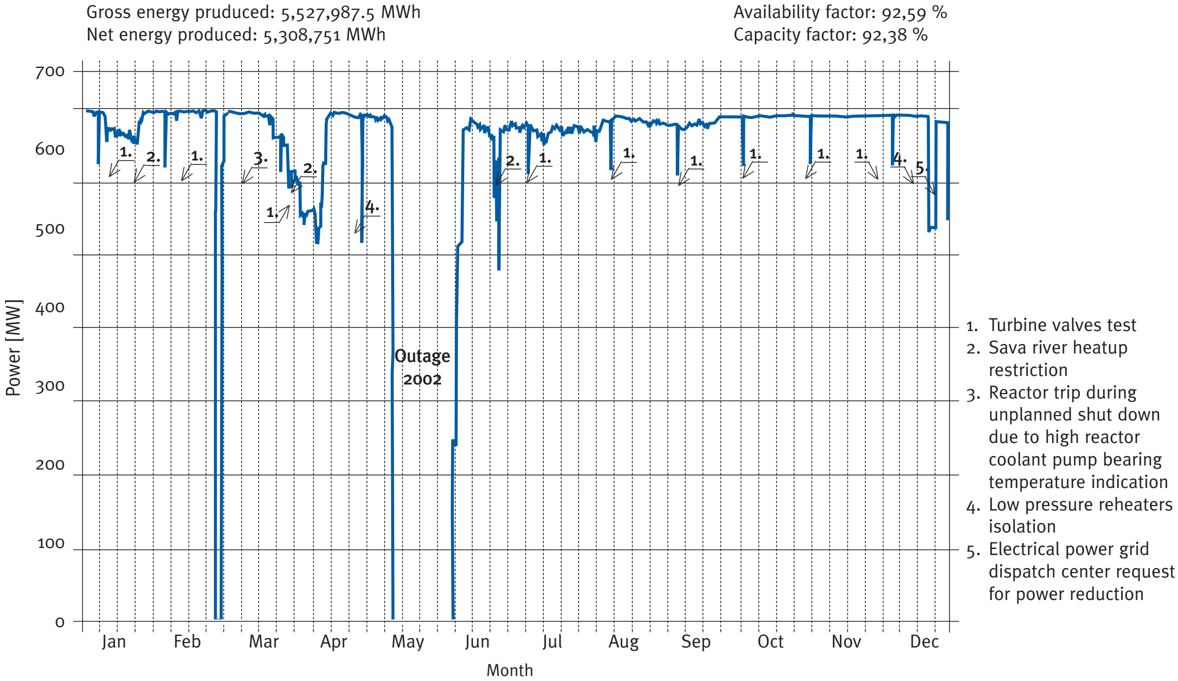

Figure 1: Diagram of electric power production in 2002

In Figure 2, production of electric energy is presented for the years of commercial operation. The reason for the maximum annual production in 2002 are a high level of availability, a high capacity factor and an increase in power by 6.3% due to the steam generator replacement in 2000. In 2002, production of nuclear electric energy , in the Republic of Slovenia amounted to 40.7% of total electric energy production (the sum of hydro, thermal and nuclear energy).

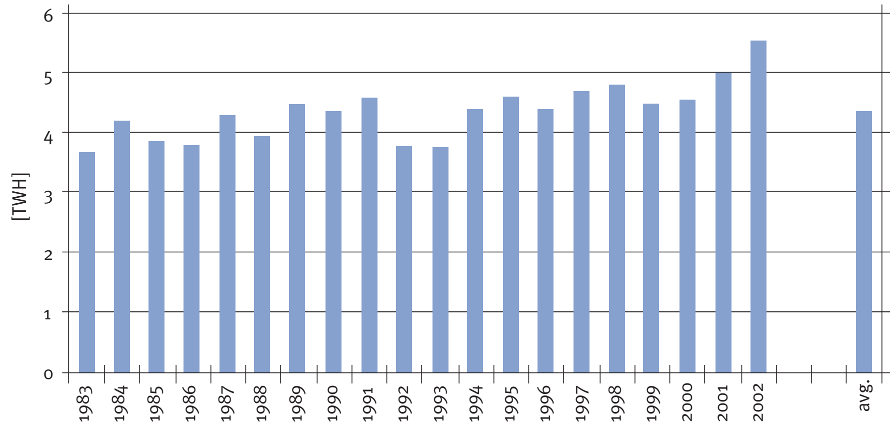

Figure 2: Realization of production since the start of the power plant operation; avg. stands for average over all operation years.

The performance indicators, which confirm the stable and safe operation of the power plant, are shown in Table 1.

Table 1: The most important performance indicators in 2002

Safety and operational indicators	**Year 2002**	**Average**
Availability [%]	92.59	83.18
Capacity factor [%]	92.38	79.68
Forced outage factor [%]	0.55	1.32
Realized production [GWh]	5,527.99	4,360
Fast shutdowns - automatic [Number of shutdowns]	0	3.22
Fast shutdowns - manual [Number of shutdowns]	1	0.42
Unplanned normal shutdowns [Number of shutdowns]	0	1.14
Planned normal shutdowns [Number of shutdowns]	1	0.81
Event reports [Number of reports]	3	3.9
Refueling outage duration [Days]	25	54
Contamination of primary coolant, cycle 18 [g Uranium]	1.5	8.5
Fuel reliability indicator [GBq/m^3]	0.00039	0.11

The capacity factor, shown in Figure 3, is used world-wide as the main indicator of succesful operation of the power plant. In 2002 it reached the highest value since the start of the Nuclear Power Plant Krško operation.

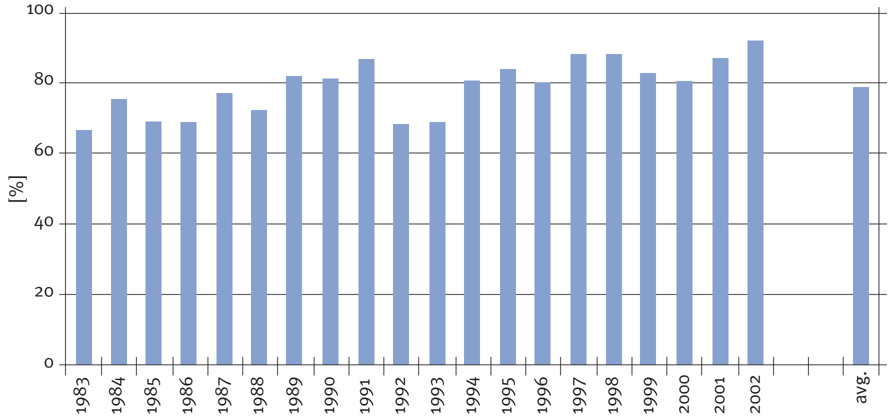

Figure 3: Capacity factor

In Figure 4 the number of fast shutdowns of the power plant is presented for each year. Nuclear power plant shutdowns for safety reasons are a very important indicator of its operation and safety.

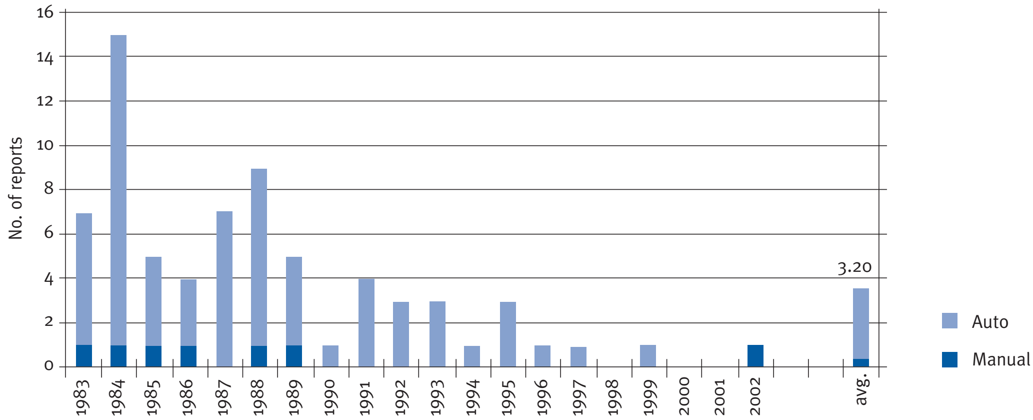

Figure 4: Fast reactor shutdowns, automatic and manual

Shutdowns of chain reactions in the reactor of the Nuclear Power Plant Krško are classified into two groups, fast ones and normal ones. Fast shutdowns are a consequence of the action of reactor protection system actuation, which is automatic or manual. Normal shutdowns are those that proceed normally with a continuous reduction of power and are further divided into unplanned, planned and the refueling outage as a special type of planned shutdowns.

During the operating period of the facility (1981-2002) there have been 178 shutdowns, 110 of these during the commercial operation (since 1983). There have been altogether 128 fast shutdowns, 71 during the commercial operation. Of these shutdowns 67 have been automatic and 4 manual. Other shutdowns with a normal course have been 50, of these 39 during the commercial operation: 15 due to annual outages, 22 unplanned and 2 planned shutdowns. Through the years we can observe a gradual decrease in the number of fast shutdowns, which have now stabilized at a minimum level. This indicates stable and safe operation of the power plant also in the period since the steam generator replacement and the power uprate in the year 2000.

The nuclear power plant is obliged to report to the regulatory body about all events that could decrease the degree of nuclear safety. These are the so-called abnormal events. Figure 5 shows the number of reports of abnormal events. In the year 2002, there were three abnormal events, which is more than in the years 2000 and 2001, but still below the long term average of 4 abnormal events per year.

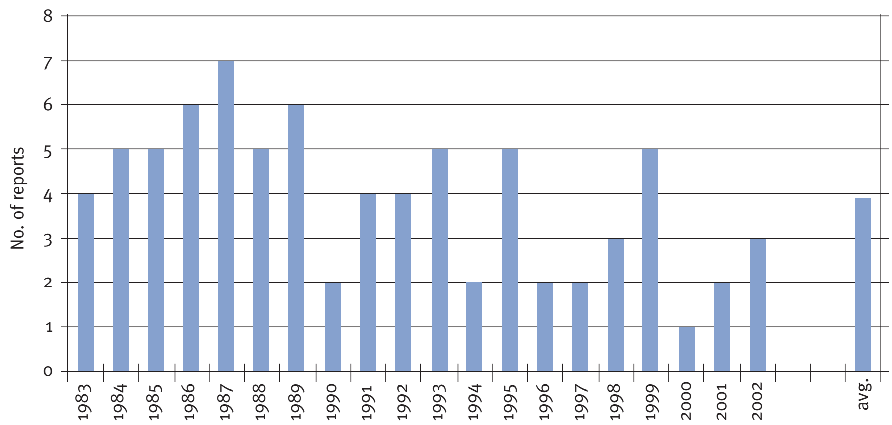

Figure 5: Number of abnormal events reports

Figure 6 presents the efficiency of failure detection by equipment testing. This is calculated as a ratio between the number of equipment failures discovered at surveillance tests and the total number of nuclear safety equipment failures. In 2002, the indicator value was slightly lower than in 2001, but still close to the long term average.

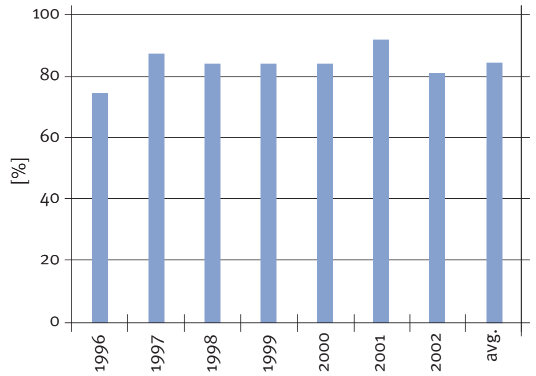

Figure 6: Defects and failures detection efficiency

The collective dose of radiation to the power plant staff is shown in Figure 7. It amounted to 582 man mSv in 2002, which is twice lower than in 2001. The collective exposure is the lowest in the last decade. In the last two years the rise of collective dose in the 3 previous years was stopped and this value is now below the target value of the Institute for Nuclear Power Operation (INPO) for the year 2005, amounting to 650 man mSv. The main activities that contributed the most to the collective dose are in-service inspections of equipment and of primary circuit components, decontamination activities and refueling outage activities.

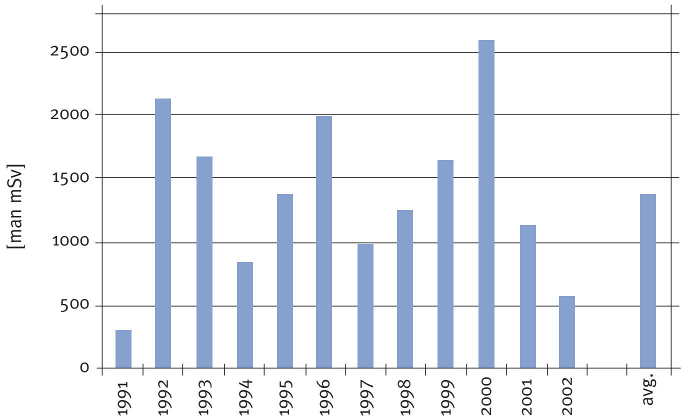

Figure 7: Collective dose in the nuclear power plant

2.1.2. Inspections

83 planned inspections were carried out, one unplanned inspection and four witnessing inspections, of which formal notes have been written.

The unplanned inspection was carried out after the power plant shutdown on 24 February 2002, due to the rise of temperature indication of the reactor coolant pump motor.

The inspections formally recorded were the following: arrival and reloading of fresh nuclear fuel at the port of Koper (33 fuel elements for the new reactor core of cycle 19), preparation for the emergency event exercise, presence at the exercise and realization of the exercise.

The refueling outage lasted 26 days. It started on 11 May 2002 and ended on 5 June 2002. It was continuously observed by an inspector of the Slovenian nuclear Safety Administration and by technical support organisations for nuclear safety.

2.1.3. Abnormal Events in 2002

In 2002, the Nuclear Power Plant Krško reported 6 events, but there were no impacts on nuclear and radiological safety. The power plant assessed as abnormal only three of these events. Despite the start of the cooling tower due to the low flow of the river Sava, the allowed increase of river temperature was exceeded on two occasions. On 19 March 2002 the temperature difference amounted to 3.079°C (the allowed difference is 3°C). The next day the reactor power was decreased and the warming up of the Sava was again below the permissible value. The upper temperature limit (28°C) was exceeded by 0.6°C on 23 June 2002 in the afternoon, although the power plant operated at only 84% of total power. The next day the power was reduced even further and the temperature of the river Sava was again below the permissible value.

