612. Resolution on the National Programme for Radioactive Waste and Spent Nuclear Fuel Management 2006–2015 (ReNPROJG)

At its session of 1 February 2006, pursuant to Article 98 of the Ionising Radiation Protection and Nuclear Safety Act (Ur. list RS, 102/04 – official consolidated text), the National Assembly of the Republic of Slovenia adopted the

R E S O L U T I O N
ON THE NATIONAL PROGRAMME FOR RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL MANAGEMENT 2006–2015
(ReNPROJG)

1. INTRODUCTION

As a producer of radioactive waste, Slovenia needs a clearly defined policy regarding all issues relating to the existence and long-term management of radioactive waste and spent nuclear fuel, since effective resolution of this issue is possible only by means of work planned over the long term. The goals of long-term radioactive waste and spent fuel management and the methods of achieving those goals, to reflect a wider professional, administrative, political and public consensus on the approach selected, must be defined on the basis of the current situation, past experience, and future plans and expectations.

Under Article 98 of the Ionising Radiation Protection and Nuclear Safety Act (Ur. list RS, 102/04 – ZVISJV-UPB2), a Resolution on the National Programme for Radioactive Waste and Spent Nuclear Fuel Management 2006–2015 (hereinafter: National Programme for RW and SNF Management), has to be drawn up and submitted to the National Assembly by the government or its line ministry. The National Programme for RW and SNF Management is an independent sub-programme of the Resolution on the National Environmental Protection Programme, which the government submitted for discussion to the National Assembly in 2005. A public utility institute, the Agency for Radioactive Waste (ARAO) was appointed to draw up the expert foundations for producing the National Programme for RW and SNF Management.

According to the general and expert publics, radioactive waste (RW) and spent nuclear fuel (SNF) management is, particularly from the social aspect, a complex and highly sensitive area. While many of the technological solutions applying to safe disposal are already well known, intensive development is still ongoing in the field of spent nuclear fuel. The majority of countries treat SNF as waste, some as a secondary raw material and others as a possible raw material for the production of fuel. The most important factors for adequate management are ensuring the protection of human beings against radiation and guaranteeing environmental acceptability. RW and SNF are, because of the radiation they emit, potentially hazardous to human health and the environment. It therefore makes greatest sense to treat RW and SNF management within the wider context of environmental protection. In comparison with other dangerous substances, waste of this type has sufficiently specific characteristics as to mean that radioactive waste management is not governed by legislation on the management of other dangerous waste but by special legislation. RW and SNF management is regulated in a similar way in other EU Member States.

The National Programme for RW and SNF Management defines the tasks required to ensure the permanent and safe resolution of the issue of RW and SNF management regardless of whether Slovenia remains a nuclear state after the end of the operating life of NEK. The construction of the LILRW repository must be treated as a key environmental project of the programme, since a location acquired and repository constructed on time provides effective protection for the natural environment against the uncontrolled discharge of radioactive substances. The public utility service provider, ARAO, is responsible for conducting activities connected with long-term RW and SNF management. Funds for RW and SNF management are chiefly provided from the state budget, the Fund for

Financing the Decommissioning of NEK and the Disposal of RW from NEK, payments made by producers of radioactive waste under the public service tariff, and NEK's own resources. The total budget funds for RW and SNF management as a whole amounts to a little over EUR 41 million (SIT 9.846 billion) in the 2005–2014 period, with most of this being used for the closure of the Žirovski Vrh Uranium Mine between 2005 and 2009.

1.1 RADIOACTIVE WASTE

Low-, intermediate- and high-level radioactive waste

The Environmental Protection Act (Ur. list RS, 41/04 – ZVO-1) defines radioactive waste as waste which, owing to certain radioactive properties pursuant to the regulations on ionising radiation protection, is categorised as radioactive waste. It also states that waste is a specific substance or article in cases where the producer or other person that holds that substance or article in his possession discards, intends to discard or is obliged to discard it.

Under the provisions of the ZVISJV-UPB2, radioactive waste means substances in gaseous, liquid or solid form, and objects or equipment which are the waste product of radiation practices or intervention measures and for which no further use is anticipated, but which contain radioactive substances or which are radioactively contaminated beyond clearance levels. Under the most general established classification, radioactive waste is divided into three groups according to its specific activity: low-, intermediate- and high-level radioactive waste. The abbreviations LLRW, ILRW and HLRW are widely used abbreviations for these groups, along with LILRW for low- and intermediate-level radioactive waste.

Spent nuclear fuel and the residues of spent fuel processing are classified as HLRW. It should be pointed out that spent nuclear fuel can also be treated as a potential source of energy and not merely as waste, since uranium and plutonium can still be obtained from its processing.

Long-lived and short-lived radioactive waste

With low- and intermediate-level radioactive waste, the lifetime of the radionuclides that the waste contains is also important (in addition to its activity), since this lifetime determines how long the waste will remain radioactive, thereby also determining its management and the conditions for its permanent storage. With regard to the 'half-life'[1] of its component radionuclides, low- and intermediate-level radioactive waste is divided into short-lived and long-lived LILRW. In the former, the half-life of the radionuclides does not exceed 30 years.[2] Since the activity of the sample falls by half after the end of every half-life period, the activity of the waste falls below the lower limit for radioactive waste after ten half-lives of the longest-lived component isotope have elapsed. For short-lived LILRW, this means that the isotopes become non-hazardous after approx. 300–500 years. Long-lived LILRW also contains isotopes whose half-lives are considerably longer than 30 years. Their activity therefore falls considerably more slowly (several tens of thousands of years or even longer); they therefore require stricter criteria when it comes to constructing repositories and using more complex technological solutions for their treatment and preparation.

1.2 PRINCIPLES APPLYING TO RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL MANAGEMENT

Ionising radiation is harmful to living creatures; radioactive waste must therefore be managed in such a way as to prevent human beings from being exposed to excessive levels of radiation. We have to ensure that radioactive waste does not cause direct radiation and to prevent contamination of the

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[1] Half-life is the period over which the activity of a radioactive sample falls to half its initial value. Over this period, half the initial number of cores of the radioactive isotope in question decays.

[2] The precise number is 30.17 years, which is the half-life of Cs-137, classed as a short-lived isotope.

environment with radionuclides. The first is achieved by storing radioactive waste in or below a sufficiently thick biological shell, e.g. concrete, a layer of earth or water. Leakages of radioactive substances into the living environment are prevented by storing waste as dry, solid substances, and by preventing water from reaching the waste by means of multiple barriers. Water is a medium able to 'dissolve' radioactive waste and to transfer radioactive substances to the human body via plants and animals.

Since the lifetime of low- and intermediate-level radioactive waste is 300–500 years, we have to ensure that waste does not threaten current and future generations alike. All permanent solutions must therefore be carefully selected and well attested. SNF management requires even greater care and attention when it is being handled as waste, since the period in which such waste remains hazardous is incomparably longer. There is currently no SNF repository anywhere in the world, although some countries (Sweden, Finland) have managed to develop acceptable plans for such repositories that provide an adequate level of safety for human beings and the environment.

Slovenia remains one of the few countries with a nuclear programme that has no regulated final disposal of any type of radioactive waste. It is still looking for a location for a LILRW repository.

2. PRINCIPLES AND STRATEGIC POLICIES

The goals of the National Programme for RW and SNF Management are:

– to ensure the safe management of all radioactive waste and spent nuclear fuel at all phases of their existence;

– to provide permanent solutions as soon as possible;

– to conduct all procedures transparently and democratically.

The current adopted and drafted strategic documents applying to radioactive waste management in Slovenia provide the starting points for the preparation of the National Programme for RW and SNF Management. Among the first of these documents was the Spent Nuclear Fuel Management Strategy drafted and adopted in 1996, which examined a number of technical SNF management options and laid down a timetable for decisions to be taken on SNF. The strategy envisaged the selection of permanent solutions for the disposal of spent nuclear fuel by 2020, and the construction and opening of a repository by 2050. It also envisaged the possibility of constructing a repository in Slovenia and/or Croatia, with the disposal of spent nuclear fuel and nuclear waste being made possible under an international agreement with a third country. Until that time, SNF would be stored in the pool at the NEK site.

In the same year the first Plan for the Decommissioning of NEK was also adopted; this determined the method to be employed to decommission NEK, and made a financial evaluation of decommissioning in particular. An estimate of the costs of disposing of LILRW and SNF was added. In 1999 ARAO compiled a draft LILRW management strategy dealing with all aspects of LILRW management; it also specified action plans of the important activities which constituted a precondition for achievement of the objectives. The draft strategy was withdrawn from the adoption procedure in 2001 as a result of the signing, in the same year, of an agreement between Slovenia and Croatia on joint ownership of NEK, which significantly affected the content of the strategy. Even though the draft strategy was withdrawn from the adoption procedure, it does constitute a good premise for the drafting of an LILRW management programme. In March 2004 ARAO, together with the Croatian Special Waste Agency (APO), drew up a new Programme for the Decommissioning of NEK and the Disposal of LILRW and SNF, which constitutes a comprehensive plan for the management of radioactive waste and spent nuclear fuel from the Krško Nuclear Power Plant, and also provides a financial estimate and timetable for decommissioning, the construction of a LILRW repository and the management of SNF.

Radioactive waste is also addressed briefly in the new Spatial Development Strategy of Slovenia (SPRS, Ur. list RS, 76/04), which states that the permanent disposal of LILRW shall be ensured in the territory of the state prior to the end of the operating life of NEK, in accordance with the applicable legislation applying to ionising radiation protection and nuclear safety, and the international conventions and treaties of which Slovenia is a signatory. The selection of a site is to be carried out by means of a combined procedure. The strategy also states the method to be used to evaluate the sites within the initial areas so as to ensure a high degree of public involvement and ensure safety on a continual basis. Solutions for the permanent disposal of HLRW are being sought with the help of the wider international community.

The spatial planning entity responsible for the disposal of radioactive waste must ensure that the LILRW repository site is determined in good time, and lay down all the technical conditions for execution of the LILRW repository, as well as for the operation, remediation and closure of the sites of existing repositories or storage facilities.

The new Resolution on the National Energy Programme (ReNEP, Ur. list RS, 57/04) mentions nuclear energy as a potentially important factor in electricity supply in the future because of its stability and because it does not emit greenhouse gases and does not produce toxic emissions into the environment. The document states that the possibility of extending the operating life of NEK must be studied by means of systematic studies and a decision to be adopted by 2012. It also states Slovenia's decision to support the joint construction of a nuclear power plant in the territory of Croatia by 2015 on the basis of and according to the principles applicable to NEK. The ReNEP sets out the promotion of domestic development and research for efficient energy management and integration into the international environment by means of measures that also include the continuation of research into future generations of reactors, nuclear fusion and radioactive waste and spent nuclear fuel management, where SNF is to be regarded as a secondary raw material.

The National Programme for RW and SNF Management is a comprehensive programme for radioactive waste and spent nuclear fuel management; it therefore covers the management of short-lived, long-lived and very long-lived radioactive waste, and waste that is not usually regarded as radioactive but which contains naturally occurring radionuclides, from all Slovenian waste producers (NEK, small producers). It presents various aspects of radioactive waste and spent nuclear fuel management at all nuclear facilities in Slovenia, i.e. NEK, the Central Radioactive Waste Storage Facility (CSRAO) at Brinje, the TRIGA Research Reactor, storage sites operated by waste producers, and the Žirovski Vrh Uranium Mine, which is undergoing closure. The proposals relating to management address the current situation (quantity of waste, current RW and SNF management), the planning of procedures, the management and estimate of waste production up to 2014, on the assumption that NEK will operate until 2023, the methods of resolving issues relating to waste management, financial estimates for achieving the objectives set, with timetables, and the legal bases.

3. LEGISLATIVE FRAMEWORKS

3.1 EUROPEAN UNION LEGISLATION

On 1 May 2004 the Republic of Slovenia became a full member of the European Union. From this date, the Accession Treaty, ratified by the Slovenian National Assembly on 28 January 2004 (Ur. list RS – MP, 3/04), began to apply. The document on the accession conditions, which is an integral part of the Accession Treaty, also sets out financial assistance to new members in the area of the strengthening, efficiency and capacity of administrative bodies involved in nuclear safety, of technical support organisations and of public waste management agencies in the period from accession to the end of 2006.

The alignment of Slovenian laws and other regulations with European Community legislation is an exceptionally complex process and one that is designed to ensure that the legislation complies with the Slovenian Constitution and with the requirements of European Union law. During the accession period, Slovenia made adjustments to its legislation and, upon entering the European Union on 1 May 2004, adopted the *acquis communautaire*, which is divided into 20 chapters. The legislation contains directives and regulations which are binding, as well as decisions addressed to domestic legal entities. Chapter 12 (Energy) is of particular importance for RW and SNF management, as is Chapter 15 (Environment, consumers and health protection). The first addresses nuclear energy from all its aspects, along with the supply of fuel to and the physical protection and operation of nuclear power plants. The second area covers nuclear safety and radioactive waste, consumer protection and health protection.

All provisions in the areas of nuclear energy production and nuclear safety are based on the 1957 Treaty Establishing the European Atomic Energy Community (EURATOM), which provides that Member States of the European Community establish uniform safety standards to protect the health of workers and of the general public and ensure that they are applied, promote research, facilitate investment, ensure the regular supply of ores and nuclear fuel, use nuclear materials only for the purposes for which they are intended, and encourage other states and international organisations to use nuclear energy for peaceful purposes.

European Union Member States are obliged to comply with the provisions of the EURATOM Treaty, particularly those relating to the supply of nuclear fuel, protection mechanisms, health and safety, and international agreements and other legislation connected with the nuclear energy production and nuclear safety. To this end, the European Union has adopted numerous regulations in the form of directives, guidelines, regulations, decisions, recommendations and opinions which expand on the content of the EURATOM Treaty in more detail. Broadly speaking, the most important of these regulations in the area of RW and SNF management are:

– the directive on the assessment of the effects of certain public and private projects on the environment, including those that deal with the disposal and long-term storage of radioactive waste (85/337/EEC, 97/11/EC)

– the directive on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency (Directive 89/618/Euratom)

– the directive on the operational protection of outside workers exposed to the risk of ionising radiation during their activities in controlled areas (Directive 90/641/Euratom)

– the directive on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community, including procedures of compulsory notification in the event of such shipments, and strict restrictions and criteria regarding export to third countries (Directive 92/3/Euratom)

– the directive laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation (Directive 96/29/Euratom)

– the directive on the control of high-activity sealed radioactive sources and orphan sources (Directive 2003/122/Euratom).

The Green Paper entitled ‘Towards a European Strategy for the Security of Energy Supply’, which emphasises that an acceptable solution to the problem of RW management must be the most transparent one, is also one of the more important European Community documents dealing with RW and SNF management and the openness of public procedures.

3.2 INTERNATIONAL RECOMMENDATIONS, CONVENTIONS AND TREATIES

In addition to the standards contained in European Union legislation, Slovenia is also obliged to comply with the international conventions it has ratified and with the recommendations of the International Atomic Energy Agency when moving to resolve issues relating to radioactive waste and spent nuclear fuel. The most important legal instruments in this area are:

– the Convention on the Physical Protection of Nuclear Material, 1979

– the Convention on Early Notification of a Nuclear Accident, 1986

– the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, 1986

– the Convention on Nuclear Safety, 1994

– the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR), 2000

– the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, 1997 (Ur. list RS – MP, 3/99 – MKVIGRO).

The Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (hereinafter: Convention) points out that the entity most responsible for ensuring safety is the state, which must attend to the safe disposal of radioactive waste in its territory. The Convention also allows the safe and efficient management of RW and SNF, under certain circumstances, to be fostered by means of an agreement between states to use facilities in one of them to the benefit of others, particularly where waste originates from joint projects. The Convention also provides for a systematic safety assessment and environmental assessment before construction of a radioactive waste management facility, and the issuing of an operating licence based on appropriate assessments and conditional on a final decommissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements. Each contracting party must ensure that responsibility for the safety of RW and SNF management rests with the holder of the licence and that the appropriate steps are taken to ensure that each licence holder meets its responsibilities. The Convention states that it also relates to discharge and uncontrolled release.

The common objectives of the legal instruments listed above are to attain and maintain a level of safety in RW and SNF management, ensure the effective protection of individuals and society as a whole against the harmful effects of ionising radiation, and prevent accidents with radiological consequences or mitigate their consequences.

The international Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on Regulation of the Status and Other Legal Relations Regarding Investment in and the Exploitation and Decommissioning of Krško Nuclear Power Plant (BHRNEK Agreement), which was ratified by the Slovenian National Assembly in February 2003, is also of particular importance. The contracting parties state, in Article 10 of this Agreement, that the decommissioning of NEK and the disposal of RW and SNF are a joint obligation, and that they will ensure an efficient joint solution for decommissioning and disposal from the economic and environmental protection points of view. In Article 11 the parties undertake to provide financing in equal shares for the costs of formulating the decommissioning programme, the costs of its implementation, and the costs of formulating the RW and SNF disposal programme.

3.3 SLOVENIAN LEGISLATION

The signing of the agreement on Slovenia's accession to the European Community signalled the start of procedures to align and harmonise national legislation with the new requirements. The legislation in force at the time arose, for historical reasons, on the basis of the federal legislation of the former Yugoslavia and of the domestic legislation in force at the time Slovenia was a member of the former federal state. When it declared independence, Slovenia assumed those parts of former federal legislation that did not contravene the Slovenian Constitution, thus ensuring legal continuity.

In 2002, as a result of accession to the European Union and of the requirement to align with the latest international recommendations, the new basic Ionising Radiation Protection and Nuclear Safety Act was adopted (Ur. list RS, 102/04 – ZVISJV-UPB2); it was aligned with European legislation in the area of ionising radiation protection and nuclear safety. This act regulates ionising radiation protection for the purpose of reducing damage to human health and the radioactive contamination of the living environment from the use of ionising radiation sources to the greatest degree possible, and at the same time of enabling the development, production and use of radiation sources and the implementation of radiation practices. The act regulates the implementation of nuclear safety measures for radiation sources intended for the production of nuclear energy and, where the use of nuclear goods is concerned, special protection measures as well.

The act additionally provides for the organisation of competent administrative authorities and inspectors from the ministries responsible for health and for the environment. It provides for the drafting of implementing regulations (decrees and rules) by a variety of deadlines of between nine and 18 months from the adoption of the act and determining in more detail the issue of compliance with the legal requirements. Certain rules and decrees are still being drafted; the legislation is therefore in the process of being adjusted. Some rules remain in force under the old legislation, while new implementing regulations are to be adopted for certain areas. The Act amending the Ionising Radiation Protection and Nuclear Safety Act, which was adopted in March 2003 (Ur. list RS, 24/03 – ZVISJV-A), sets deadlines for the drafting of the national RW and SNF management programme (by the end of 2004), and deadlines for the selection and approval of a location (by 2008) and for the acquisition of an operating licence (by 2013) for the LILRW repository.

Other legislation that more broadly addresses the issue of RW and SNF management includes the Fund for the Financing of the Decommissioning of NEK and the Disposal of RW from NEK (Ur. list RS, 75/94, 24/03), the State Administration Act (Ur. list RS, 52/02 – ZDU-1), the Public Utility Services Act (Ur. list RS, 32/93 – ZGJS), the Environmental Protection Act (Ur. list RS, 41/04 – ZVO-1), the Transport of Dangerous Goods Act (Ur. list RS, 79/99), the Energy Act (Ur. list RS, 79/99, 8/00) and others. The numerous implementing regulations detailing the legislative requirements are listed in Chapter 13.

3.3.1 *Slovenian legislation on radioactive waste and spent nuclear fuel management*

Ionising Radiation Protection and Nuclear Safety Act (ZVISJV)

This act defines the management of radioactive waste as the collection, treatment, preparation, temporary storage and disposal of radioactive waste. A nuclear facility is a facility for the storing, processing, treating and disposal of radioactive waste. The disposal of radioactive waste is also deemed to mean the approved discharge of radioactive waste substances into the environment, with subsequent dispersion.

In the chapter on ionising radiation protection, the ZVISJV-UPB2 lays down that radioactive substances may be collected, recorded, treated, stored, finally disposed of and discharged into the human environment only in the manner and under the conditions determined in the regulations based on this act. Under the act, a holder of RW and SNF must send information on the production of RW and SNF to a central register maintained by the Slovenian Nuclear Safety Administration (URSJV). The minister responsible for the environment classifies RW with regard to the level and type of radioactivity, determines the management of RW and SNF and the scope of reporting on their production, the manner and scope of maintenance of the central register, and the maintenance of records of RW and SNF stored and disposed of.

Implementing regulations

Implementing regulations issued pursuant to the ZVISJV are being drafted, which is why some rules under the old legislation remain in force.

The adopted Decree on Radiation Practices (Ur. list RS, 48/04), which determines the clearance levels for individual radionuclides and the exemption levels, is also important here.

The Rules on the Method of Collecting, Recording, Treating, Storing, Finally Disposing of and Discharging Radioactive Substances into the Human Environment (Ur. list SFRJ, 40/86) regulates the method of collecting, recording, treating, storing, finally disposing of and discharging waste radioactive substances into the human environment.

The Decree on the Method and Subject of and the Conditions for Performing the Public Utility Service of Radioactive Waste Management (Ur. list RS, 32/99), which is administered by ARAO, regulates the method of provision of the public utility service.

3.3.2 *Slovenian legislation on the competencies and responsibilities applying to RW management*

The Environmental Protection Act (ZVO-1) lays down that the management and disposal of radioactive waste is a compulsory national public environmental protection utility service the activities of which are ensured by the state in accordance with the regulations on public utility services.

The Decree on the Method and Subject of and the Conditions for Performing the Public Utility Service of Radioactive Waste Management (Ur. list RS, 32/99) addresses the manner of implementation of this public utility service in more detail. The Ionising Radiation Protection and Nuclear Safety Act (ZVISJV) additionally states that ARAO shall provide the public utility service of radioactive waste management. This includes the reception, collection, transport, preliminary treatment, storage prior to disposal and the disposal of RW and SNF which does not constitute waste, and SNF from energy-producing nuclear facilities, and the treatment of RW and SNF prior to disposal and the disposal of RW and SNF from energy-producing nuclear facilities. Under Article 96 of the ZVISJV, ARAO's obligations also include the long-term supervision and maintenance of the repositories of mining and hydro-metallurgical tailings appearing in the extraction and exploitation of nuclear mineral raw materials. Despite the scope of the obligations applying to the public utility service, the ZVISJV permits a producer to store and treat RW and SNF at the place of production for a certain period of time on the basis of a licence issued.

3.3.3 *Slovenian legislation on the import, export and transit of waste*

The ZVISJV lays down that a licence must be obtained from the ministry responsible for the environment for the import, export or transit of nuclear and radioactive substances, including radioactive waste. During the procedure of issuing a licence, the measures relating to radiation and nuclear safety are evaluated throughout the duration of the procedure, from the place of origin to the place of reception, with RW and SNF being shipped in the packaging stipulated by the regulations on the transport of dangerous goods. The Rules on Inputs from and Outputs in European Union Member States and on the Import and Export of Radioactive Waste (Ur. list RS, 60/04, 80/05) lays down the method of registering shipments of RW and SNF, providing notification, reporting and handling, and the conditions applying to nuclear and radiation safety.

3.3.4 *Slovenian legislation on funding and on liability for damages*

In the Ordinance on the Transformation of the Agencija za radioaktivne odpadke, p.o. Public Company, Hajdrihova 2, Ljubljana, into a Public Utility Institute, the Slovenian government determined that ARAO would conduct its activities in the legal-status form of a public utility institute, i.e. as a non-profit activity. The ordinance provides for three sources of funding for ARAO activities: the state budget, the Fund for the Financing of the Decommissioning of NEK and the Disposal of RW from NEK, and payments made by users of the public service/small producers (including storage) and the future radioactive waste repository. The disposal of RW and SNF from energy-producing nuclear facilities (and therefore from NEK) is financed exclusively from the resources of the dedicated Fund. ZVISJV likewise lays down that the costs of managing RW and SNF are paid by the producer of the RW, or the holder of the RW if it took the waste over or otherwise acquired it from the producer.

The Environmental Protection Act (ZVO-1) introduces the principle of liability on the part of producers of excessive environmental burden and the ‘polluter pays’ principle, under which the polluter covers all the costs of the measures prescribed to prevent and minimise pollution and environmental risk, and to eliminate the effects of pollution.

If the producer of the radioactive waste or spent fuel is not known, responsibility for managing it falls on the state.

3.3.5 *Slovenian legislation on supervision*

The administrative authority responsible for radiation and nuclear safety is the Slovenian Nuclear Safety Administration, which is part of the ministry responsible for the environment. The Slovenian Radiation Protection Administration is responsible for the protection of workers against ionising radiation and is part of the ministry responsible of health. The Slovenian Nuclear Safety Administration is primarily responsible for the nuclear and radiological safety of nuclear facilities, overseeing their physical protection, as well as the trade in and the transport and management of nuclear and radioactive materials. It also oversees the implementation of acts, other regulations and general instruments governing the field of nuclear safety. Oversight of the physical protection of a nuclear facility, a radiation facility and nuclear substances is conducted by the ministry responsible for the interior, in cooperation with inspectors from the Slovenian Nuclear Safety Administration.

4. SITUATION IN THE FIELD OF LILRW MANAGEMENT

Krško Nuclear Power Plant (NEK), which is tasked with storing all its LILRW at the site of the plant, is by far the largest producer of low- and intermediate-level radioactive waste in Slovenia. Only a small portion of LILRW is produced by small producers in medicine, industry and research institutions, including the research reactor. Most of this waste is stored at the Central Radioactive Waste Storage Facility at Brinje, which is administered by ARAO as part of activities for the implementation of the public utility service of managing RW from small producers. A producer may also store radioactive waste for a certain period of time if it has obtained a licence for this from the ministry responsible for the environment. The controlled discharge of radioactive substances into the environment as approved by the competent ministry is also deemed to be the disposal of radioactive waste. In the past, low-level radioactive waste was also produced in the extraction and processing of uranium ore at the Žirovski Vrh mine. This waste is deposited at two repository sites, Jazbec (mining tailings) and Boršt (hydro-metallurgical tailings), located at the mine itself. This is addressed in a separate chapter.

4.1 KRŠKO NUCLEAR POWER PLANT

4.1.1 *Previous quantities*

Between the commencement of operation of the plant in 1981 and the end of 2004, 2 289 m3 of solid LILRW was stored at NEK; this gives an annual average of just over 100 m3 of waste over this period. However, the average does not give a real picture of the situation, since the quantities of newly produced waste has fallen significantly in recent years to around 50 m3 per year – in the initial period, the quantity was over 200 m3 a year. The waste in the storage facility primarily contains radioactive isotopes such as Co-60, Fe-55, Sr-90, Cs-134 and Cs-137 whose half-life is a maximum of 30 years. They are therefore classed as ‘short-lived’.

All radioactive waste with low- and intermediate-level activity produced since the plant came into operation is stored at the NEK site. Table 1 shows the quantity of LILRW being stored at the temporary NEK storage facility at the end of 2004.

A decontamination building was constructed alongside the LILRW storage facility in 1999. In 2000 the replaced evaporator was placed in storage there, along with the radioactive waste generated by the replacement process and several other items of waste. The total volume of all waste in the decontamination building is estimated at around 920 m3 and its weight at around 730 tonnes. The storage facility inventory is classified into several categories with regard to source and to the method of treatment and preparation.

In addition to the waste referred to above, NEK also stores currently untreated radioactive waste from the technological process that will be treated and prepared in a form suitable for storage. The quantity of untreated waste comprises around 12 m3 of spent ion exchangers and around 2 m3 of process collector bottoms.

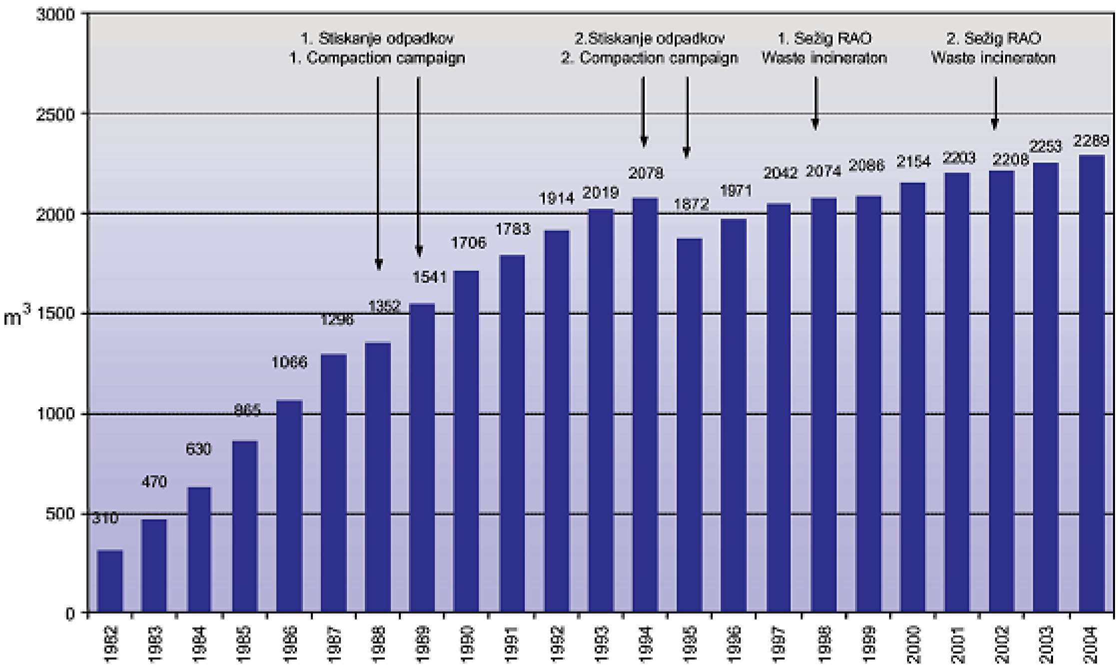

Figure 1: Cumulative quantity of LILRW at the NEK storage facility by the end of 2004, in m3 [14.4.-28]

Table 1: Inventory at the temporary LILRW storage facility at NEK, end of 2004 [14.4.-28]

TYPE OF WASTE	NO OF DRUMS	GAMMA ACTIVITY AS AT 31 DECEMBER 2004 (Bq)	ALPHA ACTIVITY AS AT 31 DECEMBER 2004 (Bq)	VOLUME (m^3)
incineration ash	49	1.32E+09	4.75E+06	10.2
dried spent ion exchange resins from the secondary cycle	48	2.44E+09	2.67E+06	9.6
compactible waste	571	2.47E+10	1.04E+08	118.8
evaporator concentrate	251	3.44E+10	1.35E+07	52.2
spent filters	114	3.90E+11	5.81E+07	23.5
other waste	701	2.33E+10	1.09E+08	145.8
compacted waste 1988 and 1989	617	2.72E+10	2.55E+08	197.4
spent ion exchange resins	689	3.27E+12	4.41E+09	143.3
super-compacted waste 1994 and 1995, and 387 standard uncompacted drums, placed in TTCs	1 765	1.01E+13	1.06E+10	1 525
products of drying placed in tubular overpacks	73	5.11E+12	3.34E+09	63.4
TOTAL	4 878	1.90E+13	1.89E+10	2 289.2

4.1.2 *Waste management*

Operations at NEK produce solid, liquid and gaseous LILRW, with liquid waste accounting for most of the waste produced. The waste is treated and prepared accordingly prior to storage with regard to its aggregate state.

NEK's operating licence, issued in 1984, permits it to discharge radioactive substances into the atmosphere and watercourses, which is regarded as a method of waste disposal. Liquid radioactive substances are discharged into the River Sava. H-3, Xe-133, Xe-135, Xe-131m, Xe-133m, Kr-85, Co-60, Fe-59 are responsible for most of the activity, along with smaller quantities of Cs-134, Cs-137, Co-58 and Sb-125 (Table 2a). Gaseous waste is discharged into the atmosphere and contains noble gas isotopes (Ar, Kr, Xe), C-14 carbons, tritium H-3, and cobalt, caesium, strontium and iodine isotopes (Table 2b). There is a restriction in place for discharges into water of 200 x 10^9 Bq/year for all radionuclides, excluding H-3 and noble gases. The restriction applying to H-3 is one hundred times higher and amounts to 20 000 x 10^9. There is no prescribed restriction on noble gases. The following restriction applies to discharges into the atmosphere: noble gases 110 000 x 10^9, iodine isotopes 18.5 x 10^9 and aerosols 18.5 x 10^9. There are no prescribed restrictions for H-3 and C-14. A conservative estimate of an effective dose received by an individual from discharges of radioactive substances into the environment from NEK is 1 μSv/year, which is therefore below the legally determined limit.

Table 2a: Liquid radioactive discharges from NEK 1999–2004 [14.4.-25]

Radionuclides in discharges	Permitted activity [Bq]	Activity of discharges [Bq]					
		1999	2000	2001	2002	2003	2004
All radionuclides excl. H-3 and noble gases	200 E+09	4.74 E+08	5.76 E+08	1.13 E+09	9.39 E+08	3.59 E+08	2.41 E+08
H-3	20 E+12	1.08 E+13	1.07 E+13	7.75 E+12	1.33 E+13	1.03 E+13	1.08 E+13
Noble gases	–	5.33 E+09	7.12 E+09	7.76 E+08	1.05 E+09	5.00 E+07	2.51 E+08

Table 2b: Gaseous radioactive discharges from NEK 1999–2004 [14.4.-25]

Gaseous discharges	Permitted activity [Bq]	Activity of discharges [Bq]					
		1999	2000	2001	2002	2003	2004

Noble gases (Xe-133 equiv.)	110 E+12	1.44 E+12	2.29 E+12	2.11 E+12	6.08 E+11	1.45 E+11	1.51 E+11
Iodine isotopes (I-131 equiv.)	18.5 E+09	5.46 E+06	52.3 E+06	0.13 E+06	1.19 E+07	3.57 E+05	8.40 E+06
Aerosols	18.5 E+09	16.7 E+03	1.06 E+06	2.83 E+06	7.56 E+05	3.23 E+04	3.35 E+05
H-3	–	1.16 E+12	1.2 E+12	0.86 E+12	1.25 E+12	1.22 E+12	2.42 E+12
C-14	–	0.12 E+12	0.12 E+12	0.11 E+12	8.38 E+10	1.10 E+11	1.23 E+11

The technologies for the treatment and preparation of all forms of LILRW used in the NEK production process are comparable with established technologies around the world. The existing treatment procedures reduce volume, separate radioactive isotopes, change the composition of waste and minimise the discharge of radioactive substances into the surrounding area.

Solid waste results from the treatment of gaseous and liquid waste, although some of it arises directly from maintenance work and cleaning. It can be divided into five groups: evaporator concentrate prepared using drying techniques within the drum, spent ion exchanger resins, spent filters, compactible waste and other waste. The waste is placed into various types of packaging: in standard 210-litre drums, in 320-litre overpacks and in 864-litre tubular overpacks (TTCs). The main methods of treatment of solid waste are sorting, compaction and incineration.

Combustible and non-flammable compactible waste is collected separately. Combustible waste is sent for incineration, where incineration plants must meet a further set of criteria (restrictions on activity, presence of PVC and weight of drums). Incineration is performed in rounds by an external contractor at its site; the main reason for using this service is to reduce the volume of radioactive waste. The ash from the incineration process is returned to the waste holder in a smaller container containing ash that has been immobilised in a standard drum.

Non-combustible waste is compacted in a high-pressure compactor (supercompactor). The pressings are placed in tubular overpacks. Products of the second round have so far been packed this way, and will be treated in the same way in the supercompactor in the future. Waste that cannot be compacted is broken down and packed in standard drums. They are also planning to smelt metallic waste, which is still currently being collected separately; their quantities are not so great that smelting would significantly affect the situation in the storage facility.

Procedures for the treatment of liquid waste include evaporation, ion exchange and separation by settling. Evaporation is used for larger quantities of liquid radioactive substances, producing water and evaporator concentrate. Evaporator concentrate is prepared using drying techniques in the drum. The drums are made of stainless steel with a volume of 210 litres. This technique was introduced in 1998 and is very effective in reducing waste volumes. Solidification using a cement-vermiculite mixture is no longer used precisely because of the greater product volume, but is nevertheless retained as a back-up technique.

Radioactive substances bind to the surface of the ion exchanger as liquid waste flows through the ion exchange apparatus. After a long period of use, ion exchangers become ineffective; they have to be replaced and the ion exchangers stored as radioactive waste. Spent ion exchangers from primary systems and from the evaporator bottoms management system are dried and packed in stainless steel drums. From primary systems they are packed in stainless steel drums with biological protection on the inside of the drum. Spent filter cartridges of liquid systems are, after saturation and replacement, packed in standard 210-litre drums. Filter cartridges that are suitable for incineration may be used at several points in the technological system.

Drums containing products from the drying system are placed in tubular overpacks (three drums per tubular overpack).

After treatment in the gaseous radioactive waste management system, gaseous radioactive waste is stored in tanks designed for radioactive gas decomposition; the contaminated air is then led through filters that retain the solid particles and aerosols created, and then released into the atmosphere in a purified state. When the filters can no longer be used, they become radioactive waste.

The radioactive waste types referred to above originate from current treatment and preparation technology; radioactive waste types that also originate from technologies and procedures that were in use in the past and which are no longer produced are stored in the storage facility alongside them; these are evaporator concentrate solidified by a cement-vermiculite mixture, solidified spent ion exchangers, and supercompacted waste from the first round of supercompaction in 320-litre drums. The use of new technologies in the future will produce additional new types of radioactive waste.

4.1.3 *Storage capacities and the anticipated quantities of waste 2008–2014*

All LILRW from NEK, treated and then prepared for storage, is stored at the NEK LILRW storage facility. This is an anti-seismic, reinforced concrete building measuring 1 470 m2 and divided into six separate compartments by dividing walls. The storage facility has capacity for around 3 000 tubular containers, or the equivalent number of other packaging units. The tubular container is the predominant packing unit in the storage facility, either as basic packaging (for pressings from supercompaction) or as overpacks (drums in a tubular container).