2.1.3.1 Failure of the Bearing Temperature Gauge of the Reactor Pump Motor on 24 February 2002

Potentially the most important event from the nuclear safety point of view was the power plant shutdown because of the temperature indication rise on the upper part of the bearing of a reactor coolant pump motor number two. The indication rise was observed in the evening hours of 24 February 2002, and the power of the plant was gradually decreased. Because of a continuing fast rise of the temperature indication, on 25 February 2002 at 2:09 the operators were forced to initiate a manual fast reactor shutdown. During or after the shutdown, a break of a small pipe elbow of the extraction steam/heaters drainage on secondary side occurred, followed by an unhinge of a fire protection system pipe and opening of a relief safety valve, which was opened on the main steam line. The damaged pipe wall was notably thinned due to erosion. During the forced power plant outage a part of the piping system was replaced. The pipe elbows of a parallel piping system were checked and four were replaced.

During the forced plant outage it was discovered that the bearing on the pump motor had not been overheated, but that just the sensor of the temperature gauge had failed. After that the power plant was sinchronized again to the grid on 27 February at 2:43.

2.1.3.2 Unplanned Start up of the Safety Injection System on 11 May 2002

At the begining of the refueling outage, immediately after switching off the power plant from the grid, and in subcritical conditions, there was an unplanned start up of the safety injection system. After the shutdown the pressure of the main steam line started to decrease because of heat losses in the secondary system. Consequently, the operators were required to isolate the main steam lines, but this action was performed too late. On 11 May 2002 at 3:14 the pressure decreased to the value that is set to activate the SI signal, initiating thus the safety injection system and consequently also the isolation of containment including the primary system letdown line. The power plant was stabilised to the hot standby mode. The safety systems responded correctly all the time. The event did not threaten nuclear and radiological safety and did not influence the rest of outage activities.

The other abnormal events in the year 2002, with no importance for nuclear safety, were: a low number of revolutions at the turbine driven auxiliary feedwater pump during testing (9 January 2002), exceeding of the permissible daily increase of temperature of the river Sava (19 March and 23 June 2002) and an elevated temperature in one of the buildings of the power plant (23-24 June and 26-27 June 2002).

2.1.4. Nuclear Fuel

The year 2002 consisted of parts of the reactor fuel cycles 18 and 19. Cycle 18 ended on 11 May 2002, followed by the planned outage for the refuelling and maintenance works. The reactor was critical again on 4 June 2002, and the new fuel cycle 19 started.

Reactor coolant radioactivity analyses until March 2002 showed no damages to the fuel elements in the reactor core of cycle 18. The reactor core operation of cycle 19 also showed no damages of fuel elements according to the results of analyses until December 2002.

In the Nuclear Power Plant Krško the so-called fuel reliability indicator is followed, representing the specific activity of radioactive iodine isotopes as a consequence of fuel leakage from which the iodine contribution from the dispersed uranium in the water of the primary cooling system is subtracted. Its trend is shown in Figure 8. After problems with the fuel elements integrity in the year 1996 it is obvious that the situation has improved. Leakage from fuel elements is lower because of a new type of fuel elements and because of a decrease in the amount of debris in the primary circuit.

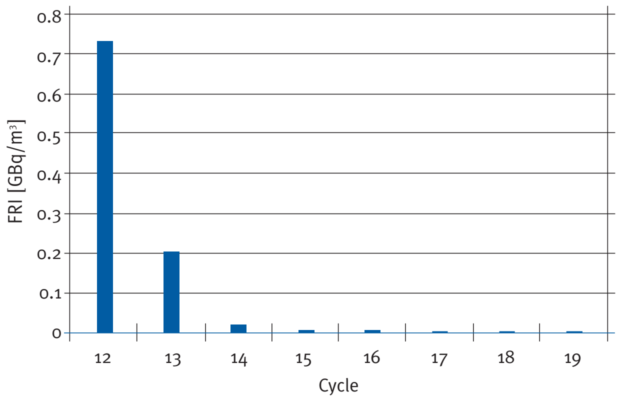

Figure 8: Fuel reliability indicator (FRI) for fuel cycles, in time intervals between two outages. Cycle 12 ended in the year 1995 and cycle 19 in 2003.

2.1.5. Modifications in the Power Plant

In the year 2002, the Slovenian Nuclear Safety Administration approved 16 changes of Technical specifications due to modifications on the facility. The new revision 8 of the Updated safety analysis report has also been confirmed, and the mistakes and imperfections found to date have been removed and the performed improvements have been included.

The major modifications in the Nuclear Power Plant Krško in the year 2002 were:

- A distribution transformer station 400/110 kV was built to support electric power supply of the Nuclear Power Plant Krško. In case of a downfall of the electric system this can be solved by the connection of the gas power station Brestanica units either indirectly or directly to the electric equipment supply of the Nuclear Power Plant Krško. This contributes to higher reliability of electric power supply in case of electric system downfall or transmission line failure.
- Replacement of racks in the spent fuel pit was approved, including building-in of the third heat exchanger for spent fuel pit cooling and cleaning, and racks replacement in the spent fuel pit. The necessary safety analyses were reviewed and approved. This modification was neccessary to increase the capacity of the spent fuel storage until the end of the power plant's lifetime. In the course of the project, the tightness of the spent fuel pit weldings was checked and a small leakage was found, which was repaired by underwater welding.
- Two compressors of compressed air were replaced with new ones with greater capacity, and additionally the electric energy supply and the control room status display were improved.
- Modification of containment leakage testing by the methodology of the American regulatory body 10CFR50 Appendix J - Option B was approved. The intervals during the testing can now be extended, depending on the success of the preceding tests.
- The Slovenian Nuclear Safety Administration required continuation of snubber testing on systems important for mitigation of the consequences of accidents.
- A part of the Technical specification on limiting curves for the heat-up and cool-down of the reactor vessel was changed.

- The chapter on environmental protection conditions of operation was removed from the Technical specifications. This chapter is not a part of the standard form of Technical specifications. Usage and exploitation of the river Sava and ground water, as well as release of waste waters to the Sava are now defined by a licence of the Environmental agency of the Ministry of Environment, Spatial Planning and Energy.

2.1.6. Surveillance of Nuclear Safety

Besides everyday control of facility operation and consideration of operational limits, both the personnel of the power plant and the regulatory body continuously control the nuclear safety status through additional activities. The two most important activities are mentioned below. The first one is a ***Periodic safety review***, which was initiated on the basis of practices of other nuclear countries in Europe, while the second activity, ***Examination of the reactor vessel head penetrations***, was triggered by the discovery of damages at the Davis Besse power plant in March 2002.

Periodic safety review is an integral, thorough and systematic review of the nuclear power plant operation through its whole lifetime, together with all its modifications. The basic guidance for the preparation of the periodic safety programme of the Nuclear Power Plant Krško are safety guidelines of the International atomic energy agency and European practice, and it is required also by the new Act on protection against ionising radiation and nuclear safety. The Periodic safety review consists of: operational safety, safety evaluations and analyses, qualification of equipment and ageing of materials, safety culture, emergency event response, impact on the environment, and radioactive waste treatment, as well as compliance with the operating licence requirements. Based on the results of the Periodic safety review proposals will be prepared for improvements and a time schedule for their implementation.

In 2002 the Nuclear Power Plant Krško, with the help of other institutions from Slovenia and abroad, prepared the first preliminary reports on the following subjects:
- Seismic safety of the power plant location,
- Ageing of material,
- Response to an emergency event,
- Status of Technical specifications and procedures.

Examination of reactor vessel head penetrations. Based on the information from the American regulatory body for nuclear safety, the Slovenian Nuclear Safety Administration called upon the Nuclear Power Plant Krško to check the penetrations of the reactor vessel head (places where the Control rod drive mechanisms penetrate through the vessel head wall). At the Davis Besse power plant (USA, March 2002) extensive damages were discovered at similar penetrations due to leakage from the reactor vessel. During a visual inspection in the Nuclear Power Plant Krško, deposits around the penetrations were found, as shown in Figure 9. Samples were taken and it was established by radiochemical analysis that the deposits had not been caused by leakage but had been deposited there by the ventilation system. Also no damages of the reactor vessel wall were found.

Due to the modifications performed to date, it was impossible to remove completely the reactor head insulation and to directly visually examine all of the penetrations. Therefore the direct and indirect visual examination were combined and, by the use of an endoscope, indirect visual examination of inaccessible penetrations and of the reactor head surface was performed. With the eddy current method 14 of the 40 penetrations were examined but there were no indications that would require reporting.

Figure 9: Deposits around the reactor head penetrations

2.2. Research Reactor TRIGA

2.2.1. Operation

The Research reactor TRIGA MARK II, operating as a part of the Reactor infrastructural centre of the "Jožef Stefan" Institute is, as a neutron source, designed for experimental work, for the production of radioactive isotopes and for education and training. In 2002 it operated approximately 197 days and released 262 MWh of heat. In the carrousel and irradiation channels in the reactor 1095 samples were irradiated, while 600 were sent into the reactor core with the pneumo post. In the year 2002, the reactor operated mainly in stationary mode and just once (5 April 2002) in pulse mode, when 8 pulses were performed. For the requirements of experiments also several reactor core design changes were performed, as well as fuel shufflings in the core. There were no abnormal events affecting nuclear safety or major failures of reactor components in the year 2002. The reactor startup and shutdown was performed 204 times in the year 2002. All 9 unplanned shutdowns were due to electric power supply disturbances (downfalls, oscillations, failures of power supply and temperature gauge failures).

There were altogether 94 fuel elements stored at the Reactor infrastructure center location at the end of 2002.

Two planned inspections were carried out, at which the following topics were discussed: safety analyses for the installation project of fast pneumo post for the transport of short lived isotopes, status of reactor equipment, planning of reactor operation activities in the year 2002, preplanned major maintenance interventions in the year 2002, radioactivity monitoring in reactor surroundings, preparedness for interventions in case of an emergency event, education of the personnel and walkdown and survey of the reactor hall and auxiliary areas status.

Figure 10: Reactor TRIGA of the "Jožef Stefan" Institute in Brinje near Ljubljana

2.3. Central Interim Storage for Radioactive Waste in Brinje

As part of the arrangement of the inventory in the storage, the Agency for Radioactive Waste Management made an action plan for repackaging of the cobalt sources stored in the Central Interim Storage for Radioactive Waste in Brinje, and issued working procedures for the performance of repackaging in the hot cell of the "Jožef Stefan" Institute.

In the year 2002 the Agency for Radioactive Waste Management accepted to the storage radioactive waste of four producers. Also accepted were 11 package units of waste, namely 12 sealed sources and 16 fire detectors.

At the end of the year 2002 the Central Interim Storage for Radioactive Waste in Brinje stored 254 drums with radioactive waste, 375 sealed sources, 140 units of special waste and 34 units of unspecified radioactive waste. The total activity of all waste amounted to 2.9 TBq.

At the two planned and one unplanned inspections no deficiencies were found.

2.4. Activity of Organisations Performing Activities Involving Radiation

According to the records of the Health inspectorate there were 99 such organisations or enterprises in May 2002, where a total of 577 sealed radiation sources were held for the control of working processes (one third of these are out of use), and 19 other organisations and laboratories which mainly held sources of low activity, designed for education, research and testing of radiation gauges. In industrial facilities 13 inspections were carried out connected to usage of radiation sources and radioactive materials storage. For the delivery of sources to the Central Interim Storage for Radioactive Waste in Brinje, 4 decrees and 14 permissions for purchasing and usage of sealed sources were issued in 2002.

Education of the workers who work with sources of ionising radiation is mostly in accordance with the regulations. Qualification, perfection and verification of knowledge is carried out by two authorised organisations ("Jožef Stefan" Institute and Institute of Occupational Safety).

Most of the organisations performing the activities involving radiation implemented their radiation activity according to the regulations and licences which define this field of work. In one case inspectors for nuclear and radiological safety had to intervene.

2.4.1. Abnormal Event at the Welding Institute in Ljubljana

On 28 November 2002 an inspector found out by coincidence an elevated dose rate on the instrument in his car in a street in Ljubljana in front of the Welding institute. Inspectors of the Slovenian Nuclear Safety Administration immediately carried out a special inspection of the Welding institute's buildings and rooms and found out that industrial radiography of turbine blades weldings was performed in the basement rooms. This was a violation of specifications in the permit for activities involving radiation. The measurements showed that also in other rooms and in a public place in front of the building there were elevated dose rates of ionising radiation. The inspectors immediately prohibited any further work and on 2 December 2002 an authorized organisation measured the following dose rates:

- 2200 μSv/h on the outer side of the building's window, where industrial radiography was performed,
- 25 μSv/h in the yard centre in front of the window,
- 0.5 μSv/h on the pavement in the vicinity.

The allowed (limit) annual dose for an individual of the population is 1 mSv (1000 μSv), while the dose rate of natural background is about 0.11 μSv/h.

The Slovenian Nuclear Safety Administration required from the Welding institute to improve the conditions, so that the allowed limits of environment burdens would not be exceeded. The institute implemented the requirements on 16 December 2002, which was also confirmed by a measurement of the authorized organisation. After that the institute was allowed to continue with their work.

The Slovenian Nuclear Safety Administration also reported the event to the international system for reporting on nuclear and radiation events INES. Although the potential radiological threat to the population was not high, the event - as a case of 'bad safety culture' - was classified as a Level 1 event on the scale from 0 to 6.

The Slovenian Nuclear Safety Administration, also because of this event, increased the frequency of inspections to holders of radiation sources and it accelerated the renewal of records and licences for activities involving radiation, in compliance with the new act on protection against ionising radiation and nuclear safety.

3. Radioactivity in the Environment

3.1. Environmental Radioactivity Monitoring

Environmental radioactivity monitoring of global radioactive contamination in Slovenia has been performed in Slovenia for more than four decades. Mainly two long-lived fission products, i.e. ^{137}Cs in ^{90}Sr have been monitored in the environmental media and in the food chain.

The results for 2002 showed that concentrations of both long-lived fission products have been further slightly decreasing and are now mostly lower than before the Chernobyl accident in 1986. The biggest part of radiation exposure of the population due to radioactive contamination of the environment (caused by bomb testing and the Chernobyl accident) comes from external radiation and from food ingestion. The effective dose due to external radiation for the year 2002 was estimated to be 6.8 µSv. The annual effective dose due to food ingestion was 4.0 µSv, shared between ^{90}Sr and ^{137}Cs contribution as 78% and 22% respectively. The annual contribution of both radionuclides to inhalation dose was quite negligible compared to radiation exposures of other transfer pathways. The total effective dose for an adult member of the public in the Republic of Slovenia in 2002 caused by the global contamination with fission products was estimated to be 10,8 µSv, as shown in Table 2. This figure is approximately 300 times lower than the level of natural radiation in the environment.

Table 2: Annual radiation exposure of the members of the public due to global radioactive contamination in Slovenia in 2002.

Exposure pathway	Effective dose [µSv/year]
Inhalation (^{137}Cs, ^{90}Sr)	< 0.02
Ingestion: food (^{137}Cs, ^{90}Sr) drinking water (^{137}Cs, ^{90}Sr; tap water - Ljubljana, consumption 2 l daily)	 4.0 0.03
External radiation	6.8
Total in 2002 (rounded)	10.8

3.2. Operational Monitoring

3.2.1. Nuclear Power Plant Krško

Monitoring of radiation in the vicinity of the nuclear power plant consists of measurements of radioactive discharges and radioactive levels in the environment. The measured values in environmental samples during normal operation of the plant are significantly lower than the detection limits of analytic methods. The environmental impacts are therefore evaluated using the data for gaseous and liquid discharges, used as input data for dispersion modelling of radionuclides in the environment.

The most important atmospheric discharges contain the following groups of radionuclides:

- noble gases, which may - during the passage of a radioactive cloud - essentially contribute to the external radiation exposure,
- radionuclides such as tritium ^{3}H and ^{14}C, which are biologically significant as internal beta emitters incorporated into the organism,
- beta and gamma emitters in particulates (isotopes Co, Cs, Sr etc.) are significant for exposure due to inhalation and due to surface contamination occurring during the passage of a radioactive cloud
- iodine isotopes in the form of various chemical compounds, significant for inhalation exposure and for intake via the milk consumption pathway.

In the liquid discharges from the Nuclear Power Plant Krško to the Sava river tritium (in water form as HTO) prevailed, while the total discharged activity of beta/gamma emitters (fission and activation products) was some orders of magnitude lower.

The environmental radioactivity monitoring programme performed due to radioactive discharges from the plant comprised the following items:

- radionuclide concentrations in air (aerosols and iodine),
- radionuclides in dry and wet deposition,
- content of radionuclides in food of vegetable and animal origin, including milk,
- content of radionuclides in soil, on cultivated and undisturbed land,
- external radiation at various locations,
- content of radionuclides in river water, sediments in water biota (fish),
- radionuclide concentrations in tap water (Krško in Brežice), water captures and underground water.

None of the environmental measurements showed the presence of radionuclides discharged with gaseous effluents from the nuclear power plant. The direct impact of the liquid radioactive discharges to the water radioactivity was measurable only in the case of tritium: enhanced concentrations were found in the Sava river downstream the power plant, at Brežice and Jesenice na Dolenjskem (1.6 kBq/m^3 upstream and 5.2 and 3.6 kBq/m^3 downstream the plant; the derived concentration limit is 60 MBq/m^3). Concentrations of other artificial radionuclides discharged into the Sava river (^{58}Co, ^{60}Co etc.) were below detection limits. In tap water and water captures no influence of the nuclear power plant was detectable in 2002.

Calculations of dispersion coefficients for atmospheric discharges, based on real meteorological data, showed that external radiation from the radioactive cloud and from deposition, inhalation of aerosols containing tritium and ^{14}C, and ingestion of ^{14}C contained in food are essential for radiation exposure of the public. Public exposures along particular pathways were very low. The highest contribution - estimated recently - was due to intake of ^{14}C through ingestion of milk by infants and ingestion of cereals by other age groups. A model calculation for liquid discharges showed that they caused very low additional exposure of the public, i.e. only 0.1 µSv per year. The levels of external radiation in the vicinity of certain building structures on-site the power plant are higher than in the surroundings. At larger distances radiation is not measurable and according to expert opinion also negligible (some hundredths of µSv). This assessement is substantially lower than in preceding years but it is based on more realistic data.

As shown in Table 3, the estimated total effective dose for a member of the public who lives in the surroundigs of the Nuclear Power Plant Krško did not exceed the value of 1.5 µSv in 2002. The estimation of this value is based on a more realistic approach and is almost by one order of magnitude lower than those obtained in previous years: it represents only a half of one thousandth (0.05%) of the individual exposure due to average natural background in Slovenia (2,500-2,800 µSv).

Table 3: Modelled estimation of public exposure due to radioactive discharges from the Nuclear Power Plant Krško in 2002

Type of exposure	Pathway	Most importanti radionuclides	Effective dose [µSv/year]
External radiation	External radiation from the cloud (immersion)	^{135}Xe, ^{131m}Xe	maks. 0.015
	External radiation from deposition	particulates (^{58}Co, ^{60}Co, ^{137}Cs ...)	< 0.02
Inhalation	Cloud	^{3}H, ^{14}C	maks. 0.18
Ingestion (atmospheric discharges)	Milk, cereals	^{14}C	< 1
Ingestion (liquid discharges)	Drinking water (the Sava river)	^{137}Cs, ^{89}Sr, ^{90}Sr, ^{131}I	0.1

3.2.2. Research Reactor TRIGA and Central Interim Storage for Radioactive Waste in Brinje

Monitoring of the site comprises the control of discharges (atmospheric and liquid discharges) and environmental radioactivity measurements and it has been carried out to assess the impact of the installations and to identify other possible radioactive pollutants in the environment (in air, underground water, external radiation, radioactive contamination of the soil, radioactivity of the sediment of the Sava river). Radioactivity in the air (aerosols) was not measured within this programme.

Measurements of environmental samples did not indicate any radioactive contamination due to reactor operation. In the dose assessment calculation only two exposure pathways were taken into account, namely external radiation and ingestion of contaminated river water. The external immersion dose due to ^{41}Ar discharged into the atmosphere was estimated by model calculation to the value of 0.29 µSv per year. Taking into account a very conservative assumption that members of the public use river water as drinking water, the corresponding dose of 0.05 µSv per year was calculated. The total annual effective dose of 0.34 µSv for an individual member of the public equals to a very small part of natural background exposure in the country (about 2,500-2,800 µSv).

The programme of environmental radioactivity monitoring in the surroundings of the Central Interim Storage for Radioactive Waste in Brinje also comprised control of radioactive discharges (atmospheric discharges - radon and its progeny from the storage as a direct consequence of the storage of ^{226}Ra sources, liquid discharges - common liquid discharges from the radwaste storage and from laboratories of the Department for environmental science of the "Jožef Stefan" Institute - and external radiation from the external part of the storage). Furthermore, it comprised also environmental radioactivity measurements (underground water - from the well, external radiation, contamination of the ground outside the storage and radioactivity of the river sediment).

Increase in radon ^{222}Rn concentrations in the vicinity of the storage was estimated using the dispersion model. An average concentration at the fence is supposed to be roughly 3 Bq/m^3 above the natural background level. In the underground water, radionuclides specific for radwaste storage operation were not detected. In the river sediment the following artificial radionuclides were found: ^{137}Cs as the consequence of the Chernobyl accident and ^{131}I originating from the sewage system as the consequence of medical treatment of patients with high activity doses of this radionuclide.

Inhalation of radon short-lived progeny and direct radiation from the storage were taken into account for dose assessment of the public. The total annual received dose for an individual member of the public (non-radiation worker of the reactor complex) was estimated at 7.5 µSv. At the fence of the site, the annual effective dose was about 0.3 µSv or 0.03% of the limit value for members of the public and 0.01% of the natural radiation background respectively.

3.2.3. Former Uranium Mine at Žirovski Vrh

The environmental radioactivity monitoring programme of the former uranium mine - now it is in the decommissioning phase - comprises measurements of long-lived radioactivity of the uranium-radium decay chain, including measurements of radon in its short-lived progeny in air and external radiation. Mostly the settled locations in the valley were monitored up to the distance of three kilometres from the mine. Radioactivity is measured also at the reference points where no impact of the mine could be detected.

Concentrations of radionuclides in the samples of particular media partly decreased. The biggest differences were found in levels of long-lived radionuclides in aerosols and in radon levels. In 2002 the average concentrations of ^{222}Rn in the vicinity of the mine (Gorenja Dobrava) were only about 5 Bq/m^3 (2001:

5.1 Bq/m^3, 2002: 5.4 Bq/m^3) higher than the natural background level which is 20 Bq/m^3 in this region. This contribution is much lower than the estimated values in the last decade (1991-2000: 7-9 Bq/m^3).

Radioactivity of the surface waters in the recent years slowly but steadily decreases, especially as regards ^{226}Ra concentrations in the Brebovščica and Todraščica streams, where the levels have almost reached the background levels.

In calculations of the effective dose for the population, the following pathways were taken into account: inhalation of long-lived radionuclides, radon and its progeny, ingestion (intake with food and drinking water) and external radiation. In 2002 radiation exposure of members of the public was 0.24 mSv, and was almost the same as the year before (2001: 0.23 mSv) but considerably lower than the estimated values in the previous years (about 0.35 mSv/year). The most important source of radioactive contamination in the mine environment remains ^{222}Rn with its short-lived progeny, contributing almost three quarters of the additional exposure (Table 4).

Table 4: Efective dose to the public due to the radiation sources of the former uranium mine at Žirovski vrh in 2002

Exposure pathway	**Detailed description and important radionuclides**	**Effective dose [μSv]**
Inhalation	• Aerosols with long-lived radionuclides (U, ^{226}Ra, ^{210}Pb), • ^{222}Rn only, • Rn - short-lived progeny	5 4 174
Ingestion	• Drinking water (U, ^{226}Ra, ^{210}Pb, ^{230}Th), • fish (^{226}Ra, ^{210}Pb), • agricultural products (^{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	1.7 - 2
Total effective dose in 2002 (rounded): 240 μSv		

The total effective dose due to the former uranium mining still represents one quarter of the limit value and is about 10% of the average exposure from the natural background radiation in Slovenia (2,500-2,800 μSv per year).

Measurements of radioactivity in the last two years (2001 in 2002) undoubtedly showed that the closure of the mining and milling and the decommissioning works performed to date have considerably reduced the environmental impact.

3.3. Early Warning Radiation Monitoring System

In the Republic of Slovenia, a Radiological Early Warning System was established . The system is one of the key elements in the system of notification and response in case of accident with radioactive releases to the environment. In such a case, the population could be exposed to external radiation and inhalation of radioactive aerosols, and in a later phase they could be internally contaminated via the ingestion pathway. The early warning radiation system is an automatic measuring system which instantaneously detects elevated radiation levels on the territory of the Republic of Slovenia. For a comprehensive assessment of the radiological situation the external radiation levels have to be known, as well as radioactivity in the air and radioactivity of deposition. The said system provides reliable measuring data. The data from all 47 measuring stations which are operated by the Krško NPP, the Environmental Protection Agency, the Slovenian Nuclear Safety Administration and thermal power plants are collected at the SNSA, on-line analysed, archived and presented on a web page (Figure 11). In the case of enhanced radiation levels, the alarm is set off.

From the year 1997 onwards the SNSA has been regularly sending the data to the European system EURDEP in the European joint research centre in Ispra (Italy), which collects data from many European early warning networks. In this way the SNSA has gained the possibility of insight into data of other European countries. The SNSA exchanges the data also with the Austrian centre in Vienna and the Croatian centre in Zagreb and sends unilaterally the data to the Hungarian centre in Budapest.

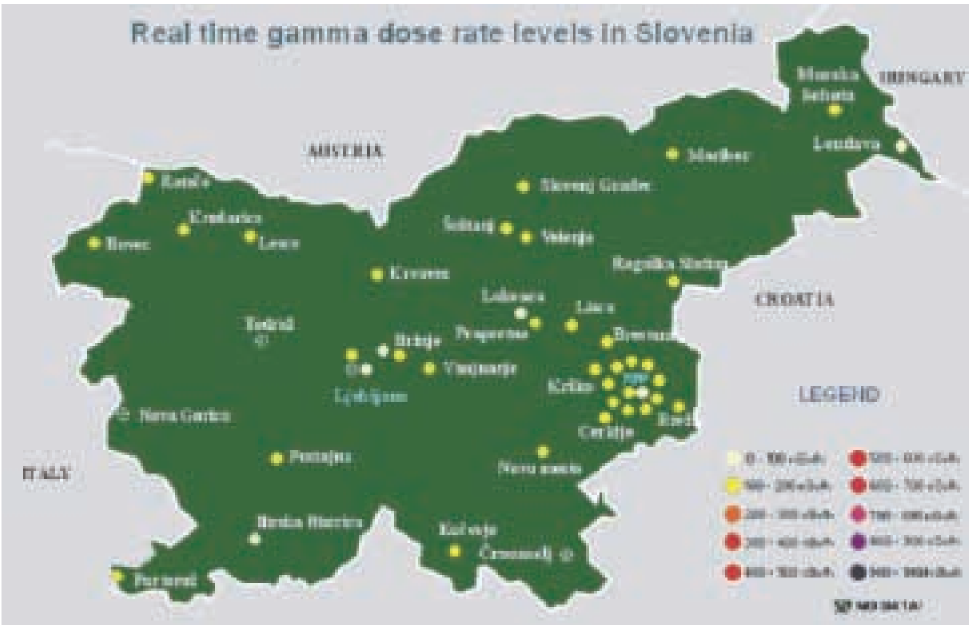

Figure 11: Map of Slovenia with probe locations for external radiation; different colours of the spots indicate the information on the gamma dose rate level in real time

3.4. Radiation Exposures of the Population in Slovenia

3.4.1. Exposure to Natural Radiation

An average member of the public on the Earth is exposed to radiation due to:

- natural radiation of terrestrial and cosmic origin,
- occupational exposure, if he is a radiation worker,
- nuclear bomb tests and accidents, where big quantities of radioactive material are released to the atmosphere,
- working activities leading to enhancement of concentrations of natural radionuclides in the living environment,
- medical exposures when a member of the public is exposed to ionising radiation as a patient.

According to the data of the scientific committee of the United Nations dealing with the effects of atomic radiation (UNSCEAR) the average individual effective dose from natural sources is 2.4 mSv and mostly in the range of 1 to 10 mSv. The biggest part, about 50% is contributed by internal exposures as a consequence of radon and its short-lived progeny. From the existing data on external radiation and on indoor and outdoor radon in Slovenia we can conclude that the average individual annual dose from natural radiation sources is slightly higher than the world average; it is 2.5-2.8 mSv. About 1.2-1.5 mSv per year is due to inhalation of radon and its progeny.

3.4.2. Occupational Exposure

In 2002 there were 4,192 radiation workers in Slovenia who were exposed to ionising radiation. This is approximately the same number as in previous years. About 60% of workers are employed in medicine. Figure 12 shows the numbers of exposed workers per a particular dose interval, and in Figure 13 the collective doses are presented.