Under the location permit from 1978, the original capacity of the LILRW storage facility at NEK was 5 000 drums (standard size). The storage facility was intended to provide storage for a transitional five-year period. The administrative restrictions on capacity were lifted in the new location permit from 1988 within the existing floor plans, with the proviso that an equivalent dose of 0.2 mSv/year as measured at the NEK boundary fence would not be exceeded.

At the end of 2004 approx. 2 289 m3 of solid LILRW was being stored at the storage facility, meaning that the storage facility and two handling areas were over 85% full. In response to the lack of space in the storage facility, efforts are being made at NEK to limit the production of new quantities of radioactive waste as far as possible and, by means of a variety of procedures, to reduce the volume of existing waste. Two rounds of waste compaction and supercompaction have already been carried out to reduce the quantity of existing waste.

The anticipated load on the capacity of the NEK LILRW storage facility has been estimated on the basis of the load at the end of 2004 and the assumed speed at which it will be filled in the future (Figure 2). In addition to the speed of production of individual radioactive waste types, due regard has also been paid to periodic rounds of waste treatment so as to reduce the volume of waste stored. Two rounds of incineration and one round of supercompaction, which is likely to be the last, have been planned by 2008. After 2005 supercompaction will be conducted on a continuous basis using the facility's own equipment, since there will be no space for the accumulation of more drums or for a round of waste treatment; it makes no economic or organisational sense to organise more rounds for smaller numbers of drums. Two further rounds of incineration are planned for 2008–2014.

According to NEK estimates, the storage facility will be approx. 90% full by the end of 2008. The forecast calculations indicate that storage facility capacity will be full (95% of the total space) by the end of 2010. According to NEK internal documents, 95% is the highest acceptable level that still ensures sufficient safety of RW management in terms of the reserve for unplanned quantities of RW and the operation of the facility (handling operations during batch treatment, etc.).

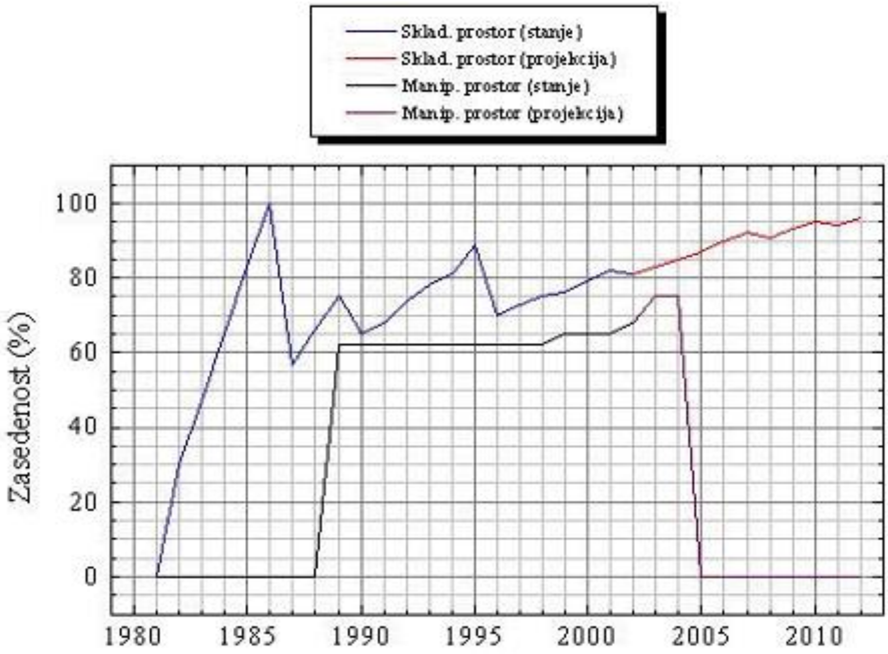

Figure 2: Level of utilisation of the NEK LILRW storage facility [14.4.–24]

Storage area (status)
Storage area (projection)
Handling area (status)
Handling area (projection)
Level of utilisation (%)
Year

4.2 TRIGA MARK II RESEARCH REACTOR

4.2.1 *Previous quantities*

Waste generated by work connected with the research reactor chiefly comprises contaminated cleaning material, paper, plastic items, glassware and material activated as a result of irradiation at the TRIGA Research Reactor. IJS also uses sealed sources which, after they ceased to be used, become radioactive waste; however, their volumes are negligible. Work with the reactor produces around 50 litres of LILRW a year with a total activity of 0.01 GBq. Work with activated samples at the laboratory also periodically produces liquid radioactive waste, which is laid in a special 20 m3 tank and released into the River Sava after reaching the clearance levels.

4.2.2 *Waste management*

Radioactive waste generated from the use of radioactive substances and the operation of the research reactor has been stored, from the time the reactor came into operation, at the Central Radioactive Waste Storage Facility at Brinje, which lies in immediate proximity to it. The material is stored in drums, with larger contaminated metal pieces stored as special waste. Around 3 m3 of radioactive waste is also temporarily being stored in hot cell chambers and will be moved to the CSRAO. Some radioactive substances are also discharged into the environment, although the quantities are very small (Table 3). The estimated annual dose received by a resident of the surrounding area from these discharges is approx. 0.3 μSv/year and results from discharges of Ar-41 and of liquid discharges in which the presence of Na-22 and Cs-137 has been measured, both in the 0.1 MBq/year class.

Table 3: Annual activity of liquid and gaseous discharges from the TRIGA Research Reactor 1999–2004 [14.4.-25]

	Liquid discharges (activity in Bq)	Gaseous discharges (activity v Bq)
1999	2.5×10^{6}	0.9×10^{12}
2000	8.7×10^{6}	0.9×10^{12}
2001	0.51×10^{6}	1.0×10^{12}
2002	1.6×10^{6}	1.1×10^{12}
2003	0.9×10^{6}	0.9×10^{12}
2004	0.22×10^{6}	0.8×10^{12}

4.2.3 *Storage capacities and the anticipated quantities of waste 2008–2014*

The quantity of LILRW generated during the operation of the research reactor and in laboratory work is not great and can be stored at the CSRAO at Brinje. According to the most conservative estimate, it generates around 200 litres of compactible waste per year. The dismantling of the reactor will create, according to initial estimates, approx. 50 m3 of LILRW, which will be deposited at the LILRW repository when dismantling is completed.

4.3 LILRW FROM SMALL PRODUCERS

4.3.1 *Previous quantities*

LILRW produced in Slovenia outside the nuclear power plant and the Žirovski Vrh Uranium Mine accounts for a mere 3% of the total amount. This LILRW has to be stored at the CSRAO at Brinje. At the end of 2004, the total quantity of waste at the storage facility amounted to 70 m3, with a total activity of around 3 900 GBq [25]. Sealed sources and special waste account for most of the activity stored at the CSRAO at Brinje. Almost two thirds of the activity is attributable to one teletherapy cobalt source stored as special waste. One third comes from a sealed source, with the remainder, around 2% of total activity, coming from LILRW packed in drums, including repacked cobalt and radium sources. The storage facility also contains approx. 12 000 ionising fire detectors. Three quarters of the waste stored so far contains short-lived isotopes and one quarter long-lived isotopes (Ra-226, Am-241).

Users of radiation sources are dispersed throughout Slovenia. Approx. 130 commercial organisations use sealed sources, which number around 700. These sealed sources contain the following radionuclides: Cs-137, Am-241, Cs-137/Am-241, Am-241/Be, Kr-85, Ir-192/containers from depleted uranium, Sr-90, Sr-90/Am-241, Cm, Fe/Cm, Tl/Pm, Pm-147, Ra-226, Pu-238, Co-60. The sealed cobalt sources, which are no longer used, were received at the CSRAO at Brinje in 2003 and appropriately repacked alongside the sources already stored there. The remaining sealed sources are partly still in use, though there is a portion that is no longer in use. Sooner or later these will become waste sources that will have to be stored or deposited, unless the holder returns them to the producer of the source.

Table 4: Situation at the Central Radioactive Waste Storage Facility at Brinje as at 31 December 2004 [14.4.-25]

Type of waste	Total no of packaged units	Main isotopes	Total estimated activity (GBq)
Drums	256	Co-60, Cs-137, Ra-226, Eu-152, uranium	70–90
Special waste	149	H-3, Co-60, uranium	2 400
Sealed sources	326	Co-60, Cs-137, Kr-85, Sr-90, Eu-152, Am-241/Be, Am-241	1 500
*Orphan sources	30	no data	no data
Total	761	H-3, Co-60, Cs-137, Ra-226, Kr-85, Sr-90, Eu-152, Am-241/Be, Am-241, uranium	~3990

*Orphan sources are sources that bore no code from the previous manager, where that code cannot be located in the old records.

Seven hospitals and clinics in Slovenia use open and sealed radiation sources. They use radioisotopes with short half-lives (Tc-99m, I-131) as open sources; they therefore do not present a particular problem as far as LILRW is concerned. Hospitals also use I-125, I-123, Cr-51, Tl-201, Ga-67, F-18, Re-186, In-111, Sr-89, Y-90, S-153, Xe-133, H-3 and Co-57 in smaller quantities. Contaminated material can be left to settle until its activity falls below the clearance level. Sealed sources with longer half-lives (Cs-137, Co-60, Ir-192, Sr-90) are also used in radiotherapy; however, the quantities of these sources are significantly lower in comparison with sources in industry.

Some radioactive waste is also produced by the Slovenian armed forces; after use, this waste is sent to the CSRAO at Brinje.

Ionising fire detectors comprise a specific group of radioactive waste (they are very numerous, numbering around 30 000, and are installed in a variety of buildings), along with ionising lightning rods, of which there are few.

4.3.2 *Radioactive waste management*

As the public utility service provider, ARAO is responsible for the overall management of RW in Slovenia, with the exception of the waste produced at NEK and the Žirovski Vrh mine. In 1999 ARAO took over the management of the radioactive waste storage facility at Brinje pri Ljubljani from Institut Jožef Stefan. A special agreement laid down that IJS would also provide ARAO with the use of the entire set of technological equipment and premises for the treatment of radioactive waste (hot cells) should ARAO require them for the purposes of providing the public utility service of radioactive waste management. ARAO is also the co-investor in the modernisation of the hot cell technological set, which is taking place as a PHARE project; ARAO has thereby become a proportionate owner of hot cell equipment (IJS remains the administrator of that equipment). The storage facility was reconstructed in 2003 and 2004, readying it for the regular monitoring of waste. A licence for trial operation was obtained in 2005.

Some waste producers from industry and research store their radioactive waste in storage areas at the production site. Around 100 radiation sources are temporarily stored at approx. 30 locations. They mostly contain the isotopes Co-60, Cs-137, Ra-226, Am-241, Eu-152/154, Sr-90 and Kr-85. Radioactive waste from healthcare activities that cannot be released into the environment after a certain period is stored at the providers' own sites, which are under the supervision of the Institute of Occupational Safety. Institut Jožef Stefan also helps supervise the waste produced at the Institute of Oncology. The Institute of Oncology has a retention basin for waste containing I-131. The waste is retained here for four months before being released into the environment. Other healthcare establishments in Slovenia using radioactive isotopes do not have retention basins. The annual discharge of I-131 into the environment totals 0.3 TBq [14.4.-25].

The Institute of Oncology stores spent sources in its own storage area. Sealed therapeutic sources with a longer half-life and a greater level of activity are generally returned to the producer; these therefore do not present a problem for Slovenia. Some sources from the Institute of Oncology that the producer no longer receives for storage will be sent on to the CSRAO at Brinje. In terms of volume, the quantity of these sources is small (up to 0.5 m3), although their level of activity is more considerable. All hospitals that use Tc-99m for diagnostics have Mo-99/Tc-99m generators. After the end of the resting period determined by the producer, the column housed in the generator becomes non-radioactive waste and the producer disposes of it as other waste. In healthcare, liquid waste is only generated by patients. Because of its short half-life and because it is diluted in the sewerage systems, this waste pollutes the environment only to a negligible extent.

Radon is continuously produced at the Central Radioactive Waste Storage Facility, with an average discharge into the environment of 52 Bq/s (1.64 GBq per year). The estimated dose received from these discharges by a farm worker in the vicinity of the storage facility is no more than 15 μSv/year.

The operations of the public service are funded by payments made by users for services and from the state budget. ARAO also maintains a register of small producers of LILRW in Slovenia, as well as records of the type and quantity of existing LILRW. Small producers of LILRW can deliver their solid radioactive waste to the Central Radioactive Waste Storage Facility at Brinje pri Ljubljani. By paying a fee under the tariff for the public radioactive waste management service, a waste producer transfers the obligations and costs of final disposal to the public service provider.

In recent years, sources of ionising radiation in waste metals have passed from third countries through Slovenia to other EU Member States; these are detected at the border and sent back to Slovenia. On several occasions it has not been possible to return sources/radioactive waste detected in this way to the country of origin; they have therefore had to be stored at the Central Radioactive Waste Storage Facility. It would therefore make sense for the countries of SE Europe to sign bilateral agreements on the receipt of radioactive and nuclear substances in the event that they are rejected by EU Member States, establish a system of reciprocal information-provision between competent border authorities and authorities responsible for overseeing the trade in radioactive and nuclear substances, and always take steps to ascertain the origin of these substances. In addition, Slovenia should, as soon as possible, ratify the International Convention for the Suppression of Acts of Nuclear Terrorism, which contains a section relating to the storage and return to the country of origin of ionising radiation, sources and nuclear substances that have been seized and that are part of a criminal offence.

4.3.3 *Storage capacities and the anticipated quantities of waste 2008–2014*

Solid LILRW from small producers is stored at the CSRAO in Brinje. The storage area is 250 m2 and the useful volume is 500 m3. The area is divided into nine sections, with the last part of the facility hollowed out to a greater depth and intended for the storage of special radioactive waste. The storage facility currently houses approx. 70 m3 of waste, meaning that its volume will suffice for the storage of LILRW from small producers until the construction of a joint LILRW storage facility that will house short-lived LILRW from NEK and small producers together. Capacities are still currently limited because waste is placed on the ground. This problem will be resolved by repacking the waste and placing in at different floor levels. Around 75% of the waste at the CSRAO at Brinje will be moved to the LILRW repository after its construction. Long-lived radioactive waste is stored at the LILRW repository site; the issue of its storage will be resolved along with the issues relating to SNF and HLRW.

We expect around 0.5–1 m3 of waste per year from healthcare activities up to 2014. In addition to this, we are anticipating the further receipt of around 2 m3 of LILRW per year from other small producers. We are also anticipating the receipt of 40–50 sealed sources per year in the period to 2008, which will, after appropriate treatment, be stored in two 210-litre drums. The quantity of sealed sources received is envisaged to fall by half in the 2008–2014 period. Leading up to 2008 the major portion of ionising fire detectors will likely be delivered to CSRAO, which will account for no more than one drum per year after appropriate treatment. In the 2008–2014 period, the quantity of fire detectors delivered will fall to one drum every three years.

5. SITUATION IN THE FIELD OF SPENT NUCLEAR FUEL MANAGEMENT

In Slovenia, spent nuclear fuel is only produced at Krško Nuclear Power Plant and at the TRIGA Mark II Research Reactor. The current quantity of SNF is low (around 312 tonnes of uranium). These quantities are exceptionally small compared with other nuclear states, and will remain so after the cessation of operation of both reactors. Currently only Krško Nuclear Power Plant has SNF, since all the spent fuel from the TRIGA reactor was returned to the USA in 1999. Both nuclear facilities have adequate storage space for SNF, with sufficient capacities for the entire operating life of both facilities.

In 2002 Slovenia and Croatia reached an agreement on the ownership and use of NEK, signing an agreement that came into force in March 2003. Under this agreement, both contracting parties are responsible for managing radioactive waste and spent nuclear fuel from NEK. Under a requirement of this agreement, the Programme for the Decommissioning of NEK and the Disposal of RW and SNF was drawn up in 2004; it addresses and analyses various scenarios for decommissioning and for the disposal of LILRW and SNF. The programme was adopted in both countries and constitutes a new direction for the long-term management of spent nuclear fuel in Slovenia. Although the programme relates solely to NEK, it will at the same time have an impact on the management of the very small quantities of fuel from the TRIGA Research Reactor.

The nuclear facility operator is competent and responsible for managing spent nuclear fuel at the site of the facility in operation. This means that Krško Nuclear Power Plant is responsible for the storage of spent nuclear fuel from NEK in the spent fuel pool, while Institut Jožef Stefan is responsible for the storage of SNF from the research reactor. ARAO is responsible for planning and delivering permanent solutions for high-level radioactive waste and spent nuclear fuel, and for the operation and management of the repository after its construction.

5.1 KRŠKO NUCLEAR POWER PLANT

5.1.1 *Previous quantities*

The reactor core at Krško Nuclear Power Plant comprises 121 fuel elements whose external dimensions are 20 cm x 20 cm x 376 cm. A fuel element comprises 235 fuel rods filled with ceramic tablets of uranium dioxide and dressed in zirconium alloy cladding. Uranium enrichment is in the order of a few per cent (between 2 and 5%).

Around a third of spent fuel elements are replaced with new ones at every fuel change. Fuel is changed once every 18 months. After removal from the core, the spent fuel elements are stored in a special spent fuel pool at the plant.

At the end of 2004 there were 763 spent fuel elements in the pool; 31 of these elements could be reused for core assembly. A total of 770 locations are full to capacity.

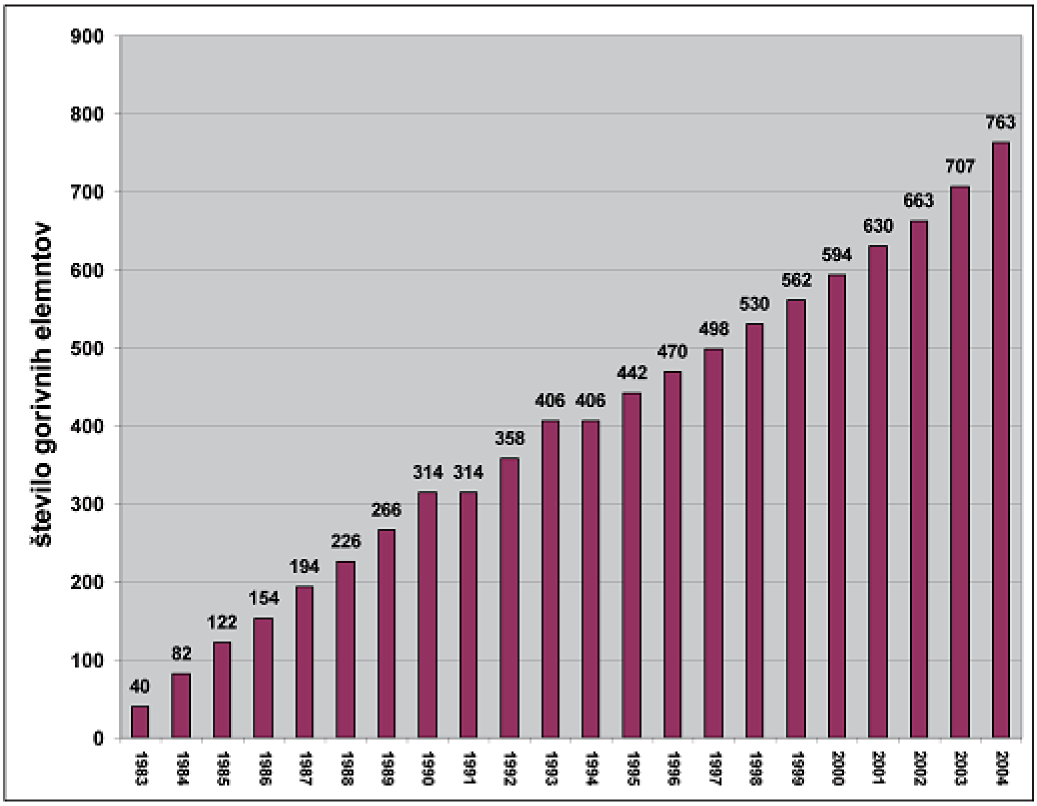

Figure 3: Growth in the number of fuel elements in the spent fuel pool at NEK after each fuel change [13.4.-25]

No of fuel elements

5.1.2 *Storage capacities and the anticipated quantities 2008–2014*

The capacity of the pool was increased in 2003. Following modifications to the spent fuel pool, the number of available locations in the pool is now 1 694. Since space for the entire reactor core must be ensured in the pool at any given moment, 121 locations (7% of available locations) must be reserved for any urgent emptying of the core. The remaining locations are available for the storage of spent fuel elements.

The 770 occupied locations in the spent fuel pool account for 46% of the available locations. There are 924 free locations suitable for storage (54%).

Two further fuel changes are planned in the period to 2008 (in 2006 and 2007), with the replacement planned of 108 fuel elements (52, 56). Fifty-two per cent occupancy of the locations in the spent fuel pool is expected at that time.

Using the same assumptions, i.e. 18-month cycles, four further fuel changes would be made in 2009–2014, involving the replacement of around 216 fuel elements. The occupancy level of the pool will be around 65% following these changes.

5.2 TRIGA MARK II RESEARCH REACTOR

5.2.1 *Previous quantities*

There are 91 locations in the TRIGA Research Reactor core that could be filled with fuel elements or other components (control rods, blind elements, irradiation channels, etc.). A fuel element with supports is a 71-cm-long rod with a diameter of 3.8 cm, dressed in stainless steel cladding. The length of the fuel rod is 38 cm, closed at the top and bottom by a 6.6-cm-long graphite cartridge. The fuel is a homogeneous mixture of zirconium hydride and enriched uranium (U-ZrH, 12% U by weight with 20% enrichment and 20% U by weight with 20% enrichment).

Despite the fact that the TRIGA Mark II Research Reactor has been in operation for almost 40 years, it currently has no spent nuclear fuel. In 1999 Institut Jožef Stefan, as the operator of the research reactor, returned all the spent fuel (219 spent elements of an entire inventory of 313 fuel elements) to the USA as part of a special programme for the return of spent nuclear fuel from research reactors.

5.2.2 *Storage capacities and the anticipated quantities of waste 2008–2014*

Following the return of the spent nuclear fuel to the USA, the current inventory at the TRIGA Research Reactor comprises 94 fresh or partly burnt elements, a fission plate and a fission counter with an overall uranium mass of 29.5 kg. All fuel elements are still in use; both pools for the storage of spent nuclear fuel in the basement of the reactor building are therefore currently empty. Their capacity is sufficient for the storage of the entire inventory.

a) The quantities of SNF in the future depend on the decision of the reactor's operator (Institut Jožef Stefan) and its owner (the state) regarding the future operation or cessation of operation and dismantling of the reactor. The TRIGA reactor has been in operation since 1966, and was thoroughly inspected and reconstructed in 1991. Fuel stocks at the reactor are sufficient for at least another ten years of operation.

The decision of the US government, which in December 2004 extended the offer to take fuel from research reactors, originally valid until May 2009, by ten years, will affect any decision. The deadline for the return of fuel to the USA is therefore now May 2019, which means that the fuel must be removed from the reactor no later than by May 2016. This is a new deadline for the export of spent nuclear fuel from research reactors to the USA.

The existing inventory of fuel elements will, according to estimates, suffice for a ten-year operating period.

6. SITUATION REGARDING THE DECOMMISSIONING OF NUCLEAR FACILITIES

Decommissioning means all works carried out, with the appropriate care for the health and safety of workers and the public and for environmental protection, after the expiry of the operating life of nuclear facilities and installations resulting from the final cessation of operation of a reactor or the cessation of use of a nuclear facility. The end objective of decommissioning is to dismantle and/or decontaminate the entire installation or facility with an increased level of radioactivity so that the location can be given administrative clearance, after which the location can be used for other purposes without radiological restrictions. Decommissioning also includes the removal of SNF produced during the last fuel cycle upon the dismantling of the nuclear reactor.

Article 79 of the ZVISJV lays down a special licence for the cessation of operation of a nuclear facility and a licence for the commencement and completion of decommissioning. Implementing regulations lay down requirements determining that the operator of a nuclear facility must, after start-up, adopt and apply a programme of measures and procedures that provide for the possibility of the permanent cessation of operation of the facility in accordance with the prescribed ionising radiation protection requirements. The rules also state that, in such a case, a programme for the permanent cessation of operation or a programme of closure must be drawn up for the permanent cessation of operation, approved by the competent authority and describing all the activities and deadlines necessary to effect the cessation of operation of a nuclear facility. The competent administrative authority shall also issue a decision on whether the location is suitable for unrestricted use after the permanent cessation of operation of a nuclear facility.

There are three nuclear facilities in Slovenia: NEK, the TRIGA Research Reactor and the Central Radioactive Waste Repository at Brinje. None of them are in the process of being decommissioned, but the Žirovski Vrh mine is in the process of being closed (see Chapter 7).

6.1 DECOMMISSIONING OF KRŠKO NUCLEAR POWER PLANT

In 2004, a Programme for the Decommissioning of NEK and the Disposal of LILRW and SNF [14.1.-11] was adopted in accordance with the requirements of Article 10 of the Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on Regulation of the Status and Other Legal Relations Regarding Investment in and the Exploitation and Decommissioning of Krško Nuclear Power Plant. It was drafted by a mixed Slovenian and Croatian working group comprising experts from ARAO and the Special Waste Agency. On the assumption that NEK will operate without interruption under normal circumstances, decommissioning is slated to begin in 2023.

The Programme for the Decommissioning of NEK and the Disposal of LILRW and SNF provides seven basic scenarios for decommissioning and for the management of RW and SNF. Two of them have two simultaneous characteristics: low cost and satisfactory flexibility to deal with changes in extreme conditions. They are labelled SID-30 (SID – Strategy Immediate Dismantling) – one is export-oriented, the other is oriented towards the disposal of SNF. Both cases envisage the 30-year dry storage of SNF after the cessation of operation of the power plant. The two scenarios additionally address the technological aspects and are financially optimised – they are labelled as SID-45 with disposal and SID-45 with export, with the dry storage of SNF in containers for approx. 45 years.

Both SID-45 scenarios proceed from a strategy of immediate dismantling in which the nuclear power plant is dismantled as soon as possible after it ceases operating. Since the type of dry storage planned does not entail high maintenance costs and can be permitted for an SNF storage period of up to 50 years, this makes use of the possibility of the longer storage of fuel (around 45 years, which leaves a space of a few years in which to deal with any unforeseen events) and the introduction of two modified scenarios which provide for the disposal or export of SNF in the 2066–2069 period. The discounted costs of the scenarios are therefore reduced substantially, which with the local disposal of SNF allows research and decision to be planned and funded for a much longer period (from 2023 to 2043). At the same time, the period of operation of the NSRAO repository is also optimised, with the repository being closed after the final decommissioning of the power plant, i.e. in 2037.

Decommissioning itself is divided into several stages and will take place from 2023 and 2037. Dismantling shall start with the preparation of plans and of all the necessary documents prior to the end of the operating period (2021–2023). The post-operation period (POP) begins immediately after the cessation of operation of the power plant; the power plant is prepared for dismantling, the systems and components are first cooled, and the activities of the irradiated components are gradually reduced. Three years after the cessation of operation of the power plant, the components that are not irradiated and that do not serve the safety and cooling systems of the plant shall begin to be dismantled. The reactor vessel and the parts of the reactor with the highest level of activity are dismantled at the end. The larger parts of the dismantled components will be deposited at the NSRAO repository, which will operate during the dismantling, while the smaller parts, such as the control rods and the dismantled reactor vessel, which will be contaminated with long-lived radionuclides, will be deposited with the SNF. The SNF is moved from the core to the pool, where it is sufficiently cooled to allow it to then be stored in a dry SNF storage facility. The dismantling of the power plant is planned to take place from 2027 and to last until 2037. A detailed timetable is given in Figure 4.

The immediate dismantling scenario (SID) will likely produce 5 540 tonnes (13 130 m3) of LILRW, which it will be necessary to dispose of. All radioactive waste from the dismantling process will be prepared and treated in 210-litre drums and in tubular and concrete containers. The proportion of long-lived LILRW depends primarily on the quantity of waste that will be generated by the dismantling of the reactor vessel. The specific activity of the reactor vessel will be over 10^8 Bq/m3 for a further 830 000 years approximately, chiefly as a result of Ni-59. The estimated quantity of long-lived LILRW that will be produced by dismantling the 300-tonne reactor vessel is 200 m3.

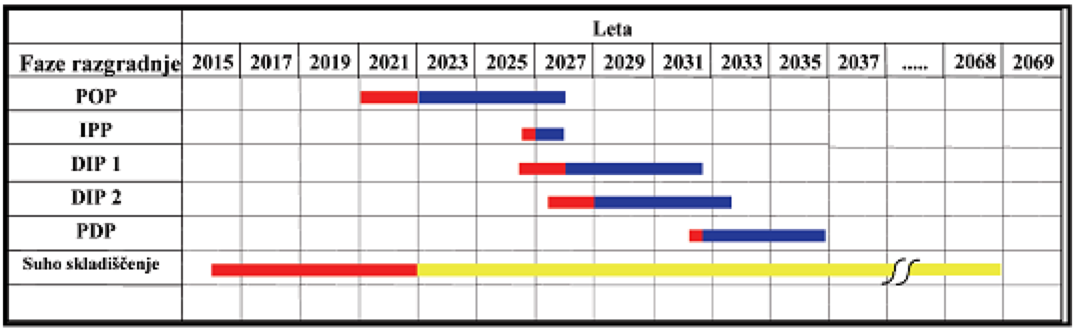

Figure 4: Timetable for scenario SID-45 with disposal (red denotes preparation, blue/yellow denotes implementation) [11.1.-11]

Key:
POP Post-operation period
IPP Internal preparation period
DIP Dismantling period
PDP Post-dismantling period

Year
Phase of dismantling
Dry storage

6.2 DISMANTLING OF THE TRIGA MARK II RESEARCH REACTOR

Following the extension of the period of validity of the programme for the return of spent nuclear fuel of American origin to the USA to 2019, a decision must be taken by the end of 2007 to determine the period for which the reactor will remain in operation. Alongside this, a programme for the dismantling of the TRIGA reactor must be drafted. Only if it demonstrates that the renovation of the reactor as a result of the established ageing of the equipment and components of the reactor is urgently required, but is also too expensive, may the operator and the owner of the reactor decide on its immediate closure. In this case, preparations for dismantling would begin after 2005. The dismantling could take place under two scenarios, with a precondition in both for the commencement of dismantling being the removal of fuel from the site:

1) Export of SNF to the USA is accelerated. After a three-year cooling period, the SNF is sent to the USA in 2009 or 2010. After this period, the facility begins to be dismantled. The costs of the removal of the fuel are estimated to be USD 2.5 million, which must be secured by 2008 or 2009 if this scenario is to be carried out.

2) Export of SNF is carried out in 2019. The fuel would be stored until then in the pool in the reactor basement. Dismantling would only take place after 2019. In this case, the costs in the period up to 2014 would only include those maintenance costs for the indispensable systems of the reactor and the pool, the costs of preparation for dismantling, and the costs of radiological supervision.

6.3 DISMANTLING OF THE CSRAO AT BRINJE

All short-lived radioactive waste from the Central Radioactive Waste Storage Facility (LILRW) at Brinje (estimated to account for 75% of all waste deposited at Brinje) will be deposited at the LILRW repository. Long-lived LILRW from the Central Radioactive Waste Storage Facility at Brinje will, after the construction of the LILRW repository, be stored at the site of the future repository. Long-lived radioactive waste will be deposited together with spent nuclear fuel, at a later date, when a permanent solution to the disposal of high-level radioactive waste becomes available. It is therefore envisaged that the CSRAO will be in operation until at least the commencement of operation of the LILRW repository, after which time the facility will be contaminated and given over to other purposes.

7. SITUATION REGARDING THE ŽIROVSKI VRH MINE (UNDERGOING CLOSURE)

The excavation of uranium ore began at Žirovski Vrh mine (RŽV) in 1982, with the production of 'yellowcake' (uranium concentrate) beginning in 1984. Production ceased in June 1990.

The obligations of the mine during the closure process are laid down by the Permanent Cessation of the Excavation of Uranium Ore and the Prevention of the Effects of Mining at the Žirovski Vrh Uranium Mine Act (Ur. list RS, 36/92) and the Act amending the Permanent Cessation of the Excavation of Uranium Ore and the Prevention of the Effects of Mining at the Žirovski Vrh Uranium Mine Act (Ur. list RS, 28/00). A public company (Javno podjetje za zapiranje rudnika urana, d.o.o.) was established by decree in 2001 (Ur. list RS, 79/01). The closure of the mine is being carried out in accordance with a long-term programme for the permanent cessation of exploitation of uranium ore and the prevention of the effects of mining at the Žirovski Vrh Uranium Mine, which was adopted by the government in 1994 and subsequently updated in 2001. Under the updated programme from 2001, the permanent closure of the pit and the permanent remediation of the Jazbec mining tailings repository and the Boršt hydro-metallurgical tailings repository are envisaged over a five-year period.

In the course of the operation of the Žirovski Vrh Uranium Mine, the following radioactive substances were produced, which contained, in addition to natural occurring radioactivity, heightened radiation resulting from uranium decay types:

– radioactive waste substances produced in the procedure of obtaining uranium ore and processing it into uranium concentrate;

– infills and earth contaminated as a result of mining and processing activities at Žirovski Vrh;

– the ruins of former mining buildings and contaminated technological equipment.

There are two repositories at RŽV:

– the Jazbec mining tailings repository, into which material is deposited which has been produced in the course of the excavation of ore, the closure of the uranium concentrate production plant and decontamination, together with 1 200 tonnes of plant technological equipment, as well as material produced in the dismantling of the pit building and the decontamination of buildings;

– the Boršt hydro-metallurgical tailings repository, into which hydro-metallurgical and, to a lesser extent, mining tailings are deposited.

The Jazbec and Boršt repositories are permanent sites of deposited radioactive substances; under the ZVISJV, they are classified as radiation facilities. There are no plans for removal to another site outside the RŽV.

7.1 QUANTITIES OF RADIOACTIVE WASTE AT RŽV

The final quantities of waste substances deposited at the Jazbec and Boršt repositories and the activity of this waste will be known at the end of 2005. The estimated quantities are given in Tables 6 and 7.

Table 6: Estimated final quantity of material deposited at the Jazbec repository.

Material	Average specific activity (kBq/kg)	Total activity (TBq)	Deposited weight (t)	Volume (m^3)
Mining tailings and contaminated materials	10.1	23.7	1 828 000	1 138 500
Red precipitate	65	3.12	48 000	34 000
Total		26.57	1 876 000	1 172 500

Mining tailings and poor ore have mainly been deposited at the Jazbec mining tailings repository. At the repository, red precipitate (the residues of the neutralisation of acid liquors from the technological process of producing uranium concentrate, approx. 48 000 tonnes), which contains only a few tens of grams of uranium per tonne, i.e. 60 kBq thorium-230/kg, is also deposited in horizontal layers between the layers of mining tailings. The thickness of the intermediate layers of red precipitate is up to 0.5 m and the thickness of the mining tailings up to 1.5 m. A total of 44 000 of poor ore with an average concentration of 180 g U-238 /t (2.2 kBq U-238 /kg) was deposited in a special section in the lower part of the repository between 1984 and 1986.

Following the end of production, the ruins of surface mining buildings, contaminated infill and earth, the contaminated residues of technological equipment, mining tailings brought from all three temporary locations, ore from trial excavations and the core of the research boreholes and the material generated by the dismantling of the mining plant and the decontamination of processing facilities were deposited at the Jazbec mining tailings repository.

With the exception of a portion of the mining tailings that will remain in the area of the P-10 platform along the lower edge of the Jazbec repository, all mining tailings with heightened radiation will be collected in one place, i.e. at the Jazbec repository.

Table 7: Quantities of tailings at the Boršt hydro-metallurgical tailings repository

Material	Average specific activity (kBq/kg)	Total activity (TBq)	Deposited weight (t)	Volume (m^3)
Hydro-metallurgical tailings	78.2	47.7	610 000	339 000
Mining tailings	10.2	1.1	111 000	70 000
Total		48.8	721 000	409 000

Industrial residues from the processing of ore, i.e. hydro-metallurgical tailings, were deposited at the Boršt hydro-metallurgical tailings repository, with disposal taking place in layers from the bottom up. In the hydro-metallurgical tailings, 90% of the uranium activity of the radionuclides of the uranium-238 decay type is lacking (leached out to acquire uranium concentrate) along with 60% of the thorium-230 (in the procedure of neutralising the liquor, it moved to the red precipitate neutralisate, which is stored at Jazbec).

Around 600 000 tonnes of hydro-metallurgical tailings, containing 68 g U-238/t (0.9 kBq U/kg), approx. 4 kBq of thorium-230/kg and approx. 8.6 kBq of other progeny of uranium decay uranium-238/kg, 73 000 tonnes of mining tailings used for the production of mine transport routes, and 25 000 tonnes of mining tailings that will be used for the final re-regulation of the Boršt repository have been deposited at the repository.

The uranium ore which remained in the banks of uranium ore on the platform above the mill upon the cessation of regular production in 1990, and the uranium ore measured at the transport of the mine tailings from the temporary repositories through the radiometric gates to the Jazbec repository, were transported to the mine and permanently deposited there in suitable mine facilities. A portion of the excavations from both temporarily repositories will be used for the embankment of the mining areas of larger volume, such as ventilation shafts and uranium ore extraction sites.

With the final re-regulation of both repositories, there will no longer be any new radioactive waste with heightened radiation generated during uranium mining at Žirovski Vrh and which would require special disposal measures.

7.2 SITUATION UP TO 2008 AND 2014

The pit will be permanently closed by the end of 2005. In 2007 the Jazbec repository will be remediated and finally re-regulated. Re-regulation of the Boršt repository will be completed by the end of 2009. A five-year transitional period will follow the re-regulation of both repositories. Both repositories will be prepared for long-term supervision, with measurements and controls to ensure that the planned and executed works are carried out successfully. The management of the two repositories and the implementation of long-term supervision will be taken over from the RŽV by the Agency for Radioactive Waste.