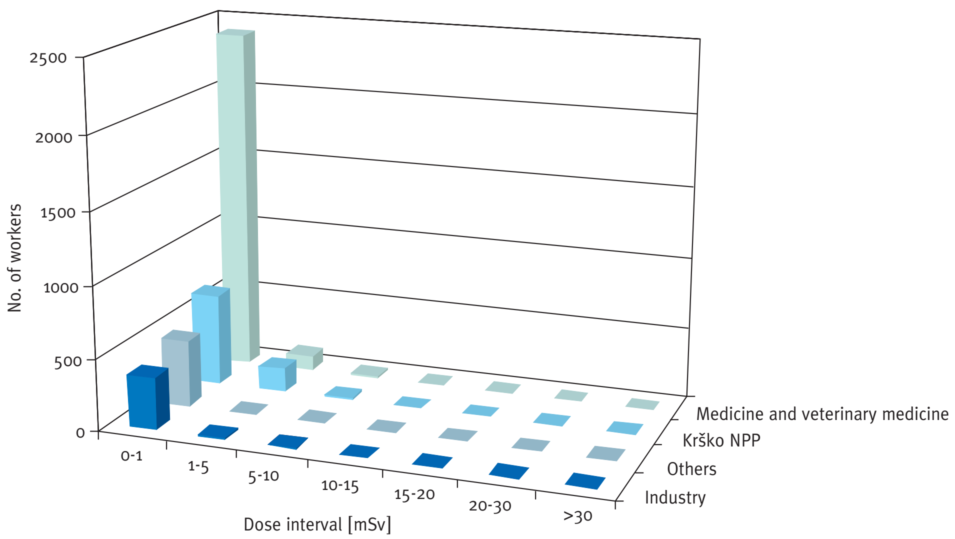

Figure 12: Number of exposed radiation workers per dose intervals in 2002

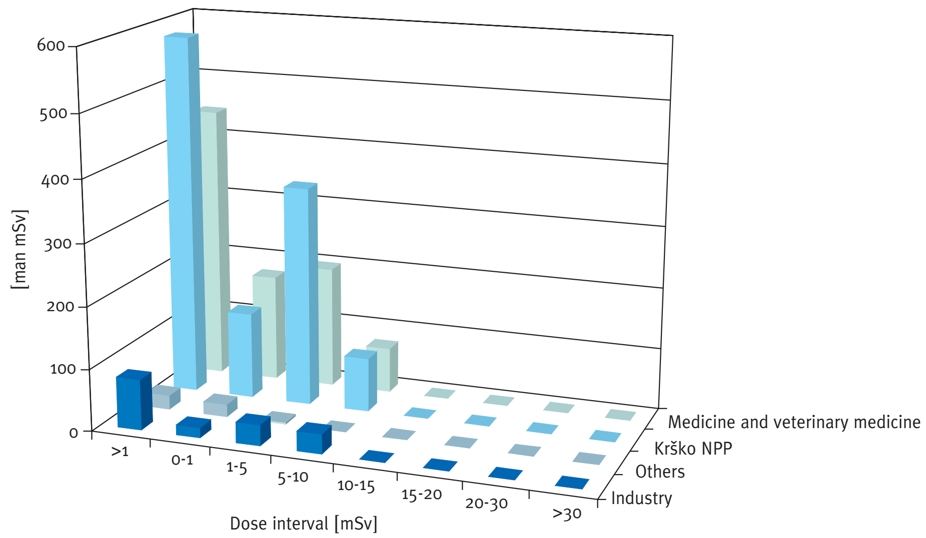

Figure 13: Collective dose in man mSv per dose intervals and average doses for various practices in 2002

The highest doses were received by radiation workers in medicine (in nuclear medicine and in brachytherapy at the Institute of Oncology - more than 2 mSv), while the lowest occupational exposures were found in the process technology in industry and in dental diagnostics - 0.1 mSv and less. The average dose of occupationally exposed worker in Slovenia is 0.27 mSv per year. If we calculate the average value for the total population of the Republic of Slovenia, we get a figure near 0.6 µSv per capita or slightly more than 0.02% of the total dose caused by natural radiation sources.

3.4.3. Population Exposure due to Man-Made Sources and Practices

Population of the Northern Hemisphere is exposed to radiation originating from global contamination of the environment caused by atmospheric bomb testing and the nuclear accident in Chernobyl. Estimation of the effective dose showed that the average annual dose received by a member of the public in Slovenia from these sources slightly exceeded the value of 10 µSv in 2002.

Radiation doses due to regular operation of nuclear installations and radiation sources are as a rule received only by local population. The population exposures originating from radioactive discharges from these installations are described in more detail in the section dealing with operational monitoring. Figure 14 shows the magnitudes of annual doses received by members of the public for different critical groups relating to the particular installations, including also the average effective dose due to global contamination (bomb testing and the Chernobyl accident). The highest exposures of members of the public were found in the surroundings of the former uranium mine at Žirovski vrh, which reached about one tenth of the natural radiation exposure.

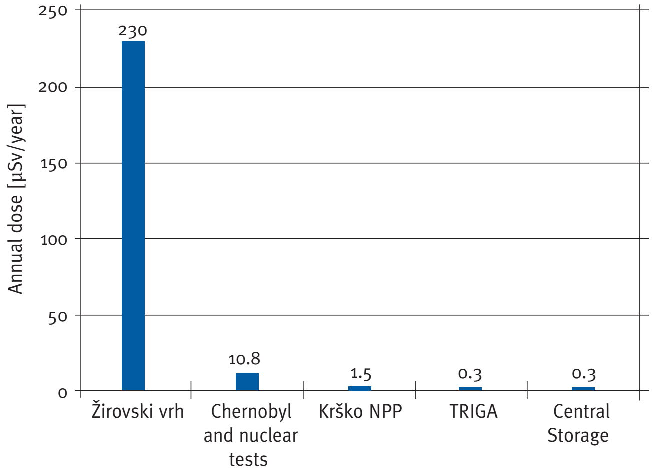

Figure 14: Radiation exposures of the population due to installations releasing radioactive materials into the environment and due to global contamination in 2002 (the limit value is 1,000 µSv)

Besides operational exposure from nuclear and radiation installations, the population of Slovenia is exposed also to some other radiation practices.

Up to date results of radioactivity measurements in the environment of the Šoštanj thermal power plant show that in the worst case public exposure can reach the annual value of some µSv, due to radionuclides in fly ash dispersed via air pathways.

There are not much data on public exposure in the country due to past practices related to processing of raw materials with addition of uranium or thorium (mining and extraction of mercury, bauxite processing, phosphate processing). Some data on materials with enhanced contents of natural radionuclides are available, but the exposures of population have not been estimated due to the limited number of data.

The Health Inspectorate of the Republic of Slovenia financially supported a study on radon concentrations in the cellar and ground-floor spaces of 26 hospitals in the country that are occupied by the personnel. The results of measurements in 196 rooms, performed by the "Jožef Stefan" Institute, showed that only in seven cases radon concentrations exceeded 400 Bq/m^3. Above this limit value, remediation works are required to reduce radon concentrations.

3.4.4. Impact of Stack Emissions from Coal-Fired Thermal Power Plants to Radioactivity in the Environment

Operation of coal-fired thermal power plants (TPP) due to stack releases and fly-ash disposal enhance radioactivity levels in the environment and therefore create additional radiation exposures of the population. The "Jožef Stefan" Institute measured concentrations of the most important radionuclides in stack gases of the Šoštanj power plant and estimated the radioactive releases. In addition, It also took samples from the affected environment and analysed them for further evaluation of enhanced radioactivity levels as the consequence of these releases.

In the first phase of the study analyses were done of input and output materials for blocks 4 and 5 of the Šoštanj TPP for the content of natural radionuclides ^{238}U, ^{226}Ra, ^{210}Pb, ^{232}Th and ^{40}K. In the second phase, the contents of radionuclides in samples of soil, grass, precipitation and lichens, taken at different locations in the surroundings were determined. The results showed that uranium, radium, thorium, lead and polonium mostly concentrate in fly ash, while radionuclides ^{210}Pb in ^{210}Po are additionally adsorbed also on aerosols and in stack gases. In the environmental samples higher contents of both radionuclides were measured in the upper layer of soil and in precipitation, especially on those locations situated in prevailing wind directions, where the contribution of stack releases is supposed to be the highest. In soil samples from Zavodnje, levels of 500 Bq/kg were measured for ^{210}Pb in ^{210}Po; at the location Veliki vrh, the levels were over 300 Bq/kg, and at the reference point (unaffected location) only about 100 Bq/kg of both radionuclides was measured. The radioactivity of bioindicators (lichens) did not show high values. The contribution of stack releases to the annual deposition of ^{210}Pb was estimated: from the total annual deposition of 100 Bq/m^2 the TPP is supposed to increase this level by about 10%. The estimated radiation exposure of the local population was about 5 µSv per year.

3.4.5. Radioactive Contamination of the Ground with Artificial Radioisotopes

Strontium-90 is a long-lived and radiologically important radionuclide that came into our environment as the consequence of the former atmospheric bomb testing (1945-1980) and the Chernobyl accident (1986). In Slovenia we have no data on ground contamination with ^{90}Sr except for some locations covered by regular monitoring of environmental radioactivity monitoring. A study was performed by the Institute of Occupational Safety and comprised 16 sampling points on the territory of Slovenia. Soil samples were taken in two depths (0-5 cm and 5-10 cm) and analysed for ^{90}Sr content. The results are shown on the map in Figure 16.

3.4.6. Medical Exposure

Exposures of patients undergoing radiological examinations in medicine have not been measured or determined systematically, and have not been regularly monitored, either. Several studies on patient exposure have been elaborated by the Institute of Occupational Safety, which investigated characteristic reference levels for particular radiological examinations. Hospitals and other medical institutions are not obliged to report to the regulatory authority even about the annual number of radiological examinations and therefore no data on average medical exposures exist in Slovenia. The dose estimates in some European countries vary between 0.3 and 1.5 mSv per year and are typical of each country, depending on the level of its development and the quality of the equipment in use.

According to the register at the Health Inspectorate, 712 X-ray machines were in use in medicine and veterinary medicine at the end of 2002 (Table 5). This year 58 user licences were issued for work with X-ray equipment and 8 licences for work with accelerators. Four inspections were performed, and deficiencies were found in three cases. According to these decisions, interdictions of use of the equipment were issued.

Table 5: Number of X-ray equipment in medicine and veterinary medicine classified regarding their purpose

Purpose	2001	New	Written off	2002
Dental	347	21	15	353
Diagnostic	257	13	11	259
Therapeutic	4	1	1	4
Simulator	2	0	0	2
Mammography	30	0	1	29
Computer tomograph CT	15	4	1	18
Densitometric	17	7	1	23
Veterinary	24	0	0	24
TOTAL	696	46	30	712

Figure 15 shows that in 2002 almost one quarter of all diagnostic X-ray machines did not meet the quality requirements. This shows a great probability that patient exposures during medical examinations might be relatively high. Only equipment of perfect quality can ensure that reference levels at radiological examinations are not be exceeded.

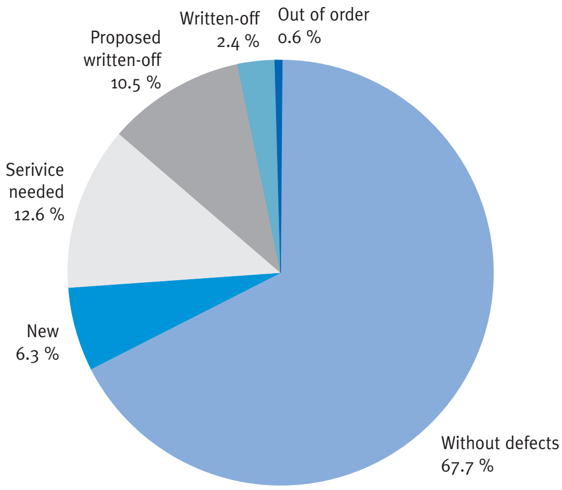

Figure 15: Status of the diagnostic X-ray equipment in medicine

Seven clinics or hospitals in Slovenia where unsealed sources (radiopharmaceuticals) are used in diagnostics and therapy were under inspection surveillance of the Health Inspectorate. In 2002 six inspections were carried out. Some deficiencies were found at the Institute of Oncology (inadequate handling procedures for handling in case of contamination and for quality assurance at operating the equipment). During this year two unexpected events occurred leading to overexposure of workers and patients. The Clinic of Nuclear Medicine has still not been equipped with a special closed system with holding tanks for liquid radioactive effluents, in spite of the decision issued by the Health Inspectorate in 1995. No essential deficiencies were found in other clinics for nuclear medicine by the technical support organisations during their semi-annual radiological surveillance.

In 2002 there were 2720 radiation workers medically examined by the authorised medical support institutions. The inspectors did not find any essential deficiencies as regards the frequency of examinations. Only about one percent of the examined radiation workers failed to meet the prescribed criteria for capability of work with radiation sources.

3.5. Research Activities

Figure 16 presents the distribution of radioactive contamination with the radionuclide ^{90}Sr on the territory of Slovenia. Measurements showed that surface contamination of the ground with ^{90}Sr in the depth of 0-10 cm was mostly in the interval from 0.1 do 0.4 kBq/m^2. The maximum value was measured in the upper basin of the Soča river (around 0.7 kBq/m^2). At the time of the Chernobyl accident a value of around 0.5 kBq/m^2 was measured in Ljubljana and in the upper Soča river basin about 1.1 kBq/m^2. Nowadays the values are considerably lower than those in mid seventies. An extended study on surface contamination of undisturbed ground with ^{137}Cs in ^{90}Sr showed that in the upper layer of 10 centimetres, mostly 0.5 do 2.2 kBq/m^2 of ^{90}Sr was found, with the maximum values up to 3 - 4 kBq/m^2 in the upper Soča basin. Most of ^{90}Sr contamination at that time was the consequence of atmospheric bomb tests in the sixties of the last century.