8. TECHNOLOGICALLY ENHANCED NATURALLY OCCURRING RADIOACTIVE SUBSTANCES

8.1 QUANTITIES OF WASTE CONTAINING TECHNOLOGICALLY ENHANCED NATURALLY OCCURRING RADIOACTIVE SUBSTANCES

Technologically enhanced naturally occurring radioactive substances are waste or materials usually treated as radioactive but which contain naturally occurring radionuclides that accumulate during the technological process. These materials or waste can cause the irradiation of workers and those living in the surrounding area. As in other countries, the quantities of waste containing technologically enhanced naturally occurring radioactivity is very high in comparison with the quantities of radioactive waste.

The most important commercial activities in Slovenia in which waste containing technologically enhanced naturally occurring radioactivity are:

– mining and the production of metals;

– the phosphate industry;

– coal-mining and incineration in thermal power plants;

– natural gas and oil extraction;

– the titanium oxide industry, and the extraction and use of rare earth elements;

– the zirconium and ceramics industries;

– the production of construction materials (bricks, cement);

– waste water treatment plants.

The largest producers of waste containing technologically enhanced naturally occurring radioactivity are thermal power plants based on solid fossil fuels: Trbovlje Thermal Power Plant (TET), Šoštanj Thermal Power Plant (TEŠ) and Ljubljana Thermal/Heating Power Plant (TE-TOL). Every year these three plants produce around 1.3 million tonnes of fly ash, slag and wet gypsum containing concentrated natural radionuclides (Ra-226, U-238). More than 80% of the waste from the thermal power plants is produced at TEŠ, which also contributes the highest share of activity of waste containing enhanced naturally occurring radioactivity. Some of the fly ash is used in Slovenia as an additive in construction materials, for road maintenance and for the remediation of subsidence resulting from mining; the rest is deposited at disposal sites close to the plants.

Waste containing technologically enhanced naturally occurring radioactive substances is also generated in the production of TiO(2) at Cinkarna Celje (Celje zinc works). Cinkarna Celje stores all industrial equipment that has become radioactive during the production process (Ra-226, Ra-228 and other radionuclides) separately. In 2005 approx. 270 210-litre drums containing spent contaminated equipment was being stored at its own site. This includes a large amount of contaminated rubber. Waste gypsum from the production process is deposited at the works' own disposal sites.

As waste containing technologically enhanced naturally occurring radioactivity, the waste originating from the mining industry and metals processing includes locally significant tailings and smelting residues produced in the extraction of mercury in Idrija, which contains Ra-226 and U-238 in such quantities that the radiation burden on the population is increased. The waste contains between four and 40 times more uranium in comparison with normal soil and its specific activity is up to 1 200 Bq/kg [25]. This waste is scattered across 25% of the surface area of the built-up land in the town of Idrija, with around 90 buildings having been built on it. Since the mine is being closed down (completion of the closure process in 2006), no new waste is being produced.

8.2 MANAGEMENT OF WASTE CONTAINING TECHNOLOGICALLY ENHANCED NATURALLY OCCURRING RADIOACTIVITY

In the management of waste containing technologically enhanced naturally occurring radioactivity, the most pragmatic solution has often been to address each case separately. This waste can be handled in the same way as low-level radioactive waste, using temporary storage, immobilisation and decontamination. It may be released it into the environment in certain conditions; dilution and recycling are also permitted.

Table 9: Sites of production of waste containing technologically enhanced naturally occurring radioactivity, and its quantities and activity [11.4.-36]

Past activities	Weight of material deposited	Surface area of deposit	Specific activity
Smelting residues Idrija mercury mine	1 000 000 tonnes	~30 ha	Ra-266: 400–1200 Bq/kg
Phosphate gypsum TKI Hrastnik	600 000 tonnes (most discharged into watercourse)	0.5 ha	Ra-226: 400 Bq/kg
Red mud and ash Talum Kidričevo	6 450 000 tonnes (red mud) 1 500 000 tonnes (wet ash)	42 ha 8 ha	Ra-228: 400 Bq/kg Ra-226: 300 Bq/kg
Coal ash (Kočevje)	No data	1.25 km^2	Ra-226: up to 2 700 Bq/kg
Pipe coverings, formation water (Nafta Lendava)	No data		Ra-226: 170 Ra-226: 0.82 Bq/L
Current activities	Weight of material deposited	Surface area of deposit	Specific activity (Bq/kg)
Fly ash TEŠ, TET, TE-TOL	1 000 000 tonnes/year (total 30 000 000 tonnes)	TEŠ: 0.5 km^2	TEŠ: Ra-226: 350 Bq/kg TET: Ra-226: 180 Bq/kg TE-TOL: Ra-226: 400 Bq/kg
Gypsum from TiO_2 production (Cinkarna Celje)	600 000 tonnes (wet deposit)	38.5 ha	Th-228: 66–165 Bq/kg
Slag Jesenice, Ravne na Koroškem	Jesenice: 12 000 tonnes/year (total 317 000 tonnes) Ravne na Koroškem: 20 000 tonnes/year (total 1 500 000 tonnes)	2.2 ha 100 ha	Ra-226: 100–600 Bq/kg U-238: <30 Bq/kg

9. NATIONAL PROGRAMME FOR RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL MANAGEMENT

Based on the objectives of the National Programme for Radioactive Waste Management, data on the types and quantities of RW and SNF, and trends in their production, with due regard to the requirements for the timely securing of conditions for the resolution of problems connected with radioactive waste, a reference scenario for RW and SNF management has been drawn up in the Programme for the Decommissioning of NEK and the Disposal of RW and SNF (2004) and this Programme. On its basis, a proposed set of measures has been compiled, deadlines set for the timely securing of conditions for the safe management of radioactive waste, and an estimate made of the funds required for realisation.

The central points of the long-term national programme for radioactive waste management are the management of low- and intermediate-level radioactive waste from NEK, the decommissioning of NEK and the disposal of spent fuel from NEK. All other management of radioactive waste has been adjusted to this Programme in terms of timetabling and technology.

NEK was planned and constructed on the basis of an assumption that it would operate for 40 years. Since it entered commercial operation in 1983, this means its operating life would end in 2023. In practice, this operating life could be extended by 20 years. Of course, any extension would only be possible after extensive technical inspections and safety studies; the Resolution on the National Energy Programme (ReNEP, Ur. list RS, 57/04), which states that nuclear energy is also potentially important for the supply of electricity in the future, therefore requires that the possibility of extending the operating life of NEK be addressed in systematic studies and a decision adopted by 2012.

Based on the assumption that NEK will cease operating in 2023, a programme for the decommissioning of NEK and the disposal of RW and SNF has been drawn up under the agreement in force between Slovenia and Croatia. This National Programme for RW and SNF Management incorporates the scenario for decommissioning and for the management of RW and SNF which was chosen and which was approved by the international commission for the monitoring of the implementation of the BHRNEK.

The agreement with Croatia is an important factor in the planning of the decommissioning of NEK. This anticipates that the contracting parties will seek solutions by mutual agreement and finance them in equal shares. Should the contracting parties fail to reach agreement on the joint project, each shall ensure the final disposal of their own part of the radioactive waste and spent nuclear fuel generated by the operation and dismantling of NEK, whether on their own territory or that of third countries, at their own expense. The Programme for the Decommissioning of NEK and the Disposal of LILRW and SNF was drawn up on the basis of the provisions of the agreement between Slovenia and Croatia. The material interests of both contracting parties for joint management lie in the fact that the separate management of half of waste pertaining to them in turn would, because of the relatively small quantities of low- and intermediate-level radioactive waste produced at NEK, cost only just over one per cent less than the management of all waste.

The construction of RW and SNF repositories is envisaged as a basic scenario in the preparation of the long-term plan for the National Programme for RW and SNF Management. The National Programme submitted for 2006–2015 envisages, within its framework, the construction of an LILRW repository of half-capacity to cover the requirements only of Slovenia's portion of LILRW produced by the operation and dismantling of NEK and the disposal of all other Slovenian LILRW from other producers. At the same time, the Programme paves the way for the technical design and construction of a repository suitable for the disposal of all LILRW from NEK should an appropriate agreement be reached with Croatia on a joint solution to the problem.

9.1 MANAGEMENT OF RADIOACTIVE WASTE DURING THE OPERATION OF NUCLEAR FACILITIES

Radioactive waste (LILRW, HLRW and SNF) generated by nuclear facilities will be managed in the same way as hitherto, i.e. in accordance with the approved safety reports for the operation of specific nuclear facilities. When the operation of suitable repositories is secured, radioactive waste will be disposed within them.

9.2 MANAGEMENT OF RW PRODUCED THROUGH THE USE OF RADIOACTIVE SOURCES IN INDUSTRY AND RESEARCH

Radioactive waste generated through the use of radioactive sources in industry and research will be managed in accordance with practice established so far. Following the cessation of use, the radioactive sources will be sent to the public utility service of radioactive waste management or returned to the supplier. The users of sources endeavour to ensure that radioactive waste is not produced in greater quantities than is required for the implementation of their activities. Sources should, where possible, be supplied from suppliers prepared to take the spent sources back after use.

The funds for RW management shall be provided by those responsible for generating the waste.

9.3 MANAGEMENT OF LILRW IN MEDICINE

It is envisaged that a tank for collecting faecal matter contaminated with radioactive substances will be constructed by 2007 at Ljubljana University Hospital, which uses open sources of radiation in hospital treatments. Storage areas for the breakdown of solid waste contaminated with short-lived radionuclides used in therapy and diagnostics will be laid out. Procedures will be introduced to ensure that faecal matter and solid short-lived radioactive waste is left to settle until such time as the radioactivity falls below the legally prescribed limit. Sealed sources that are no longer used will be sent to the public utility service of radioactive waste management.

9.4 DISPOSAL OF LILRW, SNF AND HLRW IN SLOVENIA

Regardless of whether an agreement is reached with Croatia regarding realisation of a joint programme for decommissioning and for the management of the radioactive waste produced by NEK operation, the construction of an LILRW repository is planned and, as a basis for evaluating possible solutions through the export of SNF to a third country or the disposal of SNF to an international or regional repository, the possibility being studied of constructing LILRW and SNF or HLRW repositories in Slovenia. If an agreement with Croatia is signed, all waste will be deposited at repositories in Slovenia. If the agreement with Croatia is not signed by 2023, Slovenia shall address its own share of the waste, with the other half of the waste being taken by Croatia under contract and disposed of as that country sees fit.

9.5 CONSTRUCTION AND OPERATION OF THE LILRW REPOSITORY

Under the Ionising Radiation Protection and Nuclear Safety Act, we are obliged to select and approve a site for the low- and intermediate-level radioactive waste repository no later than by 2008, and to obtain an operating licence for the repository no later than by 2013. The repository and all the required infrastructure must operate until at least 2038, when the main phase of the dismantling of NEK will be completed. The following have been taken into account in the project conditions for the construction of the LILRW repository:

– the social and environmental acceptability of the repository site;

– the requirement to build infrastructure alongside the radioactive waste repository necessary for the receipt, treatment and temporary storage of radioactive waste;

– the requirement for the site and the method of construction to allow flexibility with regard to the repository's capacity and period of operation. Owing to the uncertainty regarding the required capacities, modular construction should be considered; this will also allow re-operation (filling) of the repository after a stand-by period;

– during the process of deciding on the selection of an LILRW repository type, a comparative study will be conducted in 2006 for the adoption of a decision on whether to opt for the surface or underground disposal of LILRW. The study will, among other things, take into account acceptability to the public, experiences abroad, the natural features, and the costs of construction and operation.

The construction and operation of the LILRW repository will be financed from funds collected within the Fund for the Financing of the Decommissioning of NEK and, should a repository be constructed for the disposal of all LILRW from NEK, from funds from Croatia as the contracting partner. The disposal of waste from other producers of radioactive waste shall be charged for through an investment made by the state, expressed in suitably revalued amounts, which has been used ever since its establishment in 1991 to finance the operations of ARAO for requirements relating to the planning and construction of the LILRW repository.

9.6 CONSTRUCTION AND OPERATION OF THE DRY SPENT FUEL STORAGE FACILITY

The scenario selected for the dismantling of NEK envisages the dry storage of SNF. Because of the concentration of technological activities, a dry storage facility shall be constructed at the NEK site or at another suitable location. The dry storage facility will be constructed between 2024 and 2037 and is planned to operate until 2070, when the spent fuel will be disposed of or permanently exported to another country.

The construction and operation of the dry SNF storage facility will be financed from funds collected within the Fund for the Financing of the Decommissioning of NEK and, in agreement with Croatia, from funds from Croatia as the contracting partner.

9.7 DISPOSAL OF SNF AND HLRW IN SLOVENIA

Since the disposal of SNF and HLRW from a single nuclear power plant at its own SNF and HLRW repository has already been shown in brief preliminary studies to be ineffective, it makes sense to look for a more favourable option with an international dimension. Slovenia will construct its own SNF and HLRW repository if such solutions cannot be found. The planning process must pay due regard to other waste that cannot be disposed of at the LILRW repository.

Along with the countries of Central and Eastern Europe with similar nuclear programmes or problems with SNF that has not been disposed of (Bulgaria, Czech Republic, Croatia, Italy, Slovakia, Hungary, Romania), the option must be sought of a joint regional SNF and HLRW repository on their own territory, most likely after 2030.

The possibility must be studied of initiating a similar process within the European Union to find a joint solution to the issue of the disposal of SNF and HLRW;

due regard must also be paid to the possible export of SNF and HLRW to a third country, where the economic consequences of doing so and the level of infrastructural development of the receiving country must be given proper consideration.

Any SNF and HLRW repository constructed by Slovenia shall be planned and constructed in deep geological formations. The geological formations and engineering measures must ensure the safety of disposal of SNF for a period of 10 000 years or more. The SNF and HLRW repository would begin operating in 2065. Research into what makes a repository site suitable, carried out over the long term, suggests that sites must be obtained that are suitable for research, and a site obtained by 2035 and 2055 that is suitable and socially acceptable. In the period up to 2035, the planning process shall include comparative studies and conceptual design projects and the preparation of staff for project implementation. The operational programmes for radioactive waste management 2006–2015 must address only those works that constitute preparation for an increased activation of this programme in the next decade, and the activities expected or demanded of Slovenia by the European Union to resolve this problem.

All activities towards finding solutions for the disposal of SNF and HLRW, preparatory works for possible own construction, the construction and operation of a repository financed from funds collected within the Fund for the Financing of the Decommissioning of NEK and, in agreement with Croatia, from funds from Croatia as the contracting partner.

9.8 DECOMMISSIONING OF NEK

Decommissioning shall start with the preparation of plans and of all the necessary documents prior to the end of the operating period (2021–2023). Three years after the cessation of operation of the power plant, the components that are not irradiated and that do not serve the safety and cooling systems of the plant shall begin to be dismantled. The reactor vessel and the parts of the reactor with the highest level of activity shall be dismantled at the end. The larger parts of the dismantled components will be deposited at the NSRAO repository, which will operate during the dismantling, while the smaller parts, such as the control rods and the dismantled reactor vessel, which will be contaminated with long-lived radionuclides, will be deposited with the SNF. The SNF will be moved from the core to the pool and, after cooling, moved to the dry storage facility in 2030. The dismantling of the power plant itself is planned to take place from 2027 and to last until 2037. The National Programme for 2006–2015 has, within this framework, made provision for work aimed at updating the Programme for the Decommissioning of NEK and the Disposal of RW and SNF. This process must be carried out in the next five years at the latest.

The decommissioning of NEK will be financed from funds collected within the Fund for the Financing of the Decommissioning of NEK and from funds from Croatia as the contracting partner.

9.9 MANAGEMENT OF LILRW, SNF AND HLRW FROM THE TRIGA RESEARCH REACTOR

By 2007 the operator of the TRIGA Research Reactor must adopt a decision on when the reactor is to be removed from operation. In doing so it must take account of the fact that Slovenia has had an offer from the USA to take back spent nuclear fuel from this reactor by May 2019, which means that the reactor must cease operating by 2016. In this case, funds of around EUR 2.5 million will be required; they will have to be provided by the ministry financing the operation of the research reactor.

If the operator opts to keep TRIGA operational after 2016, it must propose a solution for the management of SNF and HLRW, ensure that the solution it proposes is included in the future revised National Programme for RW and SNF Management, and provide the necessary financial resources.

Funds for the management of LILRW, SNF and HLRW or for the return of SNF to the USA shall be provided by the ministry financing the operation of the research reactor.

9.10 DECOMMISSIONING OF THE TRIGA RESEARCH REACTOR

By 2007 the operator of the TRIGA Research Reactor must adopt a decision on when the reactor is to be removed from operation. Alongside this it must draw up a programme for the dismantling of this facility. All HLRW from the dismantling of the reactor shall be deposited at the LILRW repository.

The necessary funds shall be provided by the ministry financing the operation of the research reactor.

9.11 OPERATION OF THE CSRAO

The Central LILRW Storage Facility at Brinje shall remain in operation until at least the construction of the LILRW repository. Following the construction of the LILRW repository, the inventory from the CSRAO shall be partly disposed of at the LILRW repository and, with the prior agreement of the local community, partly stored at the infrastructure centre at the LILRW repository. The CSRAO will then be decontaminated and made available for other purposes or dismantled.

The funds for the operation and decontamination of the CSRAO shall be provided by the ministry financing the operation of the public utility service (ARAO) as the direct state budget user, and by those responsible for producing the radioactive waste.

9.12 REMEDIATION WORKS TO REMOVE THE EFFECTS OF MINING AT THE ŽIROVSKI VRH URANIUM MINE

The processing plant has been dismantled and the appurtenant land already returned to unrestricted use. The closure of the pit, the dismantling of the above-ground mining buildings and the closure of the Jazbec and Boršt repositories will signal completion of the mining works to remove the effects of mining at the Žirovski Vrh Uranium Mine. Appropriate licences will be issued for the completion of mining works in order to cease the extraction of nuclear mineral raw materials and for the closure of the repositories for mining and hydro-metallurgical tailings. Most of the land will be remediated immediately after technical takeover and the repositories returned to unrestricted use. Restricted use is only envisaged for the area of the repositories for mining and hydro-metallurgical tailings. Works will be completed in 2009, after which time the RŽV public company shall cease to exist. Institutional supervision of the RŽV facilities which cannot be given over to unrestricted use shall be conducted by ARAO.

The works shall be financed from the budget of the Ministry of the Environment and Spatial Planning.

9.13 MANAGEMENT OF RADIOACTIVE WASTE CONTAINING NATURALLY OCCURRING RADIONUCLIDES

The effect on human health and the environment of radioactive waste containing naturally occurring radionuclides must be regularly monitored. Should the acceptable levels be exceeded, measures must be taken to remedy the situation. Such waste should be handled in accordance with its established level of radioactivity.

10. OPERATIONAL PROGRAMMES OF THE NATIONAL PROGRAMME FOR RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL MANAGEMENT

The objectives advanced by the National Programme for RW and SNF shall be realised in operational programmes, the bases of which are presented below.

The programmes shall cover all relevant aspects of RW and SNF management:

– Public utility service of the management of RW from small producers: securing the conditions for own transport, characterisation of waste at the CSRAO at Brinje, pilot waste treatment and preparation, modernisation of the hot cell, securing of storage capacities – responsible entity is the Agency for Radioactive Waste and IJS.

– Provision of an adequate retention basin at the Clinic for Nuclear Medicine – responsible entity is Ljubljana University Hospital.

– LILRW at NEK: the highest possible reduction in the volume of LILRW being produced – supercompaction, incineration, repacking and modernisation of equipment – responsible entity is Krško Nuclear Power Plant.

– Construction of an LILRW repository: acquisition of a location in a combined procedure and the physical siting of the facility, preparation of the documentation required to commence construction, drafting of criteria of acceptability for the repository – responsible entity is the Agency for Radioactive Waste.

– Closure of Žirovski Vrh Uranium Mine: remediation of the mine, regulation of repositories – Jazbec and Boršt heaps – responsible entity is the public company for the closure of Žirovski Vrh Uranium Mine, transfer of management to ARAO, which shall conduct long-term monitoring and maintenance of the repositories.

– SNF management: decision on the future operation of the TRIGA Research Reactor with the halting of the export of fuel to the USA – responsible entity is IJS; wet storage of SNF from NEK – responsible entity is NEK; initial planning and development activities for ensuring the temporary dry storage and permanent disposal of SNF from Nek and HLRW from the TRIGA Research Reactor and NEK in Slovenia or abroad – responsible entity is ARAO.

– Dismantling of nuclear facilities: dismantling of NEK envisaged from 2023 under the Programme for the Decommissioning of NEK and for RW and SNF Management, preparation of a revised programme with ARAO in Slovenia and APO in Croatia, and the preparation of a programme for the decommissioning of the TRIGA Research Reactor – responsible entity is IJS.

– National Programme for RW and SNF Management: preparation of four-year operational programmes under of the National Programme for RW and SNF Management and the revised National Programme for RW and SNF Management – responsible entity is ARAO.

10.1 PUBLIC UTILITY SERVICE OF MANAGEMENT OF RW FROM SMALL PRODUCERS

OBJECTIVE: To ensure the smooth operation of the public utility service of management of all LILRW from small producers

Medicine, industry and research activities represent the most dispersed source of radioactive substances in the environment in terms of the radioactive waste production. All radioactive sources are recorded and placed under supervision during use and after they become waste. Very short-lived RW accounts for most of the waste produced in medicine in terms of quantity. It is not problematic in terms of management, since all producers of such waste have appropriate premises in which the waste can be temporarily stored until its activity falls below the level required to maintain control of it. Suitable retention basins have to be provided at hospitals that use open sources for treatment purposes before the waste can be discharged into the environment as sewage. Industry chiefly uses sealed sources, while a pronounced fall in the use of radioactive isotopes has been noted in research activities. The quantities of waste containing (technologically) enhanced naturally occurring radioactivity are large; issues pertaining to it are, as in other countries, being dealt with on a case-by-case basis.

ARAO is responsible for managing radioactive waste from small producers. The receipt of this waste at the Central Radioactive Waste Storage Facility at Brinje was limited until 2004 owing to the inadequate state of the facility. The obstacles preventing regular receipt were removed following the completion of remediation and reconstruction in 2004. Small producers of LILRW in Slovenia have been informed of and have an interest in the obligations regarding the delivery of waste. ARAO also informs them of the method of managing waste so that it meets the requirements for acceptance at the storage facility. A tariff of services is in use for provision of the public service of the management of RW from small producers (Ur. list RS, 102/00), which lays down the prices for waste storage, treatment and preparation services and for transport for all small producers. A legal requirement is already in place laying down that the costs of managing RW are paid by the waste producer. The storage capacities must be secured, with the regulation of the inventory and the rearrangement of the storage method, by the time the LILRW repository comes into operation.

The general priority of waste management is to reduce quantities of waste; this also applies to radioactive waste management. ARAO is already noticing a downward trend in the quantities of waste produced by small producers, with a considerable portion of radiation sources no longer in use being returned to the producers. At the same time, there is also a noticeable growth in the use of radionuclides with the shortest half-life and the replacement of radiation sources with other devices. In light of this general trend, the quantities of LILRW from small producers will fall. ‘Old pollution’, i.e. radioactive waste temporarily stored in producers’ storage areas, will have to be accepted at the storage facility.

The next most important principle applying to RW management is ensuring the safety of people and the environment. In consequence, the properties of the waste must be recognised and all regulations relating to the transport, storage, treatment and preparation of waste complied with. The preparation and treatment of the more complex waste is being carried out in the hot cell at the IJS Reactor Centre, which needs to be equipped and which will be part of the system for the preparation and treatment of waste from small producers.

Most of the conditions for achieving the objective set have already been met. Further measures will have to be taken by 2008 so as to enable the appropriate level of safe and environmentally acceptable management of LILRW from small producers to be reached, and to improve the operations of the public utility service of the management of LILRW from small producers.

NECESSARY MEASURES	DEADLINE FOR IMPLEMENTATION
Acquisition of operating licence for the Central Radioactive Waste Storage Facility at Brinje	Trial operation 2005–2006 Operation 2007
Characterisation of waste stored at CSRAO Brinje	First part 2005, second part 2008
Arrangement of hot cell	2006
Establishment of pilot treatment and preparation of RW, provision of storage capacities	2008
Revised safety report	2006
Securing of conditions for own transport of radioactive waste at ARAO	2006

The entity responsible for the measures is the public utility service provider, ARAO. The entity responsible for arranging the hot cell within the IJS Reactor Centre is IJS.

10.2 MANAGEMENT OF RADIOACTIVE WASTE IN MEDICINE

OBJECTIVE: To secure an appropriate retention basin at the Clinic for Nuclear Medicine and a storage area for the breaking-down of solid radioactive waste.

The clinic shall arrange the retention basin and storage area in accordance with the regulations, thereby limiting the radioactive burden on the environment.

10.3 LILRW AT NEK

OBJECTIVES: To ensure the safe storage of LILRW in terms of environmental impact and the safety of operations staff within the framework of NEK's existing operating licence.

The existing storage capacities for radioactive waste at NEK are extremely limited. The process of rationalising the use of space in the storage facility must continue. Administrative, organisational and technological changes will ensure substantially lower annual quantities of LILRW in comparison with the past. The input of substances is limited, which shows in the quantity of radioactive waste being produced. It is established practice to use the technologies of drying, incineration and supercompaction as a matter of priority. New techniques are being sought to reduce the volume of waste. The storage facility is expected to be full by the end of 2010 if all the above measures are applied strictly.

In order to free up the handling area, a portion of the RW already produced will have be re-compacted in 2005. The third planned round of compaction is planned for 2005, when the quantity of waste suitable for supercompaction will increase to 1 250 drums. The third round of supercompaction will produce 200 tubular containers containing the products of supercompaction.

Additional storage capacities will be freed up after the next round of incineration (2005), the next round of supercompaction of compactible waste, and the repacking of compacted waste that arose during the first round of supercompaction in 1988 and 1989. The storage capacities are being used more efficiently with the drying of evaporator bottoms and spent ion exchangers. Combustible NEK waste is sent for incineration to Studsvik in Sweden. The most recent shipment to Studsvik, of 250 standard 208-litre drums containing combustible waste, took place in 2002. Sixteen drums containing the incineration products (ash and filter residues), made ready using the planned processes, were returned to Slovenia. The same process is planned for all future incineration operations, with the final quantity of RW incinerated and stored expected to be around 20 drums. Around 250 drums of combustible waste are prepared for incineration every three years. If the trend continues as before, the next shipments of drums to Studsvik for incineration will be sent in 2005 and 2008.

Some metal components and steel structures replaced during the maintenance of the power plant will be dismantled, decontaminated, smelted and then stored at the RW storage facility. This will free up additional space at the facility.

Most of the activities for which NEK is responsible take place on a continual basis and with the use of NEK's own resources – human as well as material – in accordance with internal procedures. These activities are adjusted to the dynamics of the production of waste and the capacities of the treatment equipment.

Activities that take place in rounds and which are usually associated with external contractors are subject to a timetable with the following markers:

– incineration planned in 2005 and 2008;

– supercompaction in 2005, with own regular supercompaction thereafter;

– the treatment of the existing quantity of spent ion exchangers from the primary cycle gradually until the end of 2005.

NECESSARY MEASURES	DEADLINE FOR IMPLEMENTATION
Processing of LILRW and the maintenance of LILRW management systems	Regularly on an annual basis
Management of untreated spent ion exchangers, process collector bottoms and contaminated waste oils	Regularly on an annual basis
Supercompaction (equipment, tubular containers for products of compaction)	Regularly on an annual basis
Incineration	2005, 2008
Repacking of first supercompaction	2006
Smelting of metal waste	2008
Modernisation of equipment	2005–2008

10.4 SELECTION OF A LOCATION FOR THE LILRW REPOSITORY

OBJECTIVE:

– To acquire a suitable location for the LILRW repository with a combined procedure, with public involvement in accordance with the Aarhus Convention.

– To prepare all the necessary documentation (project for acquisition of construction permit, execution project, safety report, environmental impact assessment report, etc.) for acquisition of the construction permit.

On the basis of a thorough analysis of management in other countries, the construction of the repository is recommended as the most suitable permanent solution to the issue of the long-term management of low- and intermediate-level radioactive waste from the operation and dismantling of NEK, and from medical, industrial and research activities. Surface and underground repositories could be considered, selection of the type being dependent on the location chosen and the requirements of the local community that will be receiving the repository.

The basic requirement in the planning of the LILRW repository is to ensure safe final disposal. The repository must be sound technically and in terms of safety, compliant with environmental requirements and economically feasible. Above all, it must be socially acceptable. From the safety and economic points of view, a permanent solution to the problem of LILRW should ideally be found as soon as possible. The construction and operation of the repository will relieve the burden from the two current LILRW storage facilities: the storage facility at NEK and the Central Radioactive Waste Storage Facility at Brinje. The delay in the construction of the repository is a particularly pressing issue at NEK, from both the safety aspect and the aspect ensuring the undisrupted operation of the power plant.

As part of the search for a permanent solution to the problem of low- and intermediate radioactive waste produced in Slovenia, ARAO has designed a combined procedure for seeking a location for a repository for this waste based on the involvement, cooperation and joint decision-making of the public. The procedure requires that a finding be produced as to the most and least advantageous places in Slovenian territory for the siting of the facility before the public is included in the process of preparing the appropriate expert foundations. At the start of 2001, ARAO presented the public and the representatives of local communities (invitations were extended to representatives of all Slovenian municipalities) with a map of initial potential areas for the repository; the map was drawn up on the basis of an evaluation made at ARAO cabinet level. The map is based exclusively on the geological characteristics that ensure a safe natural environment for disposal (i.e. poorly permeable bedrock) and technically more straightforward facility construction. The dark shaded areas represent the areas being given priority in the search for locations for the LILRW repository.

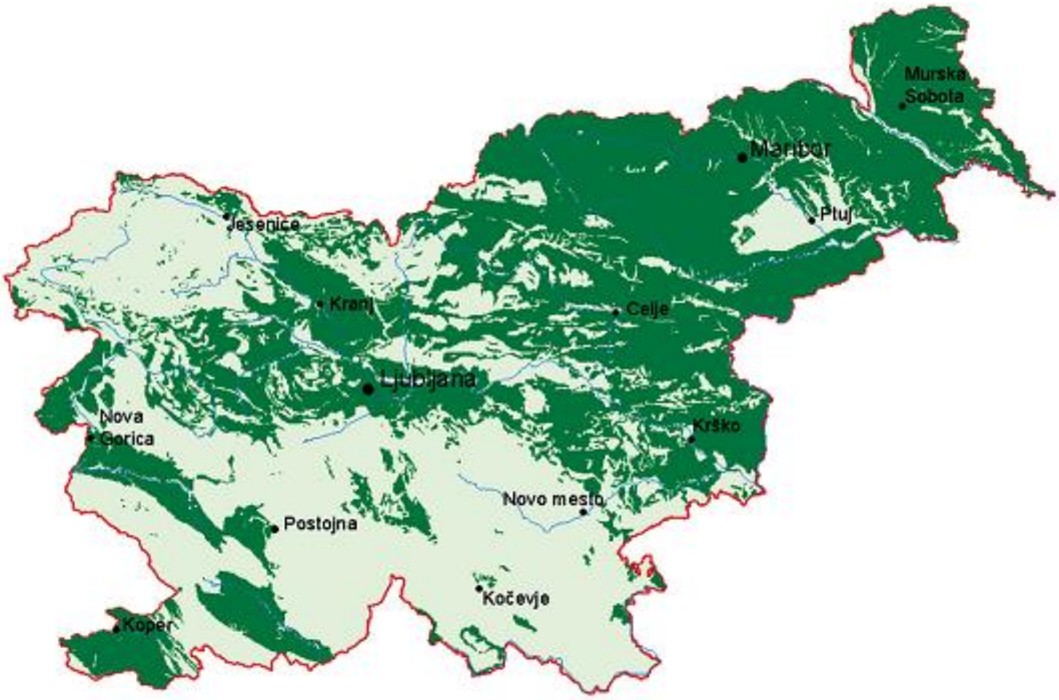

Figure 5: Map of initial potential areas for the siting of the repository

The areas, all except five of which are located in all other Slovenian municipalities, were identified by treating the entire territory of Slovenia equally, solely on the basis of existing data. The actual geological suitability of the possible locations within these areas must be demonstrated and confirmed in subsequent field research. The map therefore shows the initial areas exclusively and not the potential locations. The map of initial areas, which is one of the starting points for the establishment of contacts, has been drawn up exclusively on the basis of geology, while the issue of the public interest will be crucial to the process. This will have to be given due regard in any further consideration of the areas concerned with the participation and involvement of the public. The special institute of 'mediator' will ensure the involvement of and provision of information to the public in a combined procedure; this will ease negotiations with the local communities. The task of the mediator is to ensure the cooperation of the local communities and of ARAO as the entity conducting the procedure as neutrally as possible; this is in order to achieve consensus on the location of the LILRW repository.

The adoption of an implementing regulation (Decree on the Criteria for Determining the Compensation for Restricted Use of Space within the Area of a Nuclear Facility) is of exceptional importance for future activities relating to public participation in the procedure of selecting a location and acquiring tenders. The annual compensation for the restricted use of space for the LILRW repository is, under this Decree, the tolar countervalue of EUR 2 331 180. The local community also receives compensation of 10% of the entire compensation during the performance of field research and the construction of the repository.

The quantities of LILRW at the NEK storage facility, at the Central Radioactive Waste Storage Facility at Brinje and at storage facilities at small producers amounted to approx. 2 360 m3 at the end of 2004. The entire quantity of LILRW that will be produced in Slovenia by the end of operation and the dismantling of the existing nuclear facilities, estimated on the basis of current quantities and projections of the growth of LILRW from NEK operation and of waste from small producers (medicine, industry and research), and the expected quantities of waste from the dismantling of these facilities estimated within the Programme for the Decommissioning of NEK and the Disposal of Radioactive Waste and Spent Nuclear Fuel, is 17 650 m3. The plan for the technical LILRW repository solution has been drawn up to account for the possibility of a surface as well as underground repository. For both options, scenarios for the disposal of all LILRW that will be produced at NEK and of half this waste have been produced. The further optimisation of technical solutions applying to the repository and the projection of the repository will have to pay due regard to the provisions of the international agreement between Slovenia and Croatia regarding ownership of the waste.

The timetable of the plan of activities for the selection and construction of the repository is derived from the legal provisions and is shown in Diagram 1 (p. 54). Owing to the complexity and level of interconnectedness, a wider period from 2000 onwards has been shown, working from the assumption that some activities have already been carried out. Optimistic timetables are given consideration that anticipate that the location for the repository will be selected by 2008 (the legal requirement), while the repository will be constructed and will start operating by the end of 2010 (the legal requirement is 2013). The plan is very optimistic in terms of the timetable and does not take into consideration any delays in the implementation of individual activities, even though some deadlines are very tight. The activities for selection of the location and the construction of the repository are divided into six main groups:

1. selection of the location of the LILRW repository and the purchase of land;

2. communications activities (acquisition of consent of the local community);

3. planning and acquisition of permits;

4. technology of disposal and safety assessments;

5. construction of the repository and of the infrastructure up to the repository;

6. compensation.

Some activities will be carried out simultaneously, others consecutively. Based on experiences from previous years, public resistance can be expected in the process of selecting the location; the most critical period is therefore between 2004 and 2006, when negotiations are planned to take place with local communities as part of communications activities.

Since 2006, when it began a new procedure to select a location for the LILRW repository, ARAO has met most of the conditions for achieving the objectives set. The procedure for selecting a location has been set democratically, ensures the involvement and cooperation of the public from the outset, and puts in place all measures for determining a safe location. All documents for the generic location constituting the starting points for the preparation of project and other technical documentation were drawn up by 2004. The following measures will also have to be carried out by 2008 in order to facilitate, with the consent of the public, the legal and democratic acquisition of a suitable location for the LILRW repository and to prepare the appropriate documentation for acquiring the construction permit.

NECESSARY MEASURES	DEADLINE FOR IMPLEMENTATION
Production of a comparative study for adoption of a decision on the surface or underground disposal of LILRW	2006
Acquisition of repository location	2007
Acquisition of land	2008
Field research of location characteristics	2005–2006
Plant for supervision of repository	2007
Investment documentation	2005–2007

Spatial planning	2005–2007
Criteria of acceptability for disposal	2005–2007
LILRW transport plan	2006–2007
Programme for RW disposal	2008
Project documentation: Conceptual solution Conceptual design project Project for acquisition of construction permit Construction permit PZR PVO	2005–2008 2005 2006 2008 2008 2008 2007
Safety report	2005–2007
Plan of physical security, protection and rescue	2007–2008
Payment of compensation	2005–2009

The entity responsible for all activities is the national public utility service provider, i.e. the Agency for Radioactive Waste. The project is being financed by from the state budget and the Fund for the Decommissioning of Krško Nuclear Power Plant. The main source of funding is the Fund for the Decommissioning of NEK, since it covers the major portion of the anticipated costs. The budget only covers those costs which ARAO requires in order to carry out its activities in connection with this project.

10.5 CLOSURE OF ŽIROVSKI VRH MINE AND TRANSFER TO ARAO

OBJECTIVE: Closure of Žirovski Vrh Uranium Mine with environmental remediation

The Žirovski Vrh Uranium Mine is undergoing closure; considerable quantities of low-level radioactive waste have been stored over the long term at the two repositories. This material remains at the site of the repositories, which must be adequately secured so that radionuclides are not dispersed into the environment, and especially not into water, through which it would enter the food chain and accumulate in organisms.

In the remediation of the pit, the high-lying abandoned mine excavations must be filled in so as to prevent the surface from subsiding. The dissolution of uranium from ore, which could pollute the pit water flowing from the mine, must be prevented. In remediating the repositories, the reorganisation of the body of the repositories is planned to increase the stability of the embankments, along with rearrangement of the rainwater drainage system.

Implementation of the closure programme is already under way. The following measures will have to be carried out in order to achieve the objectives:

NECESSARY MEASURES	DEADLINE FOR IMPLEMENTATION
Remediation of the pit	2005
Regulation of the Jazbec repository	2005–2008
Regulation of the Boršt repository	2006–2009
Commencement of institutional supervision and the transfer of management to ARAO	2008

The entity responsible for implementation of all the measures until the commencement of institutional supervision is the public company for the closure of the Žirovski Vrh Uranium Mine, with the long-term supervision and maintenance of the repository for mining and hydro-metallurgical tailings being carried out by ARAO.