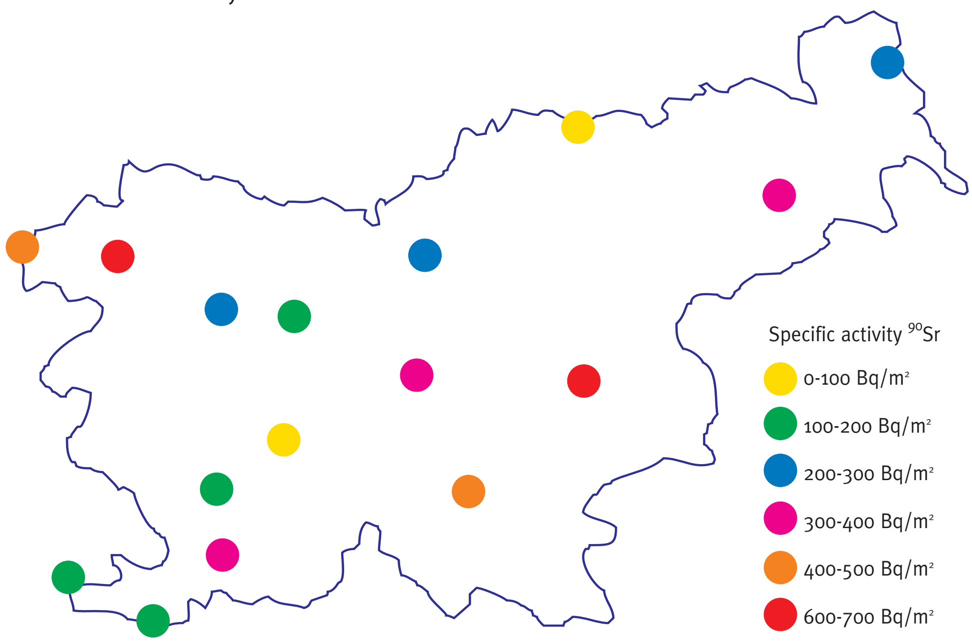

Figure 16: Radioactive contamination with ^{90}Sr on the territory of Slovenia in 2002

4. Control over the Radiation and Nuclear Safety

4.1. Legislation

The Act on Protection against Ionising Radiation and Nuclear Safety was adopted by the Parliament of the Republic of Slovenia at its session on 11 July 2002. The act was published in the Off. Gaz. RS, Nr. 67/2002 and entered into force on 1 October 2002. The new act is adjusted to the EU legislation in the field of radiation and nuclear safety and to international agreements succeeded, ratified or signed by the Republic of Slovenia. Furthermore the new act is adjusted to the provisions contained in the Constitution (care of state for healthy environment and determination of conditions to perform economic and other activities) and to the provisions contained in the Act on Environmental Protection and regulations in the filed of land use planning, building, protection against natural and other disasters, physical protection and discharging of public services.

The act includes the main principles in the field of nuclear and radiation safety and the provisions on:

- practices involving ionising radiation (reporting an intention, a permit to carry out practices involving radiation, a permit to use a radiation source),
- protection of people against ionising radiation (principles, justification, dose limits, protection of exposed workers, medical exposure),
- radiation and nuclear safety (the classification of facilities, use of land, construction and carrying out of construction and mining activities, trial and actual operation of radiation and nuclear facilities, radioactive contamination, radioactive waste and spent fuel management, import, export and transit of nuclear and radioactive substances and radioactive waste, intervention measures),
- issue, renewal, modification, withdrawal or expiry of a licence,
- physical protection of nuclear facilities and nuclear substances,
- non-proliferation of nuclear weapons and safeguards,
- monitoring radioactivity in the environment,
- removal of the consequences of an emergency event,
- report on protection against radiation and on nuclear safety, records containing information on radiation sources and practices involving radiation,
- financing of protection against ionising radiation and of nuclear safety (costs incurred by the users and public expenses) and compensation for the limited use of land due to a nuclear facility,
- inspection, penal provisions and transitional and final provisions.

In its transitional provisions the act provides for the issuing of several regulations of the government and the competent ministers. Until new regulations are issued, the regulations issued on the basis of prior acts (Act on Radiation Protection and the Safe Use of Nuclear energy, Off.Gaz. SFRY, Nr. 62/84 and Act on Implementing Protection Against Ionising Radiation and Measures on the Safety of Nuclear Facilities, Off.Gaz. SRS, Nr. 82/80) are still applicable.

Furthermore the act clearly divides the field of activity or competence in the area of nuclear and radiation safety in Slovenia, in the first place between the SNSA as a regulatory body within the Ministry of the Environment, Spatial Planning and Energy and the Slovenian Radiation Safety Administration as a regulatory body within the Ministry of Health.

4.2. Slovenian Nuclear Safety Administration

The Act on Ionising Radiation Protection and Nuclear Safety provides for that the Slovenian Nuclear Safety Administration of the Ministry of the Environment, Spatial Planning and Energy performs administrative and professional tasks related to:

- the removal of the consequences of an emergency event,
- carrying out practices involving radiation and use of radiation sources, except in medicine or veterinary medicine,
- protection of people and environment against ionising radiation,
- nuclear and radiation safety,
- radioactive waste management,
- import, export and transit of nuclear and radioactive substances and radioactive waste,
- radiation monitoring,
- physical protection of nuclear substances and facilities,
- non-proliferation of nuclear substances and safeguards
- supervision of laws and other rules, and regulations governing the domain of nuclear safety.

In addition to the above Act, the legal basis for the administrative and professional tasks in the field of nuclear and radiation safety, as well as inspection supervision of nuclear facilities, is also provided by the:

- Act on Inspection Supervision (Off. Gaz. RS, 52/2002),
- Act on Administration (Off. Gaz. RS, 52/2002),
- 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),
- 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 and 116/2002),
- Decree on Export and Import Regime of Specific Goods (Off. Gaz. RS, 111/2001, 20/2002 64/2002 and 116/2002),
- ratified and published international agreements in the field of nuclear energy and nuclear and radiation safety,
- regulations and rules in the field of nuclear and radiation safety.

The Rules of Internal Organization and Job Systematization of the SNSA contain 65 systematized workplaces. The organizational scheme is shown in Figure 17.

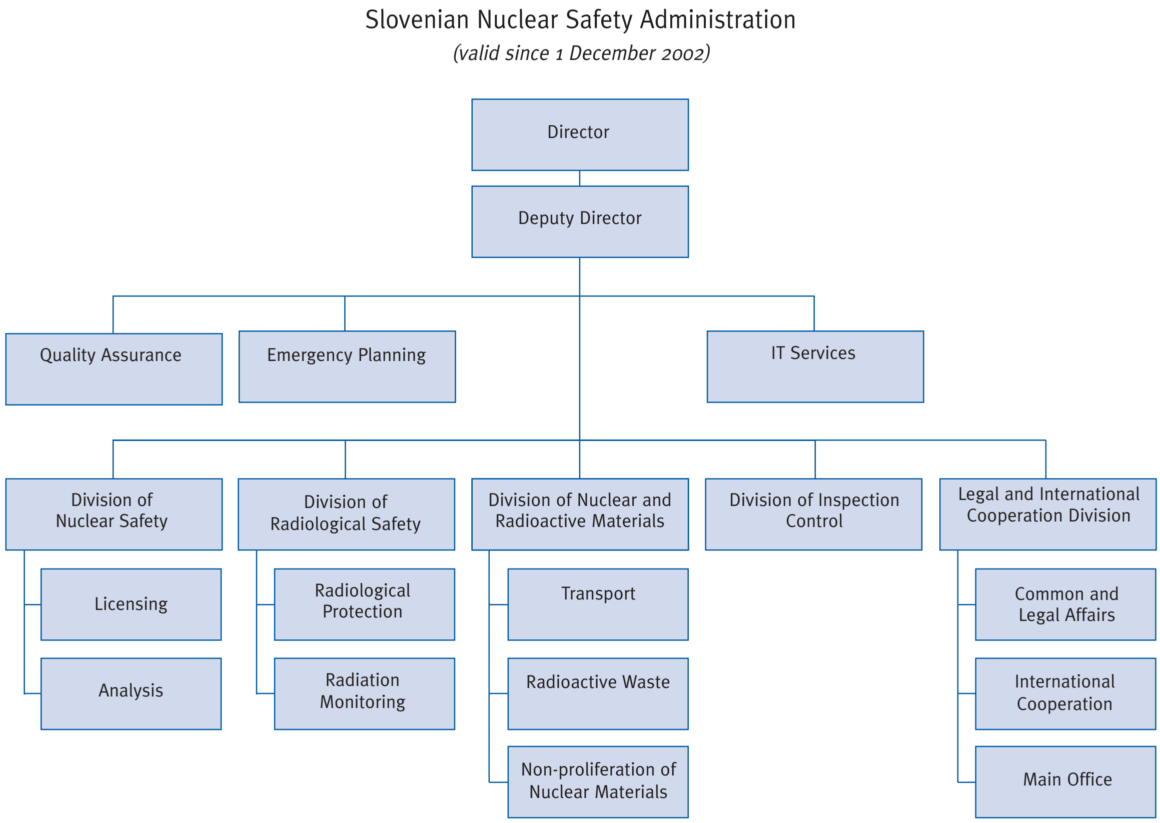

Figure 17: The organizational scheme of the Slovenian Nuclear Administration

46 employees had the following professional qualifications: there were 7 Doctors of Science, 12 Masters of Science, 23 University graduates, 1 employee with a College degree and 3 employees with Secondary education.

All SNSA employees have passed the state exam for civil service as prescribed in relevant legislation. Due to a specific field of work which is under continuous development, the SNSA also endeavours to assure its employees other forms of education, especially in the field of nuclear safety and radiation protection. Within this frame, SNSA employees participated in courses on Basics of Nuclear Technology at the Nuclear Training Center of the “Jožef Stefan” Institute, in courses on radiation Protection and above all in courses organised by international organisations such as the International Atomic Energy Agency, the Nuclear Energy Agency and the European Union.

4.2.1. Expert Commissions

For the purposes of assisting the SNSA in performing its tasks there were two expert commissions, consisting of external experts, officials from ministries and regulatory bodies and SNSA officials.

4.2.1.1 Nuclear Safety Expert Commission

The Nuclear Safety Expert Commission, composed of 22 members, met twice in 2002. In addition to the standard issue, i.e. "safety of nuclear facilities operation in the period after the last meeting", the commission also discussed the manual shutdown of the Krško NPP on February 25, 2002, preparations for the 2002 outage in the Krško NPP and the 2002 outage report in the Krško NPP, questions and answers to the second National Report of the Convention on Nuclear Safety, the draft Act on Protection Against Ionising Radiation and Nuclear Safety and the Annual Report on Nuclear and Radiation Safety in the Republic of Slovenia in 2001.

Based on the provisions of the new Act on Protection Against Ionising Radiation and Nuclear Safety the commissions shall be dissolved and substituted by the Expert Council on Nuclear and Radiation Safety, consisting of five members.

4.2.1.2 Expert Commission for Testing Krško NPP Operators Qualifications

The Expert Commission for Testing Krško NPP Operators Qualifications organize testing for qualifications of operators concerning the operation of the Krško NPP. In the year 2003, the commission in the autumn period (November and December) organized three examinations for 19 candidates. All candidates passed the examinations. Altogether seven candidates passed the examination for the first time and one candidate passed the examination for the Senior Reactor Operator. Five candidates acquired the extension of the Senior Reactor Operator license and six candidates acquires the extension of the Reactor Operator license. All candidates who passed the examinations for the first time the Slovenian Nuclear Safety Administration issued the license for one year, while others received the licenses for four years.

4.3. Health Inspectorate of the Republic of Slovenia

The Health inspectorate of the Republic of Slovenia performed inspection of the safe use of ionising sources as part of its activities. The new law has delegated some of these responsibilities (industry, education and research) from the Ministry of Health to the Ministry of Spatial Planning, Environment and Energy, i.e. to the Slovenian Nuclear Safety Administration. The law foresees a new state institution at the Ministry of Health with responsibilities for radiation protection.

The main activities regarding protection of humans against ionising radiation in the year 2002 concerned preparation and adoption of the new legislation. In spite of this, inspection activities were increased compared to the year before. Inspection of buildings with higher concentration of radon was intensified. On the other hand, inspections concerning trasnport of radioactive sources were less intensive, due to the changes of legislation in this field and the transfer of responsibilities for issuing permissions to the Slovenian Nuclear Safety Administration.

In the year 2002, inspection of the use of ionising sources was coordinated by the Office of the chief inspector, where three work posts were available. Part of the tasks was done by the regional inspectors as well as by inspectors of the border control (inspection of radioactive sources at the border control, prescription of the analysis of samples). The office issued consensus to permits, as well as permits for the activities involving all radiation sources, and the inspectors performed regular and irregular inspections and issued decrees on corrective measures.

The inspectorate performed inspection of radiation protection at the Nuclear Power Plant Krško (9 inpections), "Jožef Stefan" Institute (2 inspections) with the research reactor TRIGA in Brinje near Ljubljana and in the Agency for Radwaste Management with the Central Interim Storage for Radioactive Waste in Brinje (2 inspections). No major irregularities were found. The irregularities regarding the management of computerised data related to dosimety and personal doses should be corrected in the first half of the year 2003. The inspection discovered some deficiencies regarding the person responsible for radiation protection at the Agency for Radwaste Management. Four inspections were performed at the Žirovski vrh Mine, relating to the remediations of mine, waste disposal sites and other objects.

The Health Inspectorate regularly maintained the Central records of personal doses where data on external exposure are sent every month from the authorised dosimetry service, and internal dose data related to radon exposure are sent semi-annually or annually. As prescribed in the European directive, the Central records of personal doses also contain data on outside workers who are occupationally exposed due to their work at the licensee who is not the employer of these workers.

The Institute of Occupational Safety, the Nuclear Power Plant Krško and the "Jožef Stefan" Institute are authorised for performing dosimetry service using thermoluminescence dosimeters, while the Institute of Occupational Safety, the "Jožef Stefan" Institute and the Žirovski vrh Mine are authorised to perform dosimetry related to exposure to radon.

4.4. Veterinary Administration

The Veterinary Administration, as a part of the Ministry of Agriculture, Forestry and Food, inspects the contamination of food of animal origin and feeding stuff at the border as well as inside the state. The Veterinary Administration ordered seven samplings related to the import of food, and all activities were within the prescribed limits. Regarding the inspection of food the Veterinary Administration collaborates with the Institute of Occupational Safety.

4.5. Techical Support Organisations

According to Article 13 of the Act on Implementing Protection against Ionising Radiation and measures for the Safety of Nuclear Facilities, two organisations, namely "Jožef Stefan" Institute and the Institute of Occupational Safety, have acquired authorisation for monitoring of radioactive contamination, for measuring exposure of workers to ionising radiation, for periodic monitoring of levels of exposure in the working environment, for control of operability of measuring instruments and protective equipment, for decontamination of the working and living environment, and for training of radiation workers. Žirovski vrh Mine has been authorised for performing measurements of ionising radiation in mines.

For the implementation of active medical protection, the following institutions are authorised: the Clinical Institute for Medicine of Work, Traffic and Sport, the Institute of Occupational Safety, the Community Health Centre Krško (for Krško NPP employees) and the Community Health Centre Škofja Loka (for Žirovski vrh Mine employees).

The most extensive professional tasks performed by these organisations in the year 2002 were control measurements of radioactivity in the environment and assessment of impact of the nuclear facilities to the environment, inspection of radiation sources, monitoring of exposure in the working environment and radiation exposure of workers, training of radiation workers, preparation and presentation of expertise in the field of radiation protection and evaluation of radiation protection measures. Authorised public health organizations were monitoring the state of health 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 organisations were authorised for performing certain tasks in the field of nuclear safety and radiation protection on the Slovenian territory.