10.6 SNF MANAGEMENT

OBJECTIVE: Provision of a long-term solution to the problem of the management of SNF from NEK, and of HLRW from NEK and from the TRIGA Research Reactor

Under the provisions of the Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on Regulation of the Status and Other Legal Relations Regarding Investment in and the Exploitation and Decommissioning of Krško Nuclear Power Plant, the contracting parties will, where possible, resolve the issue of the long-term management of SNF and HLRW from NEK jointly. Resolution of the issue of long-term HLRW management from the TRIGA Research Reactor is Slovenia’s problem. Since joint resolution of the issue of the long-term management of SNF and RW by both contracting parties cannot be ensured in advance, Slovenia must carry out a least the initial planning and development measures to ensure a long-term solution to the issue of the management of SNF and RW from both nuclear facilities. A long-term solution is being sought first of all through international links; however, several of the activities must also be directed towards Slovenian territory in the interests of securing long-term solutions and ensuring suitable negotiating positions in the international environment. Activities in the international environment are directed towards a study of the possibility of constructing a regional repository. Activities for the construction of the country’s own repository are being directed towards international cooperation in the preparation of SNF and HLRW for disposal, the study of the possibility of disposal in Slovenia and the formation of Slovenian personnel as part of EU research and development programmes. The entity responsible for all activities is ARAO.

NECESSARY MEASURES	DEADLINE FOR IMPLEMENTATION
Activities towards the construction of a regional (international) repository for SNF and HLRW	2006–2009
Activities towards the construction of Slovenia’s own repository for SNF and HLRW	2006–2009

10.7 DECOMMISSIONING OF NUCLEAR FACILITIES

OBJECTIVE: Revision of the Programme for the Decommissioning of NEK and the Disposal of LILRW and SNF

The Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on Regulation of the Status and Other Legal Relations Regarding Investment in and the Exploitation and Decommissioning of Krško Nuclear Power Plant requires the revision of the Programme for the Decommissioning of NEK and the Disposal of LILRW and SNF, which was drafted in 2004. The revision must be produced within five years at the latest. The project group that prepared the decommissioning programme has also compiled a plan that defines the set of measures for the drafting of a new revised version by 2008. The entity responsible for all activities under the bilateral agreement are ARAO in Slovenia and the Special Waste Agency in Croatia.

NECESSARY MEASURES	DEADLINE FOR IMPLEMENTATION
Identification of the scope and the required new documents and studies	Conducted in 2005
Production of all documents and the new revision	2006–2009
Review and adoption of the document	2009

OBJECTIVE: Preparation of the programme for the decommissioning of the TRIGA Mark II Research Reactor

A decommissioning programme must be drawn up for the TRIGA Mark II Research Reactor. Preparation of the decommissioning programme is required if the owner and operator decide to close the reactor. The entity responsible for all measures is IJS.

NECESSARY MEASURES	DEADLINE FOR IMPLEMENTATION
Production of the decommissioning programme and adoption of the document	2006
Decision on the operation of the research reactor	2007

10.8 REVISION OF THE OPERATIONAL PROGRAMMES AND THE RW AND SNF MANAGEMENT PROGRAMME AFTER 2015

OBJECTIVE: To prepare more targeted operational programmes for 2010–2015 and a programme for RW and SNF management after 2015

The operational programmes, valid for a period of no more than four years, are set out in more detail in the National Programme for RW and SNF Management. The results achieved and the development of the activity will dictate the nature of the detailed operational programmes over the next four-year period. The operational programmes will therefore have to be reviewed and supplemented prior to the end of the first four-year period. The entity responsible for the preparation of the new draft measures is ARAO.

NECESSARY MEASURES	Deadline for implementation
Review of implementation of the operational programmes 2005–2008	2009
Preparation of more detailed operational programmes 2009–2015	2009 in 2012
Preparation of an RW and SNF management programme after 2015	2014

11. IMPORTANT RW AND SNF MANAGEMENT ENTITIES

11.1 STATE ADMINISTRATION

The central RW and SNF management functions of state administration relate to the implementation of tasks in the area of radiation protection and nuclear safety. Responsibility for the implementation of these tasks has been allocated to bodies affiliated to the ministries: The Slovenian Nuclear Safety Administration, which is a body affiliated to the Ministry of the Environment and Spatial Planning, and the Slovenian Radiation Protection Administration, which is a body affiliated to the Ministry of Health. The Ministry of the Interior is responsible for overseeing all activities relating to the transport of radioactive substances, including radioactive waste, in cooperation with the inspection service of the Slovenian Nuclear Safety Administration. The Protection and Rescue Administration at the Ministry of Defence is responsible for planning radiation and nuclear safety measures in response to emergency events.

The Decree on Bodies Affiliated to Ministries (Ur. list RS, 58/03, 45/04, 138/04, 52/05) lays down that the Slovenian Nuclear Safety Administration (URSJV) performs specialist tasks, development administrative tasks, and inspection and supervision tasks in the following areas:

– radiation and nuclear safety;

– the implementation of radiation practices and the use of radiation sources, except in healthcare or veterinary medicine;

– protection of the environment against ionising radiation;

– the physical protection of nuclear substances and facilities;

– the non-proliferation of nuclear weapons and the protection of nuclear goods;

– the monitoring of the state of radioactivity in the environment;

– liability for nuclear damage.

The Slovenian Radiation Protection Administration (URSVS) conducts expert, administrative, supervisory and development tasks in the following areas:

– the implementation of activities and the use of sources of ionising radiation in healthcare and veterinary medicine;

– the protection of human health against the harmful effects of ionising radiation;

– supervision of the working and living environment owing to human exposure to natural sources of ionising radiation;

– monitoring of the radioactive contamination of food and drinking water;

– the restriction of, reduction in and prevention of the harmful effects of ionising radiation;

– assessments of competence and the authorising of radiation protection experts.

The radiation protection inspection service operates as a special organisational unit within the URSVS. It is responsible for supervising sources of ionising radiation in medicine and veterinary medicine, and for implementing regulations in the area of the protection of human health against ionising radiation.

For radiation protection purposes, the URSVS maintains a central register of radiation doses. Authorised dosimetry providers use the register to report the external doses measured of all exposed workers on a monthly basis, and the internal doses from exposure to radon on a twice-yearly or yearly basis. The authorised providers of personal dosimetry are the Institute of Occupational Safety (ZVD) and Institut Jožef Stefan (IJS). NEK (for external radiation) and Žirovski Vrh Uranium Mine (for measurements in the working environment of the mines) also have special authorisations.

An expert council for radiation and nuclear safety has also been formed which gives expert assistance to the ministry responsible for the environment and spatial planning and the URSJV in the areas of radiation and nuclear safety, the physical protection of nuclear substances and facilities, the protection of nuclear goods, the state of radioactivity in the environment, environmental protection against ionising radiation, intervention measures, and the remediation of the consequences of emergency events and radiation sources not used in healthcare and veterinary medicine.

The Police, as a body affiliated to the Ministry of the Interior, is responsible for overseeing the carriage of radioactive substances and waste by road; the inspection service of the Ministry of Transport is responsible for overseeing the carriage of these substances by rail, air or water; and the Protection and Rescue Administration at the Ministry of Defence is responsible for planning radiation and nuclear safety measures in response to emergency events.

11.2 PUBLIC UTILITY SERVICE PROVIDER

The Agency for Radioactive Waste (ARAO), founded by government ordinance (Ur. list RS, 5/91) in February 1991, is responsible for providing the public utility service of radioactive waste management in Slovenia. ARAO's tasks relate to ensuring the conditions for the permanent and safe disposal of radioactive waste. It was originally organised as a public company. In 1996 it was reformed, under the new legislation (Ur. list RS, 45/96), into a public utility institute. ARAO's activities thereby expanded to include the management of the Central Radioactive Waste Storage Facility at Brinje pri Ljubljani, the collection and storage of radioactive waste from industry, healthcare and research activities, the transport of radioactive waste, and many other areas. In 1999, by special government decree (Ur. list RS, 32/99), ARAO also became the actual provider of the public utility service of the management of radioactive waste from small producers. The provision of information to the public on the work of ARAO and on RW management in Slovenia, and the organisation of education and R&D activities in the field of radioactive waste and spent nuclear fuel management, all gained special weight within the set of tasks entrusted to ARAO.

ARAO's activities are financed from three sources: Slovenia's state budget, the Fund for the Financing of the Decommissioning of NEK and the Disposal of Waste from NEK, and payments from users of the radioactive waste repository. The payments are set in the Tariff of Services (Ur. list RS, 102/00), which is set by the Slovenian government. The price covers the costs of the public service provider and is differentiated according to the type of radioactive waste in terms of its activity and the amount of space it occupies in the storage facility, and to the scope of the treatment and preparation required before storage.

11.3 NON-GOVERNMENTAL ORGANISATIONS

As part of the RW and SNF management programme, the participation of expert institutions and decision-makers from non-governmental environmental organisations is of great importance. The management of RW and SNF is a specialised and professionally complex field; at the same time, it causes a great deal of mistrust among the general population. It periodically becomes a subject of interest to general non-governmental environmental organisations whose role in environmental protection in Slovenia is already addressed in the National Environmental Protection Programme. Experience from the work carried out with REC (Regional Centre for the Environment for Central and Eastern Europe) shows that decision-making on RW and SNF management is not a central topic likely to engage the interest of non-governmental organisations.

Expert non-governmental organisations operating in technical fields, such as the Society of Nuclear Professionals and the Association of Technical Culture Organisations, are more important than general non-governmental environmental organisations in this respect. Their role is primarily linked to public education and awareness-raising, and to acquainting the public with modern approaches to nuclear technology as one of the technologies capable of contributing to environmental protection (e.g. by reducing greenhouse gas emissions). Under the public education and awareness-raising programmes, NGOs must be included as a specific target public, since it is through their operations that the possibility for constructive dialogue between local communities and holders of state authorisations to manage RW and SNF can be improved. The key tasks of non-governmental organisations relating to RW and SNF are:

– to increase their own awareness of RW;

– to take part in establishing local partnerships with the local communities in which nuclear facilities are located.

11.4 BUSINESS AND AUTHORISED PERSONS

Producing more than a third of electricity in Slovenia, Krško Nuclear Power Plant is a very important commercial facility. It is also charged with managing radioactive waste stored at the location of the power plant. NEK has strong expert support in authorised organisations, which train NEK staff in different expert areas and draw up specific expert analyses for NEK.

The ZVISJV provides for several types of authorised organisation and expert. The areas for which authorisations are used are:

– Authorised radiation protection experts, who work with employers in drawing up assessments of the radiation safety of exposed workers, advise on the working conditions of exposed workers, the scope of implementation of radiation protection measures in monitored and controlled areas, verification of the effectiveness of these measures, the regular calibration of measuring equipment and verification of the effectiveness of protective equipment, and conduct training in radiation protection for exposed workers. Authorised radiation protection experts also check ionising radiation levels, contamination of the working environment, and the working conditions in controlled and monitored areas at regular intervals.

– Authorised radiation and nuclear safety experts compile assessments and opinions on activities at nuclear and radiation facilities.

– Authorised dosimetry experts carry out tasks relating to establishing the level of exposure of persons to ionising radiation.

– Authorised providers of health checks of exposed workers carry out health checks of exposed workers within the public healthcare service.

A Fund for the Decommissioning of NEK has been established to provide funding for the decommissioning of NEK and the disposal of RW and SNF; this Fund collects resources from the Slovenian owner of the nuclear power plant. ELES GEN, d.o.o. is liable for the payment of a regular contribution to the Fund.

The insurance and reinsurance of nuclear risks by a special insurance company (Jedrski pool GIZ, which is a contractually established legal entity in the legal-organisational form of an economic interest association, also contributes to nuclear safety. It has been in operation since 2004 and currently has eight members. Zavarovalnica Triglav, d.d. and Pozavarovalnica Sava, d.d. have the highest share.

12. COMMUNICATION AND EDUCATION

12.1 PUBLIC PARTICIPATION IN DECISION-MAKING

The principles of the Aarhus Convention are consistently adhered to in the planning of and decision-making on RW and SNF in Slovenia. The most important task is to find a suitable location for the LILRW repository by 2008 – one that will be acceptable to the local community and the general public in Slovenia. A combined location selection procedure has been chosen in the programme for the preparation of the national location plan for the LILRW repository, with prospective areas for the location being first selected under technical criteria, followed by an invitation to tender inviting local communities to take part in the location selection procedure. In addition to technical, environmental and economic criteria, the social acceptability of the potential location will be given equal consideration when selecting a location for the LILRW repository. The procedure has been designed so that no decision is taken in the procedure of selecting the location and acquiring the permits without the consent of the public.

Intensive communications activities, which ARAO, as the responsible entity, is already carrying out as part of the location-selection process, are required to allow the proper involvement of the public in the decision-making process. The public has the opportunity to express its opinion using all accessible media of communication (surveys, written opinions, telephone, e-mail, etc.). Moderated workshops play an important role in forming public opinion, as does the involvement of representatives of non-governmental organisations and civil initiatives.

12.2 PUBLIC AWARENESS

RW and SNF management is very poorly represented in general education programmes. Activities that increase the knowledge and understanding of this field are urgently required if the public is to participate in the decision-making process in a constructive way. The public must be acquainted with the following in particular:

– the different types of radioactive waste;

– legislation applying to RW and SNF management;

– actual radiation dangers and measures to protect human health;

– the wider environmental protection aspects, including the necessity to manage RW and SNF properly.

There is a great deal of popular material for raising public awareness, there is an information centre, and informative articles appear in the media. In order to raise the level of awareness, media interest in reporting objectively on radioactive waste management must be strengthened. The key target publics are school-age children, teachers and interested parties in those local communities in which nuclear facilities are located. Awareness of the issue of radioactive waste must be linked to a general awareness of environmental protection, since RW and SNF management is one of the waste management programmes in force.

13. FUNDING

The implementation of measures from the proposal for RW and SNF management is evaluated by individual year and by source of funding in relation to the area concerned. In the evaluation process, assessments are derived from the studies already prepared by competent institutions, while some measures or ensuing activities are assessed on the basis of an internal assessment by internal experts. The assessments of the costs adhere to the level of detail from the proposal for RW and SNF management. The costs are assessed in greater detail for 2005–2008, while for 2009–2014 they are assessed more generally, since most institutions plan their programmes for a five-year period. The sources of funding are different for different areas, with funds being collected from the state budget, the dedicated NEK decommissioning fund, and grants under the PHARE programme or from technical cooperation with the MAAE. NEK is financed entirely from the sale of electricity for all activities directly linked to the management of LILRW; in addition, compensation is paid for the restricted use of space for the storage of LILRW in the area of NEK from the decommissioning fund. All currency conversions were made in September 2004. The grey-coloured background in the tables show the costs for the previous period, i.e. the assessment for 2004.

13.1 PUBLIC UTILITY SERVICE OF MANAGEMENT OF RW FROM SMALL PRODUCERS

Sources of funding: Slovenian state budget
payments by producers of RW under the public service tariff
grants under the PHARE programme
IAEA technical cooperation.

Estimate of costs by year (sources ARAO, IJS):

Year	Amount in SIT millions	Sources of funds	
		State budget (SIT millions)	Other (SIT millions)
2004	150	140	10

2005	220	140	80
2006	300	170	130
2007	180	170	10
2008	270	260	10
2009	310	300	10
2010	210	200	10
2011	210	200	10
2012	210	200	10
2013	210	200	10
2014	210	200	10
2015	210	200	10

13.2 NEK: OPERATING COSTS OF LILRW AND SNF MANAGEMENT

Source of funding: NEK's own sources from the sale of electricity
Fund for the Financing of the Decommissioning of NEK and the Disposal of RW from NEK

Estimate of costs (source NEK):

The operating costs of the management of LILRW are included in the operating costs of the power plant.

Until the adoption of the location plan for the LILRW repository (expected in 2008), the local communities of Brežice, Krško and Sevnica are being paid compensation for the restricted use of space for the storage of LILRW in the area of the existing NEK of EUR 2.331 million[3] or SIT 558.97 million.

13.3 SELECTION, CONSTRUCTION AND OPERATION OF THE LILRW REPOSITORY

Sources of funding: Fund for the Financing of the Decommissioning of NEK and the Disposal of RW from NEK, state budget

Estimate of costs by year (source ARAO):

Since the type of repository has not been finally determined on the basis of the Programme for the Decommissioning of NEK and the Disposal of RW and SNF, the costs for the surface and underground repository variants are presented. In converting the costs, consideration has been given to the fact that work will be carried out up to the adoption of the location plan for the LILRW repository for three potential locations.

[3] The exchange rate of the Bank of Slovenia from September 2004 is used for the conversion of EUR to SIT: EUR 1 = SIT 239.8.

Table 11: Timetable for the financing of activities by year, in SIT and EUR millions, and the financial structure by source of funding (fixed prices December 2002, EUR 1 = SIT 230.3), surface LILRW repository.

	1998–2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Surface SIT millions	1 218.7	696.2	977.8	2 488.1	2 932.2	2 143.1	903.6	903.6	894.3	894.3	894.3
Surface EUR millions	5.29	2.883	4.246	10.804	12.732	9.306	3.923	3.923	3.883	3.883	3.883
Budget EUR millions	0.73	0.42	0.42	0.46	0.46	0.46	0.46	0.46	0.42	0.42	0.42
Fund EUR millions	4.55	2.59	3.83	10.34	12.27	8.84	3.46	3.46	3.46	3.46	3.46

Table 12: Timetable for the financing of activities by year, in SIT and EUR millions, and the financial structure by source of funding (fixed prices December 2002, EUR 1 = SIT 230.3), underground LILRW repository.

	1998–2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Underground SIT millions	1 218.7	688	942.9	5 731.2	6 051.8	4 735	903.6	903.6	894.3	894.3	894.3
Underground EUR millions	5.29	2.987	4.094	24.886	26.278	20.560	3.923	3.923	3.883	3.883	3.883
Budget EUR millions	0.73	0.42	0.42	0.46	0.46	0.46	0.46	0.46	0.42	0.42	0.42
Fund EUR millions	4.55	2.56	3.67	24.43	25.81	20.1	3.46	3.46	3.46	3.46	3.46

Table 13: Estimate of the costs of individual activities for the acquisition of a location and the construction of a repository, in SIT and EUR millions (fixed prices, EUR 1 = SIT 230.3), underground and surface repository scenario

Activity/costs	Investment value in SIT millions	Investment value in EUR millions	Investment value in SIT millions	Investment value in EUR millions
	Surface repository	Surface repository	Underground repository	Underground storage facility
1. Acquisition of repository location	1 171	5.08	1 224.8	5.32
Valuation of area	151.4	0.66	151.4	0.66
Field research, characterisation and approval	1 019.7	4.43	1 073.4	4.66
– Field research programme (expert foundations)	*3.8*	*0.02*	*308*	*0.02*
– Confirmation of suitability of location (field research)	*204.7*	*0.89*	*231.9*	*1.01*
– Purchase of land	*140.4*	*0.61*	*70.2*	*0.3*
– Approval of repository and monitoring	*670.8*	*2.91*	*767.6*	*3.33*
2. Negotiations with local communities and provision of information	902.4	3.92	902.4	3.92
Introduction of a mediator	13.1	0.06	13.1	0.06
Operation of the mediator	53.0	0.23	53.0	0.23
Co-funding of local infrastructure in support of selection of location	836.3	3.63	836.3	3.63
3. Planning and acquisition of licences (three locations)	766.2	3.33	766.2	3.33

4. Construction of the repository and infrastructure	6 486.2	28.16	15 343.9	66.63
Earth and construction works	4 530	19.67	14 004.7	60.81
Costs of investment in electrical and machine installations	1 686	7.32	1 069	4.64
Construction of infrastructure to the repository	270.2	1.17	270.2	1.17
5. Disposal technology and safety assessments	401.4	1.74	401.4	1.74
Criteria for receipt of waste at the repository	60.7	0.26	60.7	0.26
PA/SA for generic location	135.4	0.59	135.4	0.59
PA/SA for known locations	109.1	0.47	109.1	0.47
Technology of preparation and treatment of LILRW	96.3	0.42	96.3	0.42
6. Compensation (three locations)	811.8	3.53	811.8	3.53
Total costs	10 539	45.76	19 450.5	84.46

Table 14: Operating costs of the LILRW repository per year of operation

Breakdown	Costs EUR millions/year
Fixed	1.086
Variable	0.326
Compensation	2.331
Start-up (trial operation)	0.14–0.18
Total	EUR 3.883–3.923 million

13.4 CLOSURE OF RŽV, LONG-TERM SUPERVISION AND MAINTENANCE

Source of funding: Slovenian state budget

Estimate of costs by year in EUR millions (EUR 1 = SIT 239.8; source Javno podjetje za zapiranje rudnika urana RŽV, d.o.o.):

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Costs in EUR millions	6.25	7.6	9.31	6.39	0.9	0.42	0.42	0.42	0.42	0.42

13.5 SNF MANAGEMENT

Sources of funding: Fund for the Financing of the Decommissioning of NEK and the Disposal of RW from NEK, state budget

Estimate of costs by year (source ARAO):

The Programme for the Decommissioning of NEK and the Disposal of RW and SNF has not yet finalised the solution to be adopted for the disposal of SNF and HLRW (own repository or repository in partnership, export), although the most likely scenario envisaged is temporary dry storage over a number of decades. An assessment of the costs is therefore based on an assessment of the start-up planning and development costs for Slovenia’s own dry storage facility and repository, and on assessments of the costs of forming international links (regional repository), participation in EU R&D projects, and the training of staff.

in SIT millions	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Own repository – budget	10	10	10	10	10	10	10	10	10	10
Own repository – Fund	20	20	20	20	20	30	30	30	30	50
Regional repository – budget	10	10	10	10	10	10	10	10	10	10
Regional repository – Fund	25	25	25	30	30	30	50	50	50	50

13.6 DECOMMISSIONING OF NUCLEAR FACILITIES

Revised Programme for the Decommissioning of NEK:

Sources of funding: Fund for the decommissioning of NEK

Estimate of costs by year (source ARAO):

in the period 2006–2009: total EUR 1 million for Slovenia and Croatia, from the NEK fund EUR 0.5 million

in the period 2010–2015: total EUR 1.3 million for Slovenia and Croatia, from the NEK fund EUR 0.65 million

Production of the programme for the decommissioning of TRIGA:

Sources of funding: Slovenian state budget

Estimated of costs by year (source IJS):

period to 2006: total SIT 20 million

13.7 NATIONAL PROGRAMME FOR RW AND SNF MANAGEMENT

Sources of funding: Slovenian state budget

Estimate of costs by year (source ARAO):

As part of ensuring the implementation of the National Programme for RW and SNF Management, we include, in addition to the direct costs of preparing operational programmes for implementation of the National Programme for RW and SNF Management and the updated versions of this programme, the infrastructural costs of the operation of the public service that ensures implementation of the national radioactive waste management programme.

in SIT millions	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Infrastructure strategy of National Programme	113	123	140	140	150	150	150	150	150	150

13.8 TOTAL ESTIMATE OF COSTS 2005–2014

All the envisaged costs of implementation of the operational programme for RW and SNF management are given in EUR millions. Conversions of the amount were performed in September 2004, with fixed prices being used. The budget sources of funding are also given if other sources of funding are also possible for the given area. The total amount, stated by year, only covers budget funds (the aggregated rows are coloured in yellow).

The total budget funds for the implementation of operational programmes for RW and SNF management are given in the last row of Table 15 by year in EUR millions. The highest use of funds is expected in 2006–2009. In the period following, the use of budget funds will be substantially lower, since the majority of the objectives financed from the budget have already been implemented. The main portion of the budget funds is being used for the closure of Žirovski Vrh Uranium Mine. The budget funds for the implementation of operational programmes in 2006–2015 total EUR 51.93 million.

Table 15: Anticipated costs of implementation of the operational programme for RW and SNF management in EUR millions (only budget funds included), EUR 1 = SIT 239.8.

EUR millions	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Public utility service of RW MP	0.63	0.63	1.00	1.21	0.79	0.79	0.79	0.79	0.79	0.79
LILRW repository	0.42	0.42	0.46	0.46	0.46	0.46	0.46	0.42	0.42	0.42
RŽV	6.25	7.6	9.31	6.39	0.9	0.42	0.42	0.42	0.42	0.42
SNF management – own repository	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
SNF management – regional repository	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Decommissioning of TRIGA	0.04									
Infrastructure strategy of National Programme	0.47	0.51	0.58	0.58	0.63	0.63	0.63	0.63	0.63	0.63
Budget total	7.89	9.24	11.43	8.73	2.86	2.38	2.38	2.34	2.34	2.34

14. BIBLIOGRAPHY AND SOURCES

14.1 STRATEGIC DOCUMENTS

1. Economic Development Strategy of Slovenia, 1995

2. Strategy for the Management of Spent Nuclear Fuel, MGD, 1996

3. Plan for the Decommissioning of Krško Nuclear Power Plant, MGD, 1996

4. Strategic Waste Management Policies of the Republic of Slovenia, MOP, 1996

5. National Environmental Action Programme, MOP, URSVN, 1999

6. Strategy of the Republic of Slovenia for Integration into the European Union (Economic and Social Chapter), Poročevalec DZ, 11/99

7. Environmental Accession Strategy of Slovenia for Integration into the European Union, Poročevalec DZ, 11/99

8. Resolution on the National Environmental Action Programme, adopted by the Slovenian government, October 2004

9. Spatial Development Strategy of Slovenia, MOPE, 2004

10. Resolution on the National Energy Programme, MOPE, 2004

11. Programme for the Decommissioning of NEK and the Disposal of LILRW and SNF, ARAO and APO, 2004

14.2 LEGAL SOURCES

European Community legislation:

– Treaty establishing the European Atomic Energy Community (EURATOM), MAE 764 e/57

– COUNCIL DIRECTIVE 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment

– COUNCIL DIRECTIVE 89/618/EURATOM of 27 November 1989 on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency

– COUNCIL DIRECTIVE 90/641/EURATOM of 4 December 1990 on the operational protection of outside workers exposed to the risk of ionising radiation during their activities in controlled areas

– COUNCIL DIRECTIVE 92/3/EURATOM of 3 February 1992 on the supervision and control of shipments of radioactive waste between Member States and into and out of the Community

– COUNCIL DIRECTIVE 96/29/EURATOM of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation

– COUNCIL DIRECTIVE 97/11/ES of 14 March 1997 amending Directive 85/337/EEC

– COUNCIL DIRECTIVE 97/43/EURATOM of 30 June 1997 on health protection of individuals against the dangers of ionising radiation in relation to medical exposure, and repealing Directive 84/466/Euratom

– COUNCIL DIRECTIVE 2003/122/EURATOM of 22 December 2003 on the control of high-activity sealed radioactive sources and orphan sources

– Draft Proposal for a Council Directive (Euratom) setting out basic obligations and general principles on the safety of nuclear installations/* COM/2003/0032 final – CNS 2003/0021

– Draft proposal for a Council Directive (Euratom) on the management of spent nuclear fuel and radioactive waste (COM/2003/0022) (CNS)

Conventions and international treaties

– Decree ratifying the Statute of the International Atomic Energy Agency (including amendments to Articles VI and XIV) (Ur. list FLRJ – MP, 1/58)

– Decree ratifying the Agreement on the Privileges and Immunities of the International Atomic Energy Agency (Ur. list FLRJ – MP, 11/97)

– Vienna Convention on Civil Liability for Nuclear Damage (Ur. list RS – MP, 9/92)

– Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention (Ur. list RS – MP, 22/94)

– Convention on Physical Protection of Nuclear Material (Ur. list SFRJ – MP, 9/92)

– Decree ratifying the Convention on Early Notification of a Nuclear Accident (Ur. list RS – MP, 9/92)

– Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Ur. list RS – MP, 9/92)

– Convention on Nuclear Safety (Ur. list RS – MP, 16/96)

– Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water (Ur. list RS – MP, 9/92)

– Treaty on the Non-Proliferation of Nuclear Weapons (Ur. list RS – MP, 9/92)

– Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Sea Bed and the Ocean Floor and in the Subsoil Thereof (Ur. list RS – MP, 9/92)

– IAEA Incident Reporting System, ratified by the former Yugoslavia in 1987 (Ur. list RS – MP, 9/92)

– European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) (Ur. list RS – MP, 9/92, 9/03, 66/03)

– Convention concerning International Carriage by Rail (COTIF) and the Protocol amending the Convention concerning International Carriage by Rail (Ur. list RS, 5/04)

– Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Ur. list RS – MP, 3/99)

– Comprehensive Nuclear-Test-Ban Treaty (Ur. list RS – MP, 20/99)

– Agreement between the Republic of Slovenia and the International Atomic Energy Agency on Protection in relation to the Treaty on the Non-Proliferation of Nuclear Weapons (Ur. list RS – MP, 11/97)

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– Administrative Agreement between the Slovenian Nuclear Safety Administration and the Canadian Nuclear Safety Commission (Ur. list RS – MP, 5/96)

– Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Hungary on the Early Exchange of Information in the Event of Radiological Danger (Ur. list RS – MP, 2/96)

– Agreement between the Republic of Slovenia and the Republic of Austria on the Early Exchange of Information in the Event of Radiological Danger and on Issues of Joint Interest in the Area of Nuclear Safety and Radiation Protection (Ur. list RS – MP, 15/96)

– Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on the Early Exchange of Information in the Event of Radiological Danger (Ur. list RS – MP, 6/94)

– Agreement between the Government of the Republic of Slovenia and the Government of the Slovak Republic on the Early Exchange of Information in the Area of Nuclear Safety (Ur. list RS – MP, 49/00)

– Agreement between the Slovenian Nuclear Safety Administration and the Council for Nuclear Safety of South Africa on the Exchange of Technical Information and Cooperation in the Area of Nuclear Safety (Ur. list RS – MP, 18/00)

– Agreement between the Slovenian Nuclear Safety Administration and the Ministry of Science and Technology of the Republic of Korea on the Exchange of Information and Cooperation in the Area of Nuclear Safety (Ur. list RS – MP, 18/00)

– Agreement between the Slovenian Nuclear Safety Administration and the Directorate for Nuclear Installation Safety of the French Republic on the Exchange of Information and Cooperation in the Area of Nuclear Safety (Ur. list RS – MP, 18/00)

– Agreement between the Slovenian Nuclear Safety Administration and the State Office for Nuclear Safety of the Czech Republic on the Exchange of Information (Ur. list RS – MP, 22/01)

– Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention) (Ur. list RS – MP, 62/04)

– Act Ratifying the Agreement between the Government of the Republic of Slovenia and the Government of the Republic of Croatia on Regulation of the Status and Other Legal Relations Regarding Investment in and the Exploitation and Decommissioning of Krško Nuclear Plant (Ur. list RS, 5/03)

Nuclear and radiation safety, physical protection, security and quality assurance in Slovenian legislation

– Ionising Radiation Protection and Nuclear Safety Act (ZVISJV) (Ur. list RS, 67/02, 24/03, 50/03, 46/04, 102/04 as ZVISJV-UPB2)

– Rules on the Conditions for the Location, Construction, Trial Operation, Start-Up and Use of Nuclear facilities (with an Annex on quality assurance) (Ur. list SFRJ, 52/88 – Rules E-1)

– Rules on the Production and Content of Safety Reports and Other Documentation Required to Ensure the Safety of Nuclear Facilities (Ur. list SFRJ, 68/88 – Rules E-2)

– Rules on the Professional Education, Work Experience, Tests of Knowledge and Certificate of Compliance with the Conditions for Persons Performing Certain Work in Nuclear Facilities (Ur. list SFRJ, 86/87 – Rules E-3)

– Rules on Material Balance Areas, on the Method of Keeping Records on Nuclear Materials and on the Sending of Information from these Records (Ur. list SFRJ, 9/88 – Rules E-4)

– Rules on the Locations and Time Intervals for the Systematic Investigation of Radionuclides in the Living Environment, and on Early Detection and Notification of Radioactive Contamination of the Living Environment (Ur. list SFRJ, 40/86 – Rules Z-1)

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– Rules on the Method of Collecting, Recording, Treating, Storing, Finally Disposing of and Discharging Radioactive Substances into the Human Environment (Ur. list SFRJ, 40/86)

– Rules on the Placing into Circulation and Use of Radioactive Substances whose Activity Exceeds the Determined Threshold and X-Ray and Other Devices that Produce Ionising Radiation, and on the Measures to Protect Against Radiation from these Sources (Ur. list SFRJ, 40/86, 45/89, 48/04 – Rules Z-4)

– Rules on the Highest Doses of Radioactive Contamination of the Human Environment and on Decontamination (Ur. list SFRJ, 8/87, 27/90, 49/04 – Rules Z-9)

– Rules on the Method of Keeping Records on Sources of Ionising Radiation and the Exposure to Radiation of the Population and of those Exposed to Ionising Radiation at Work (Ur. list SFRJ, 40/86, 33/04 – Rules Z-10)

– Rules on the Conditions Regarding the Sanitary Compliance of Feed Materials, Compound Feedingstuffs, Premixtures and Feed Additives (Ur. list RS, 18/04)

– Rules on the Method and the Periods for which Professional Organisations of Associated Labour Authorised to Work and Perform Tasks in the Field of Nuclear Safety and Organisations of Associated Labour that Manage Facilities and Installations are Obliged to Keep Records and Report to the National Energy Inspectorate, and on the Method of Mutual Provision of Information (Ur. list SRS, 12/81)

New implementing regulations:

Code no	Adopted legislation	Uradni list RS
UV1	Decree on Practices Involving Radiation	48/2004
UV2	Decree on Dose Limits, Radioactive Contamination and Intervention Levels	49/2004
UV3	Decree on Areas of Restricted Use of Space Resulting from a Nuclear Facility and the Conditions of Construction of Facilities in these Areas (Ur. list RS, 36/04, 103/06)	36/2004
UV8	Decree on the Criteria for Determining the Compensation for the Restricted Use of Space within the Area of a Nuclear Facility	134/2003
JV1	Rules on the Expert Council on Radiation and Nuclear Safety	35/2003
JV11	Rules on Inputs from and Outputs in EU Member States and on the Import and Export of Radioactive Waste	60/2004
SV1	Rules on the Operation of the Expert Council for the Ionising Radiation Protection, Radiological Activities and the Use of Radiation Sources in Human and Veterinary Medicine	60/2003
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Liability for nuclear damage:

– Nuclear Damage Liability Act (Ur. list RS, SFRJ, 22/78, 34/79)

– Insurance for Nuclear Damage Liability Act (Ur. list SRS, 12/80)

– Ordinance Setting the Limit on the Amount of the Liability for Damages for Nuclear Damage of a User of a Nuclear Facility and Setting the Amount of the Insurance for Liability for Nuclear Damage (Ur. list RS, 84/98).

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– Mining Act (Ur. list RS, 56/99, 46/04)

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– Ordinance on the Transformation of the Agencija za radioaktivne odpadke, p.o., Public Company into a Public Utility Institute (Ur. list RS, 45/96, 32/99, 38/01, 41/04)

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– Tariff of Radioactive Waste Management Services (Ur. list RS, 102/00)

Protection and rescue:

– Protection Against Natural and Other Disasters Act (Ur. list RS, 64/94, 41/04, 87/00, 52/02)

– Decree on the Drafting of Protection and Rescue Plans (Ur. list RS, 48/93, 2/02)

Management:

– Organisation and Areas of Work of Ministries Act (Ur. list RS, 71/94, 47/97, 30/01, 110/02, 60/99, 119/00, 52/02)

– State Administration Act (Ur. list RS, 52/02, 110/02, 56/03, 61/04)

– General Administrative Procedure Act (Ur. list RS, 80/99, 70/00, 73/04, 52/02);

– Administrative Dispute Act (Ur. list RS, 50/97, 70/00, 65/97)

– Posts for Which the Insurance Period with Increase Applies (Ur. list SFRJ, 17/68, 20/69, 29/71, RS/91)

– Local Self-Government Act (Ur. list RS, 72/93, 57/94, 14/95, 26/97, 70/97, 10/98, 74/98, 70/00, 108/03, 6/94, 45/94, 20/95, 63/95, 73/95, 9/96, 44/96, 68/98, 12/99, 16/99, 59/99, 100/00, 28/01, 51/01)

– Standardisation Act (Ur. list RS, 59/99)

Energy:

– Decree on the Transformation of Nuklearna elektrarna Krško, p.o., into the Nuklearna elektrarna Krško, d.o.o. Public Company (Ur. list RS, 54/98, 57/98, 10/03, 106/01, 59/02)

General:

– Environmental Protection Act (ZVO-1) (Ur. list RS, 41/04)

– Criminal Code of the Republic of Slovenia (Ur. list RS, 63/94, 70/94, 23/99, 110/02, 40/04)

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– Transport of Dangerous Goods Act (Ur. list RS, 79/99, 2/04)

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– Maritime Code (Ur. list RS, 26/01, 2/04)

– Rules on Waste Management (Ur. list RS, 84/98, 20/01, 45/00, 13/03, 41/04)

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15. ABBREVIATIONS USED

ARAO	Agency for Radioactive Waste
CSRAO	Central Radioactive Waste Storage Facility at Brinje
SNF	Spent nuclear fuel
IJS	Institut Jožef Stefan
NEK	Krško Nuclear Power Plant
NPVO	National Environmental Action Programme
NPRRAO	National Programme for Radioactive Waste and Spent Fuel Management
LILRW	Low- and intermediate-level radioactive waste
ILRW	Intermediate-level radioactive waste
LLRW	Low-level radioactive waste
RW	Radioactive waste
ReNEP	Resolution on the National Energy Programme
RŽV	Žirovski Vrh mine
URSJV	Slovenian Nuclear Safety Administration
URSVS	Slovenian Radiation Protection Administration
HLRW	High-level radioactive waste
ZVISJV	Ionising Radiation Protection and Nuclear Safety Act

No 801-10/89-1/74
Ljubljana, 1 February 2006
EPA 518-IV

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of the National Assembly
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