In 2002 the following 13 organisations held the authorisation:

- Milan Vidmar Electric Institute (EIMV), Ljubljana
- ENCONET Consulting, Vienna, Austria
- High Voltage and Energetics Department, 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
- Slovenian National Building and Civil Engineering Institute (ZAG), Ljubljana
- Izolirka, Fire Engineering, Radovljica

The authorised organisations prepared yearly reports on their activities in the fields of their authorisation in 2002. The conclusion based on these reports was that there were no major changes in their performance in comparison with previous years. In the field of staffing the authorised organisations 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 the Quality Certificate. The most extensive professional task of these organisations in 2002 was independent inspection 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 authorised 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. A significant part of their activities consisted of research and development activities, which are not adequately financially supported by the Slovenian budget.

4.6. The Fund for Financing the Decommissioning and Disposal of Radioactive Waste of the Krško NPP

In 2002 the Krško NPP contributed to the Fund 3,231,603,336.00 SIT and covered all financial liabilities that occurred on the basis of production of electric energy. The income of the fund has meet the expectations. With the management of the financial portfolio the Fund created through the investment an income of 2,053,228,292.00 SIT in 2002, and achieved the profit of TOM + 5.6% (inflation + 5.6%) or EUR + 9.4%. The total assets of the portfolio that were invested in compliance with the adopted strategy for investment in 2002 amounted to 20,473,279,000.00 SIT by the end of 2002.

4.7. Nuclear Pool

The pool for insurance and reinsurance of nuclear risks (in short: Nuclear Pool) is a special type of insurance company, whose priority is insurance and reinsurance of nuclear risks. The Nuclear Pool has been operating since 1994 as a commercial association of interests including the Insurance Company Triglav, Ltd., the Insurance Company Maribor, Ltd., the Insurance Company Adriatic, Ltd., the Insurance Company Tilia, Ltd., the Insurance Company Slovenica, Ltd., the Insurance Company Mercator, Ltd., the Insurance Company Merkur, Ltd. and the Reinsurance Company Sava, Ltd.

In 2002, the Nuclear Pool operated with the same capacities as in 2001, namely in the amount of USD 6,620,000 for domestic risks and in the amount of USD 5,960,000 for foreign risks. Since 1991 the Nuclear Pool and the Croatian Nuclear Pool have (each up to 50%) co-insured the property of the Krško NPP against nuclear, fire and other risks. In 2002, two individual policies were issued with a joint limit of USD 800 million and a special limit for the risk of terrorism in the amount of USD 100 million. Both pools and the Krško NPP retained a share of 2.20%, while the rest of the risk is insured by 17 foreign pools, the most important being British, Japanese, German, Swiss and French.

The Third Party Liability cover is insured by the Slovenian Nuclear Pool only in the amount of SDR (special drawing rights) 150 million or in USD 190 million. The share retained by the Slovenian Pool is 0.84%, while the rest of the risk is insured by 17 foreign pools, the most important being British, Japanese, German, French and Swedish.

In 2002, the Krško NPP reported no loss.

4.8. Nuclear and Radiation Emergency Preparedness

The cornerstone of a comprehensive system of nuclear and radiation safety is an emergency preparedness organisation which is designed to cope with events which can release a substantial amount of radioactivity in the environment.

In 2002, most of the activities in the area of emergency preparedness were connected with the preparation, realisation and analysis of the national exercise NEK-2002, which took place on 23 November 2002.

The *National Plan for the Protection and Rescue during a Nuclear Accident* was updated in 2002 as well as its supplements and appendices. The plans for the protection and rescue during a nuclear accident in the Posavje region, in the municipalities of Krško, Brežice and Sevnica were also revised and harmonised with the national plan. Public presentations of the draft plans were held in the region and municipalities of Krško and Brežice before the plans were approved. These plans were presented to the public after the approval.

4.8.1. Preparations of the Competent Authorities and Organisations

The main Slovenian organisations whose responsibility is to take measures in case of a nuclear or radiation emergency are: the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief within the Slovenian Ministry of Defence, the Slovenian Nuclear Safety Administration within the Ministry of Environment, Spatial Planning and Energy, the Nuclear Power Plant Krško and the Mobile Laboratory ELME as a specialised unit of Civil Protection.

Administration for Civil Protection and Disaster Relief of the Republic of Slovenia is responsible for administrative and expert tasks for protection and rescuing, and for other tasks within the system of protection against natural and other disasters. In co-operation with the Nuclear Power Plant Krško this administration organised a workshop for the emergency planners from the Ministries and Governmental Services who planned the NEK-2002 exercise. The participants acquainted themselves with the protection and rescue plans in the nuclear power plant. 195 members of the units which take actions in nuclear or radiation emergencies were trained in 2002 in the *Civil Protection and Disaster Relief Training Centre* at Ig near Ljubljana.

Slovenian Nuclear Safety Administration produced a new internal organisation document which created the Emergency Preparedness Unit, which is directly subordinated to the SNSA Director. The main tasks of this Unit are:

- Maintenance of the internal emergency preparedness and response plan,
- Control of the emergency preparedness in the organisation,
- Training of emergency personnel,
- Exercise planning,
- Exercise analysis.

The Slovenian Nuclear Safety Administration has its own emergency preparedness and response plan which stipulates the organisation and operation of the SNSA during an emergency. 12 out of 26 procedures were revised in 2002.

The activities of the **Nuclear Power Plant Krško** in 2002 concerning emergency planning were directed to the maintenance of the existing preparedness, especially to:

- preparation and execution of the NEK-2002 exercise,
- increasing of the qualification and experience of the intervention personnel of the nuclear power plant,
- realisation of the tasks and recommendations assigned within the frame of the annual emergency preparedness action plan.

In 2002 the Nuclear Power Plant Krško participated in creating the regional and local protection and rescue plans of the municipalities of Krško and Brežice in case of a nuclear accident.

In 2002 the Nuclear Power Plant Krško started to build an alarming system in the power plant, modified the ventilation in the technical support centre and renovated the medical centre in the facility. It prepared an information brochure entitled *'How to React in a Nuclear Emergency'* for the people living in the area where urgent protective actions are planned. Its contents are harmonised with the emergency plans. The brochure was delivered to the inhabitants of the municipalities of Krško and Brežice prior to the exercise NEK-2002.

Radiation Unit of the Mobile Laboratory ELME had no interventions in the year 2002. Two regular drills in the vicinity of the Nuclear Power Plant Krško were performed. Besides, ELME participated in the NEK-2002 exercise, and in September its members attended the meeting of the European mobile radiological laboratories at Balaton, Hungary.

4.8.2. Exercise NEK-2002

The NEK-2002 exercise was organised as a national exercise. Its aim was to test the activities on the national and local levels as well as of the Nuclear Power Plant Krško during an emergency. It started on 22nd of November at 23:00 local time and finished next day in the afternoon. The sequence of events followed the scenario which was prepared in advance and ran on the simulator of the nuclear power plant. The real meteorological conditions on the day of the exercise were taken into account. Simulated release of radioactivity into the environment was planned to the extent of a need for urgent protective actions in the area within 10 km from the nuclear power plant. The progress of events demanded a classification from the lowest to the highest stage of danger.

Figure 18: Cover page of the brochure 'How to React in a Nuclear Emergency'

The initiating event of the simulated accident was a small leakage of the primary system, followed by a fire on a safety electrical bus. The fire was successfully extinguished. All expert groups of the SNSA and of the headquarters of the civil protection were fully operable at 5:30 local time. The leakage of the primary coolant of the power plant was continuing and increasing in the meantime. Due to the leakage and after additional failures of the safety systems the reactor core began to overheat, fuel rods were damaged and the containment failure occurred. The release of radioactivity started at 12:00 local time. The countermeasures ordered by the Civil Protection Commander were: sheltering, distribution of the potassium iodide tablets and evacuation. The release of radioactivity ended at 13:30 local time. From then on, the situation in the nuclear power plant began to improve. The exercise ended on 23 of November at 15:50 local time.

The exercise was observed by 40 guests from 14 countries (representatives of the civil protection and nuclear safety experts, military attachés and other military representatives). Their programme included acquaintance with the concept of response to the nuclear accident, with the contents and goals of the exercise and observation of the work of the expert groups at the SNSA (Fig 19).

Figure 19: Foreign visitors in the room of the Expert group for the analysis of the nuclear accident during the NEK-2002 exercise

In Krško, the guests witnessed the implementation of the radiation monitoring and radiological decontamination, and visited the nuclear power plant. For the 31 domestic guests the observation of the exercise was organised in the form of a special programme in the Krško area.

The exercise proved that an effective system of response to a nuclear accident was established. However, this system should be improved on the basis of the experiences obtained during the exercise. Regarding the great number of inhabitants living in the area of the protective measures it would be necessary to take the decision about the beginning of the protective action implementation on a national level. It is also necessary to ensure effective communication between all parties involved in decision-making. The Exercise Report was forwarded to the Government of the Republic of Slovenia, which demanded that all recommendations should be implemented by the competent authorities by the end of 2003.

4.8.3. International Activities Concerning Emergency Preparedness

International co-operation is a prerequisite for the mutual exchange of information and assistance. Slovenia takes part in international activities and has bilateral agreements with foreign countries.

Within the **regional project of the IAEA** *Harmonization and Strengthening of Regional Preparedness and Response for Nuclear Emergencies* two meetings were held: one on 25th and 26 May 2002 in Vienna and the other on 23 and 24 July 2002 in Ljubljana. The representatives of the participating countries presented the progress made in the preparedness to a nuclear accident.

The Subcommittee, whose aim is reconciliation of the protection and rescue plans, held a meeting in Zagreb in 2002, according to the *Agreement between the Government of the Republic of Slovenia and the Government of the* ***Republic of Croatia*** *on cooperation in protection against natural and civilisation disasters*. The participants discussed co-operation in response to a nuclear accident.

In 2002, **the British Ministry for Trade and Industry** carried out an assistance programme for the Slovenian regulatory authority for nuclear safety. The programme started in April and ended with the opening ceremony of the Emergency Response Centre at the Slovenian Nuclear Safety Administration on 23 November 2002. The Centre was upgraded with the information and telecommunication infrastructure and an emergency electric power source, a diesel generator, was delivered. The value of all the supplied equipment is about 15 million SIT.

In June 2002 a Financial Memorandum between the European Commission and Slovenia was signed in Ljubljana. According to this memorandum, the European Commission engaged itself to support the project within the **programme Phare** called *Installation of* ***RODOS*** *in Slovenia* with 600,000 EUR. At the end of November the documentation with the invitation to participate in the international tender was ready. The preparations for the publication of this documentation started in December.

In 2002 the SNSA obtained all the necessary computer and telecommunication equipment for the operation of the **CoDecS** system (the system for immediate exchange of coded messages concerning nuclear and radiological accidents in Europe), which represents the technical realisation of the obligations from the European legislation concerning urgent mutual notification of the member states in case of emergency (the **ECURIE system**).

5. The Radioactive Waste Management and Management of Nuclear and Radioactive Material

The high level radioactive waste is generated in Slovenia 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 of radioactive waste are spent radioactive sealed sources. They are in the possession of small holders or are stored in the Central Interim Storage for Radioactive Waste in Brinje.

5.1. The 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 super-compaction, drying and incineration, so that their total volume by the end of 2002 was 2,208.3 m^3 (Figure 20). 254 standard drums containing solid waste with total gamma activity of $1.33 \cdot 10^{11}$ Bq and total alpha activity of $7.63 \cdot 10^{6}$ Bq were stored in 2002. The NPP sent 250 drums with total activity $2{,}051 \cdot 10^{9}$ Bq to Sweden for incineration. The total mass was about 21 tonnes.

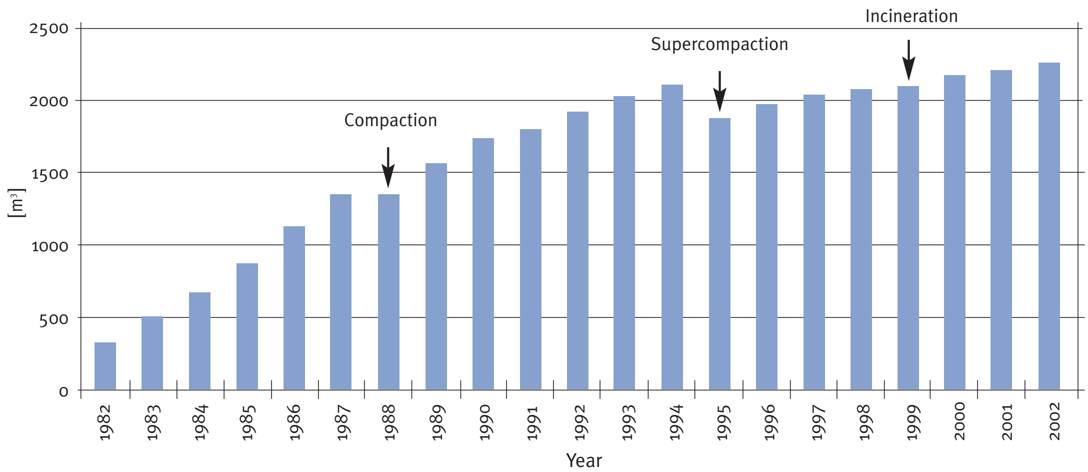

Figure 20: The volume of low and intermediate level radioactive waste in the Krško NPP

All spent nuclear fuel at the Krško NPP is stored in a pool. During the 2002 regular outage 33 spent fuel assemblies were removed from the reactor core (Figure 21). At the end of 2002 altogether 663 spent fuel elements (approximately 255.8t of heavy metal) were stored in the spent fuel pool. The remaining available storage positions would be sufficient for only two more years of reactor operation. For this reason, refurbishment of spent fuel began in 2002. The replacement of racks will facilitate safe and long-term storage of spent fuel until the termination of operation of the NPP in 2023.

In case of life extension of the Krško NPP it is possible to augment the spent fuel pool capacity for additional twenty years.

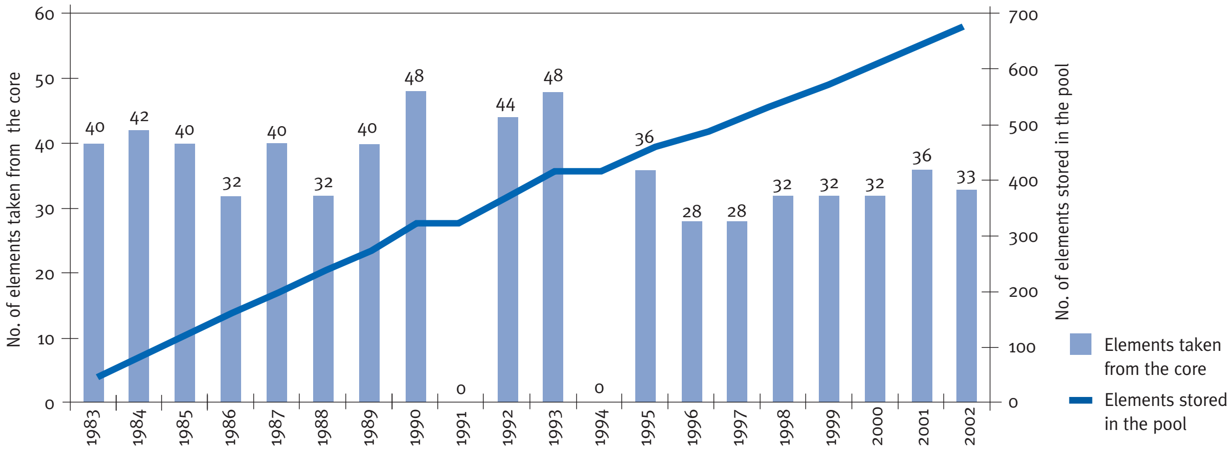

Figure 21: The annual discharges of spent fuel assemblies and accumulation of spent fuel assemblies in the Krško NPP spent fuel pool

5.2. Radioactive Waste at the "Jožef Stefan" Institute

Until the end of 2002, approximately 3m^3 of radioactive waste with total activity of $3.7 \cdot 10^7$ Bq was accumulated at the Reactor infrastructure centre of the "Jožef Stefan" Institute. They are pending for transfer to the Central Interim Storage for Radioactive Waste in Brinje. At present there is no nuclear spent fuel from the research reactor TRIGA at the "Jožef Stefan" Institute. All spent fuel was returned to the USA in 1999.

5.3. 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 of waste liquids. If determined by the technical support organisation that the specific activity does not exceed 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 is the only hospital in Slovenia with patients who, after receipt of radioactive iodine ^{131}I, are hospitalised in a separate department. However, the Clinic still has no system for hold-up of waste liquids and radioactive substances are therefore discharged into the environment.

5.4. Operation of the 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 Storage of 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. The radioactive waste is being accumulated at producers, who have a strong interest in obtaining full functioning of public service in this area.

On the request of the Slovenian Agency for the Environment, the RAO Agency has prepared a report on the environment impact of refurbishment of the Central Interim Storage for Radioactive Waste in Brinje. The report covers assessment of environmental impact of the planned works during the refurbishment and after its completion. The above report will be an integral part of the documentation supporting the application for a permit for reconstruction. In 2002 the RAO Agency filed the applications for obtaining all necessary consents on project documentation that are needed for the license for reconstruction; the license will be issued by the Ministry of the Environment, Spatial Planning and Energy, on the basis of consent of the SNSA.

With regard to the needs, the Slovenian repository for the disposal of low and intermediate level radioactive waste has to become operational by 2010 at the latest. For this reason it is necessary to intensify the activities of the RAO Agency in this particular area.

5.5. The Closure of the Temporary Storage of Sealed Sources at Blejska Dobrava

In a complex of warehouses at Blejska Dobrava, the iron smelter Železarna Jesenice ltd. had a storage for 88 unused ^{60}Co sources. Because of improper storage they presented a potential risk of radiation exposure to population, as well as risk of theft or sabotage. For this reason the company ACRONI wanted to get rid of these sources. Consequently, the Health inspectorate issued a request for transfer of the sources into the Central Interim Storage for Radioactive Waste in Brinje. For this purpose the ACRONI contracted the "Jožef Stefan" Institute, which transported the sources and repacked them into a package that was suitable for storage and finally transferred them into a storage facility. They also performed measurements of the storage at Blejska Dobrava, on the basis of which the SNSA released it to unlimited use.

5.6. Transport of Radioactive and Nuclear Materials

In accordance with the Law for transportation of dangerous goods the SNSA issued one permit for the import of nuclear material, namely for 33 fresh fuel assemblies for the Krško NPP. The fuel arrived in April 2002 by the sea to the Port of Koper, wherefrom it was transported by trucks to the Krško NPP.

For the transport of dangerous goods two permits were issued: one to the "Jožef Stefan" Institute, for the transport of 88 sealed sources from the storage at the company ACRONI at Beljska Dobrava to the Reactor Centre in Brinje; and the other to the Institute of Occupational Safety, Ljubljana, for the transport of three ^{60}Co sources and one ^{137}Cs source from small producers to the Central Interim Storage for Radioactive Waste in Brinje.

The transports that are performed only in accordance with regulations and do not require permits are being carried out daily with the purpose of delivery to the site of application in medicine, industry and research.

In 2002 the Health Inspectorate issued eight permits for the transport of radio-pharmaceuticals and three consents to permits for the transport of other radioactive substances that were issued by the SNSA.

5.7. Import and Export of Radioactive and Nuclear Materials

Because of their radio-toxicity, radioactive and nuclear materials represent a potential risk to health and the environment. For this reason, appropriate measures are applied in Slovenia concerning the import and export of such materials, as prescribed by legislation.

Until October 1, 2002, the SNSA issued permits for the import and export of radioactive and nuclear material in compliance with the Decree on Import and Export Regime of Specific goods. Since the date when the new Act on Ionising Radiation Protection and Nuclear Safety entered into force, the SNSA is issuing permits for all radioactive and nuclear materials, with the exception of medical appliances, which are regulated by the Ministry of Health.

In 2002 the SNSA issued 106 permits (Figure 22), 39 for single import, 56 for multiple imports, and 11 for export.

In 2002 three inspections on transport of radioactive materials were carried out, one at the storage of ACRONI (preparation of spent sealed sources for transport to the Central Interim Storage for Radioactive Waste in Brinje), one at the IMP company, Ljubljana, and one in connection with preparation, loading and transport of fresh fuel for the Krško NPP.

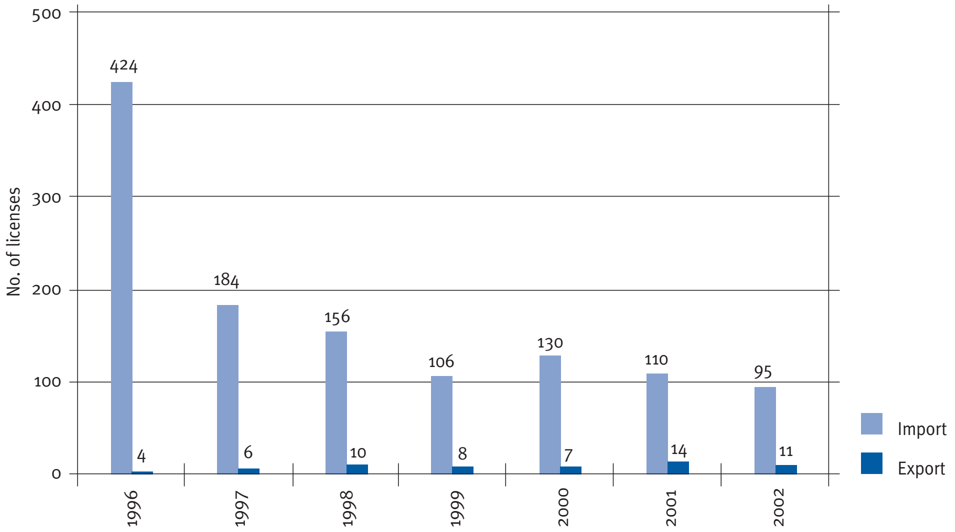

Figure 22: The number of import and export permits for nuclear and radioactive materials by year.

5.8. Open Issues

5.8.1. Disposal of 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 level radioactive waste. The responsibility for the construction and operation of the repository was entrusted to the RAO Agency. Since its foundation in 1991, the Agency has been putting significant effort in its siting and construction. The main reason for the failure of this effort has been the low public acceptance of such a repository. Consequently, the Agency oriented its efforts into communication with the public and developed for this purpose a special methodology. The process of site selection was presented to the general public at a press conferences and through the mass media. In addition, a special workshop was organised 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.

The problem of repository construction will become more and more severe in the coming years. The EU has prepared a draft directive setting the deadline for the siting of the repository to 2008, and the deadline for the beginning of its operation to 2013.

With the document “Strategy on high level waste management”, the decision on the disposal of spent nuclear fuel has been delayed to the year 2020. This is not in line with the most recent position of the EU on this particular subject.

5.8.2. The Reclamation of the Uranium Mining at the 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 the accompanying objects, has been successfully demolished. In 2002 they started with stabilisation of underground works. The biggest remaining problem is reclamation of the tailings Jazbec and Boršt. The most problematic in this regard is Boršt, where the uranium mill tailings are deposited. For this, it is necessary to ensure long term safety. The aim is to achieve adequate physical integrity of the disposal itself as well as of the soil cover that will prevent emanation of radon into the environment. According to international recommendations it is necessary to ensure safety of the disposal site for a period of several hundred years (in the USA - 1000 years). On the Boršt site it is difficult to meet such requirements. The uranium mill tailings are deposited on an extensive landslide, for which it is practically impossible ensure long-term stability. An additional problem are unfavourable geomechanical properties of the mill tailing material itself. This was discovered by the end of 2002 when an attempt to construct a test field for the planned soil cover over the mill tailings failed. It is planned to find a solution to this problem by the end of 2003.

SNSA inspections controlled the mine and evaluated the licensing process for the siting of Boršt and Jazbec waste disposals. The SNSA inspected the drainage tunnel under Boršt, the documentation on the measurement of horizontal and vertical land slide displacements, and the records on the amounts of the disposed radioactive waste (hydro-metallurgical waste).

5.8.3. Decommissioning of Nuclear Facilities

In Slovenia there are two nuclear facilities that, after their closure, are a subject of 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. On the basis of this law, the Fund for decommissioning of the Krško NPP was established and the manner for the collection of money (through the levy per kilowatt hour of electricity produced at the Krško NPP) was determined. The levy was assessed through the document "The Decommissioning Plan for the Krško NPP", which is subject to revision every three to five years. With this document it was recommended to collect 0.42 SIT per kWhe. However, because of the pending liabilities it was agreed that until the year 2002 0.61 SIT per kWhe produced at the Krško NPP would be contributed to the Fund.

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 small in comparison with the Krško NPP. If the spent fuel is not returned to the USA by May 2009, the biggest problem and costs are envisaged in relation to spent fuel management and its disposal.

6. Nuclear Non-Proliferation

6.1. Safeguards for Nuclear Material

Nuclear non-proliferation is an activity preventing the development and production of nuclear weapons in the countries which are not nuclear-weapon states. Since the Golf crisis, the discovery of clandestine activities in North Korea, the first nuclear weapon tests in Pakistan and India, and in particular since the terrorist attacks on September 11, the international community has been devoting a lot of attention to this issue.

The basic internationally binding document in this area is the Treaty on non-proliferation of nuclear weapons, also known as the NPT. On the basis of the NPT the International Atomic Energy Agency was established with a mandate to conclude safeguard agreements with the states that are parties to the NPT. Because of discovered violations in certain states, the agreement was strengthened with the Additional Protocol.

Since becoming an independent state, Slovenia has applied the Safeguard agreement concluded between the former Yugoslavia and the IAEA. In August 1997 this practice was terminated with the Agreement between Slovenia and the International Atomic Energy Agency for the Application of Safeguards in Connection With the Treaty on Non-Proliferation of Nuclear Weapons. The Additional Protocol was signed and ratified in July 2000. Both legal documents enable the international community to control the use of nuclear material in Slovenia and prescribe the safeguarding and reporting obligations.

The International Atomic Energy Agency has performed at the Krško NPP six inspections under the Safeguard agreement and two under the Additional protocol. At the "Jožef Stefan" Institute there was one inspection under the Safeguard agreement and one under the Additional protocol. One inspection under the Additional protocol was also carried out at the Žirovski vrh Mine. No violations have been reported.

6.2. Comprehensive Nuclear Test-Ban Treaty

An international legally binding instrument for combating proliferation of weapons of mass destruction is also the Comprehensive nuclear test-ban treaty. Its basic purpose is to prevent tests with nuclear explosive devices. The states which are parties to the treaty have established the Comprehensive nuclear test-ban treaty organisation (CTBTO) with its headquarters in Austria. The basic purpose of CTBTO is to establish and maintain a network of monitoring stations to detect any nuclear explosion. The monitoring stations (seismic, hydro-acoustic, ultrasound and aerosol) are evenly spaced around the world. The registered information is gathered and evaluated at CTBTO, which distributes them to the states which are parties to the CTBT. During the transitional period, that is until the treaty enters into force, CTBTO is governed by the preparatory committee in Vienna.

CTBTO has almost completed the monitoring network and is already gathering and evaluating information.

With the assistance of the Slovenian mission in Vienna, the SNSA has followed the activities of CTBTO and disseminated the received information to appropriate Slovenian organisations and institutions.

6.3. Physical Protection of Nuclear Material and Facilities

Physical protection of nuclear material and facilities is ensured by administrative and technical measures. Their purpose is to prevent unauthorised access to nuclear materials and facilities, to prevent their unauthorised removal, and to prevent sabotage with nuclear and radioactive material.

Physical protection of nuclear facilities and material at the Krško NPP and the research reactor TRIGA, and of the radioactive material in the Central Interim Storage for Radioactive Waste in Brinje, is carried out in compliance with regulations. The physical protection system is supervised by joint regular inspections of the Ministry of the Interior and the SNSA. At the Ministry of the Interior Affairs a Commission has been established for tasks concerning physical protection of nuclear material and facilities. On the basis of information provided by the police and intelligence services, the SNSA and nuclear facility operators, the commission reviewed the design basis threat for each nuclear facility. The revisions were signed and dispatched by the Director General of the Police.

In 2001, the NPP started with the refurbishment, modernisation and replacement of technical components of the physical protection system. The works are planned to be completed in 2003.

In September 2002 the International Atomic Energy Agency organised a three-day workshop on the design basis threat.

6.4. Export Controls of Dual-Use Goods

One of the provisions of the Nuclear non-proliferation treaty requires from the states, parties to the treaty, to establish control over the export of equipment or material specially designed or prepared for the processing, use or production of special fissionable material. In order to meet the above requirement, two international organisations were established to determine the list of goods and the regime under which such goods can be exported. These are the Zangger Committee (ZAC) and the Nuclear Suppliers Group (NSG). As the majority of developed states also Slovenia became their member.

In 2000, with the adoption of the Law on export of dual-use goods Slovenia set up an export regime that is in accordance with the legislation of the European Union. The list of dual-use goods encompasses goods that are subject to export control for the purpose of prevention of proliferation of nuclear weapons. For the export of the goods on the list it is necessary to obtain a permit from the Ministry of Economy, which is issued on the basis of opinion of the SNSA.

In order to strengthen the implementation of the above mentioned law, the Government has formed an Interdepartmental commission for monitoring co-ordination of export controls of dual-use goods.

6.5. Illicit Trafficking of Nuclear and Radioactive Material

In recent years the combat of illicit trafficking with nuclear and radioactive material became a subject of intensive international co-operation. In order to prevent illicit trafficking a great number of actions have been organised primarily through international organisations 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.

Slovenia has in recent years established in this field a legal system that is similar to the one in the developed European countries. When implementing the law, a need for better interdepartmental co-operation was soon discovered. With the purpose of analysing the status of work in this particular area, of better defining the role of individual governmental offices and agreeing on co-ordinated work, the SNSA is organising periodical interdepartmental meetings.

In 2002 the Slovenian governmental institutions received from the Government of the USA equipment for the detection and characterisation of radioactive and nuclear materials. The SNSA, together with the Customs administration, organised a workshop on the use of this equipment for over 60 participants from the customs and the police. The SNSA also gave access to the customs and police officers a phone number on which the SNSA staff is constantly available for consultations and co-operation in the case of discovery of an illicit nuclear or radioactive material. The Customs administration, the police and the SNSA have developed procedures for such cases.

7. International Co-Operation

International co-operation and placing of Slovenian regulatory bodies and technical organizations within international integration are under the conditions of a "global village" essential also in the field of nuclear and radiation safety. This co-operation is either institutionalized through the membership of our country in international organizations, such as the International Atomic Energy Agency, the Organisation for Economic Co-operation and Development (OECD/NEA - observers) and the European Union, or through the membership in associations such as the Western European Nuclear Regulators Association, the Network for Regulators with Small Nuclear Programs and the International Nuclear Law Association. Co-operation is also going on through multilateral and bilateral international agreements.

7.1. Co-Operation with International Organizations

In the year 2002, the successful cooperation with the **International Atomic Energy Agency** continued. Besides attendance of the Slovenian delegation at the regular session of the General Conferece (16-20 September 2002), it is worth mentioning the following:

- Within the programme of technical co-operation in 2002 Slovenia received 33 applications for training of foreign experts in our country. 14 applications out of 33 were implemented in the same year as well as 5 applications from 2001. All other applications approved by our country will be implemented in 2003.
- Within technical co-operation in 2002 there were 13 reaserch contracts going on which had been already signed in the years 2001 and 2002 and which cover areas of research and co-sponsoring of larger (national) projects. In 2002, Slovenia also submitted seven new research contract proposals, of which only three were approved by the Agency.
- Technical assistance projects are the most extensive form of co-operation between the Republic of Slovenia and the IAEA. 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 2002, the Agency approved three new projects from 2000 and extension of two projects from 2001 and a project from 1999.
- The International Atomic Energy Agency approved a follow-up Support for Nuclear Safety Review Mission (OSART Mission) to take place in the Nuclear Power Plant Krško in 2003.
- Slovenia frequently takes an active part as a host country of the International Atomic Energy Agency's fellows and of those from developing countries.

It should be emphasized that the Republic of 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 2002, Slovenia made two extra-budgetary contributions, 15,000 EUR for building an early warning monitoring system for Serbia and Monte Negro and 14,000 EUR for combating nuclear terrorism.

In the year 2002, co-operation with the **Nuclear Energy Agency (NEA)** within the Organization for Economic Co-operation and Development strengthened (OECD). In December 2001, the OECD

Council accepted Slovenia as an observer country to all seven standing technical committees of the NEA. Based on this the Government of the Republic of Slovenia designated representatives of the Republic of Slovenia to the OECD/NEA subsidiary bodies. The Slovenian representatives attended regular annual sessions of the NEA committees as observers.

An additional step forward in efforts to a close co-operation of Slovenia with the OECD subsidiary bodies was a visit of Mr. Luis Echavarri, OECD/NEA's Director General to Slovenia. The visit was organized to inform this outstanding guest with the status of nuclear safety in our country, use of nuclear energy and research going on in this field in Slovenia.

7.2. European Union Matters

In the framework of the accession to the EU activities Slovenia continued with the aligning of the domestic legislation with the acquis. Besides the translations of EU documents and their expert and legal review, an important achievement is also the adoption of the new Protection against Ionising Radiation and Nuclear Safety Act. The process of aligning the legislation will proceed with the adoption of the secondary legislation (regulations).

The area of nuclear and radiation safety is always the subject of the regular Slovenia - Progress Reports prepared by the European Commission, as well as the *Accession Committee Slovenia-EU Meetings* and the *Meetings of the Subcommittee on Transport, Energy, Environment and TENs*. The observations and recommendations given during the aforementioned meetings and the report on *Nuclear Safety in the Context of Enlargement of the EU* were the basis for the answers prepared by Slovenia and communicated to the EU representatives, i.e. legal (*de iure*) independence of the Slovenian Nuclear Safety Administration, and seismic safety of the Nuclear Power Plant Krško.

The representatives of Slovenia have already taken the role of active participants in some bodies of the EU, especially those which support the work of the Directorate General for Energy and Transport (DG TREN). Representatives of the Slovenian Nuclear Safety Administration were regularly taking part in the CONCERT (CONCentration on European Regulatory Tasks) group meetings, NRWG (Nuclear Regulators Working Group), ERWR (European Radioactive Waste Regulator's Forum) and ACCESS (Applicant Country Co-operation with Euratom Safeguards System), which is located in the European Commission Office in Luxembourg.

In the accession partnership between the EU and Slovenia in the area of radiation and nuclear safety, the Phare assistance has an important role.

In June 2002 the Financing Memorandum was signed for two projects from the Phare Nuclear Safety Programme 1999, i.e. Assistance to Regulatory Body 3rd Year including Technical Assistance in Reviews of Seismic and PSA Studies of the Krško NPP and Installation of RODOS in Slovenia.

Until the end of 2002, for the project Installation of RODOS in Slovenia the ToR had been prepared, and for the project Assistance to Regulatory Body 3rd Year the consortium led by the Belgian regulatory authority was selected.

For the 2002 Phare Nuclear Safety Programme the following projects were proposed and have been approved by the European Commission:

- Upgrading and Modernisation of the National Early Warning System,
- “Hot cells” Facility Renovation and Modernisation
- Characterisation of Low and Intermediate Level Radioactive Waste Currently Stored in a Central Facility.

7.3. Co-Operation with Other Associations

Co-operation of our representatives in other international associations, such as the Western European Nuclear Regulators Association (WENRA), the Network for Regulators with Small Nuclear Programs (NERS), the International Nuclear Law Association (INLA), the international committee and organisation in the field of dual use regime (Zangger Committee and NSG), the Decision Support System Network (DSSNET), the European Community Urgent Radiological Information Exchange (ECURIE), and the Information System on Occupational Exposure (ISOE) continued in 2002.

7.4. Co-Operation within the Frame of International Agreements

Slovenia is a contracting party to many international agreements in the field of nuclear and radiation safety, safeguards, notification and taking measures in case of nuclear accidents, physical protection of nuclear facilities, non-proliferation of nuclear weapons and liability for nuclear damage. On 12 November 2002, the Republic of Slovenia ceased to apply *the Vienna Convention on Civil Liability for Nuclear Damage*. In accordance with Article XXV of the Vienna Convention, Slovenia sent an application of termination to the depositor (Director General of IAEA) at the end of 2001. On October 16, 2001 Slovenia became a contracting party to the Convention on Third Party Liability in the Field of Nuclear Energy (Paris Convention) which covers the same area and whose depositor is the OECD. At that time Slovenia also sent to the Belgian Foreign Ministry a formal application to accede to the Brussels Convention supplementing the Paris Convention.

In 2002, representatives of the Republic of Slovenia took part in the work of a *Group of Experts*. The mandate of the group was to prepare draft protocols to amend *the Paris Convention* and *the Brussels Supplementary Convention*.

At the headquarters of the IAEA an *Open-ended Group of Legal and Technical Experts* to prepare a draft amendment of the *Convention on the Physical Protection of Nuclear Material* continued its work in 2002. A Slovenian representative took part in its work.

From 15 to 26 April 2002 a Slovenian delegation participated in the second *Review Meeting of the Contracting Parties of the Convention on Nuclear Safety*. The chairman of the review meeting was the former director of SNSA, Mr. Miroslav Gregorič.

Besides co-operating within the frame of multilateral international agreements in 2002, the SNSA also co-operated with representatives of foreign regulatory authorities for nuclear and radiation safety within the frame of bilateral international agreements. The Arrangement between the Nuclear Safety Administration of the Republic of Slovenia and the Ministry of Science and Technology of the Republic of Korea for the Exchange of Information and Co-operation in the Field of Nuclear Safety, signed on 7 January 2000, entered into force on 18 September 2002. Regular annual meetings with the representatives of foreign regulatory authorities for nuclear and radiation safety from the Czech Republic, the Republic of Hungary and the Slovak Republic were also organized.

7.5. Use of Nuclear Energy World-Wide

According to information provided by international organizations (International Atomic Energy Agency, British Petroleum, World Energy Congress) nuclear energy is the fastest growing primary energy source for electricity production. Figure 23 shows data from 2001 provided by the international corporation British Petroleum. One of the reasons for the growth are the new nuclear power plants which are under construction. However, better efficiency of the existing ones is even more important. More efficient management of the existing facilities leads to safer and longer operation in full power.

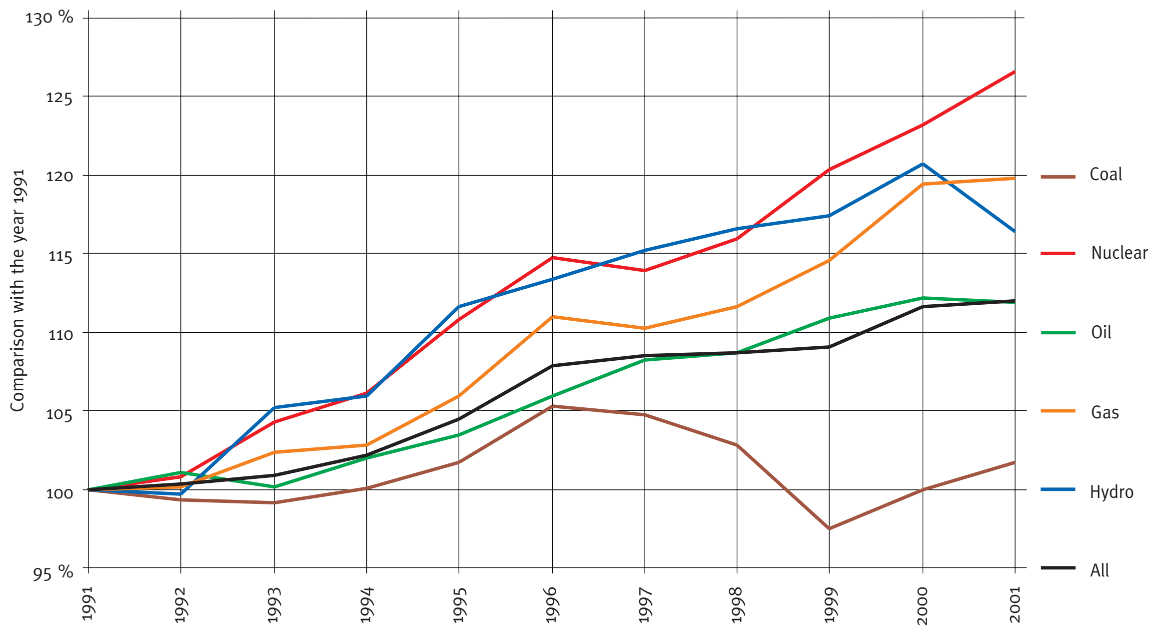

Figure 23: Comparison of the 10-year annual growth of primary energy sources for electricity production

Table 6 shows the number of nuclear power units by countries with their total electric power.

Table 6: Number of nuclear power units in operation, shut down and under construction at the end of 2002 by countries with their total electric power.

	Operation		Shut down		Construction	
	No.	Power [MW]	No.	Power [MW]	No.	Power [MW]
			EUROPE			
Belgium	7	5,712	1	11		
Bulgaria	4	2,722	2	816		
Czech Republic	4	1,648			2	1,824
Finland	4	2,310				
France	59	63,113	12	3,719		
Germany	19	21,072	17	4,965		
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
Slovakia	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
Great Britain	32	12,427	13	1,819		
Total Europa:	**212**	**169,234**	**67**	**18,060**	**11**	**9,549**
			ASIA			
Armenia	1	376	1	376		
China	5	3,636			5	5,001
India	14	2,446			8	4,322
Iran					2	1,900
Japan	54	44,394	3	320	3	4,150
Kazakhstan			1	70		
Korea, South	18	14,890			2	2,000
Korea, North					2	2,000
Pakistan	2	425				
Taiwan	6	4,885			1	1,350
Total Asia:	**99**	**70,904**	**5**	**766**	**23**	**20,723**
			AMERICA			
Argentina	2	935			1	692
Brazil	2	1,855				
Canada	20	13,601	5	2,016		
Mexica	2	1,308				
USA	104	95,622	24	9,107		
Total America:	**130**	**113,321**	**29**	**11,123**	**1**	**692**
			AFRICA			
South Africa	2	1,842				
Total World:	**443**	**355,301**	**101**	**29,949**	**35**	**30,964**

7.6. Radiation Protection and Nuclear Safety World-Wide

The International Atomic Energy Agency maintains the International Nuclear Event Scale system (INES) for reporting on abnormal radiation and nuclear events in nuclear facilities of IAEA member states. The summary reports of 2002 present the level of radiation protection and nuclear safety world-wide.

Twenty-six abnormal events were reported in 2002. Reporting of the member states is founded on a voluntary basis applying various criteria for reporting on an event. Ten reports were on events in nuclear power plants, the remaining 16 on lost radioactive sources (5 reports), on exceeded dose levels due to use of radioactive sources (3 reports), on events during transport (3 reports), on a spent source found in scrap intended for recycling (3 reports), on a worker who received internal contamination (1 report), and on industrial radiography improperly carried out (1 report).

One event in a nuclear power plant was of the third degree - serious accident, four of the second degree - incident, two of the first degree - anomaly and two events were of zero degree - below scale. Among the remaining events one was of the third degree, nine of the second degree and six of the first degree.

The events of 2002 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. They were internally contaminated, but did not suffer permanent consequences. It has been found that the most serious anomaly in any nuclear power plant was the one in Japan, where the Tokyo Electric Power Company (TEPCO) falsified a report on the leak rate interim inspection for containment in eight nuclear power plants. Fortunately, there were no consequences for the safety of nuclear power plants. All the nuclear power plants involved were later shut down until the situation has been clarified.

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