



REPUBLIC OF CROATIA

6th NATIONAL REPORT

ON IMPLEMENTATION OF THE OBLIGATIONS UNDER
THE JOINT CONVENTION ON THE SAFETY OF SPENT FUEL MANAGEMENT
AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

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EXECUTIVE SUMMARY

The 6th National Report of the Republic of Croatia in accordance with Article 32 of the Joint Convention on Safety of Spent Fuel Management and on Safety of Radioactive Waste Management contains updated information on matters covered in the fifth report, noting significant changes in applicable national laws, regulations, policies and practices. It also addresses safety issues which were identified in the previous report, as well as the issues raised during the latest review meeting. Major developments in Croatia in the period after issuing the previous national report were the following ones:

- Adoption of the Strategy on Radioactive Waste and Spent Fuel Management by Croatian Parliament
- Development of the National Programme under the Council Directive 2011/70/Euratom
- Remediation of the Radioactive Waste Storage Facility within the premises of the Institute Ruđer Bošković (IRB)
- Amendment of the Act on Radiological and Nuclear Safety that defined the Radioactive Waste Management Centre (RWMC) and appointed the Fund for the Financing of the Decommissioning and Disposal of Radioactive Waste and Spent Nuclear Fuel from the Krško Nuclear Power Plant as the operator of RWMC.

Croatian Overview Matrix of Spent Fuel and Radioactive Waste Management

	Long-term management policy	Funding of Liabilities	Current Practices / Facilities	Planned Facilities
Spent Fuel	Dry storage at Krško NPP site (joint programme with Slovenia) followed by disposal.	Krško NPP up to final shutdown. National Funds after shutdown.	Wet storage at Krško NPP site	Dry storage at Krško NPP site.
Nuclear Fuel Cycle Waste	Long-term storage (40 years) followed by near surface disposal.	Croatian Fund	Storage at Krško NPP site.	Long-term storage facility.
Non-Power Radioactive Waste	Long-term storage followed by disposal.	Users	Two temporary storage facilities (closed).	Central National Storage Facility
Decommissioning	Immediate dismantling of Krško NPP (joint programme with Slovenia). Deferred dismantling for other facilities.	National Funds, users and State for non-power waste facilities.	No facilities in decommissioning.	No planned facilities.
Disused Sealed Sources	Reuse, repatriation and long-term storage.	Users.	Reuse, repatriation and two temporary storage facilities (closed).	Central National Storage Facility

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A. INTRODUCTION

The Republic of Croatia continues its successful cooperation with the International Atomic Energy Agency (IAEA) and aims to apply widely recognized principles and tools for high-quality safety management of spent fuel and radioactive waste. Croatia signed the Joint Convention on Safety of Spent Fuel Management and on Safety of Radioactive Waste Management (further referred to as the Convention) on 9 April 1998 and ratified it on 5 February 1999. According to Article 32, each contracting party has to submit national report periodically to illustrate how the objectives of the Convention have been met. Croatian first national report was prepared at the beginning of 2003 and reviewed at the meeting organized later that year. Croatia participated in every following meeting of Contracting Parties and submitted for every meeting a National Report.

This National Report contains updated information on matters covered in the fifth report, noting significant changes in applicable national laws, regulations, policies and practices. It also addresses safety issues which were identified in the previous report, as well as the issues raised during the latest review meeting. As for the form, structure and contents, the report aims to follow the most recent version of the Guidelines Regarding the Form and Structure of National Reports issued in 2014 (INFCIRC/604/Rev.3).

Major developments in Croatia in the period after previous national report were the following ones:

- Adoption of the Strategy for the Management of Radioactive Waste, Disused Sources and Spent Nuclear Fuel by Croatian Parliament
- Development of the National Programme for the Implementation of the Strategy for the Management of Radioactive Waste, Disused Sources and Spent Nuclear Fuel under the Council Directive 2011/70/Euratom
- Remediation of the Radioactive Waste Storage Facility within the premises of the Institute Ruđer Bošković (IRB)
- Amendment of the Act on Radiological and Nuclear Safety that defined the Radioactive Waste Management Centre (RWMC) and appointed the Fund for the Financing of the Decommissioning and Disposal of Radioactive Waste and Spent Nuclear Fuel from the Krško Nuclear Power Plant (further referred to as the Fund) as the operator of RWMC
- Changes within the legislative and regulatory system.

Strategy on Radioactive Waste and Spent Fuel Management (further referred to as the Strategy) was adopted by Croatian Parliament on 17 October 2014 and issued in Official Gazette No. 125 of 27 October 2014. The Strategy is based on requirements given under the Articles 54, 55, 56 and 95 of the Act on Radiological and Nuclear Safety, Official Gazette No.

141 of 27 November 2013 and amendment Official Gazette No. 39 from 8 April 2015 (further referred to as the Act). Also, the Strategy is developed in accordance with requirements given in the Articles 10 and 11 of the Bilateral Agreement between the Government of the Republic of Croatia and the Government of the Republic of Slovenia on the settlement of status and other legal relations with respect to investments, utilization of and decommissioning of the Krško NPP (further referred to as the Bilateral Agreement), Official Gazette No. 9 of 23 July 2002 as well as in the Article 4 of the Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste (further referred to as the Directive 2011/70/Euratom), Official Journal L 199 of 2 August 2011.

After the adoption of the Strategy the National Programme for the Implementation of the Strategy (hereinafter referred to as the National Programme) was developed in accordance with the requirements given under the Articles 57, 58, 59 and 95 of the Act, with requirements given in the Articles 10 and 11 of the Bilateral Agreement and in accordance with Articles 5, 11, 12 of the Directive 2011/70/Euratom. The National Programme is currently waiting for the adoption by the Croatian Government.

In the period covered by this national report, regarding the legislative system, the Act on Radiological and Nuclear Safety was amended in 2015. The amendment includes definition of the Radioactive Waste Management Centre which will be operated by the Fund. Currently, the new amendment of the Act is in the process of enactment. The amendment currently in the procedure transposes the goals set forth in the Council Directive 2014/87/Euratom of 8 July 2014 and Council Directive 2013/59/Euratom of 5 December 2013. In addition seven new ordinances regarding nuclear safety were issued. These ordinances are focused on safety of nuclear installations and they prescribe: validation of location for nuclear installations, approval of commissioning, operation and decommissioning, approval of nuclear activities, safety analysis report, Quality Assurance Programme and certification of expert organizations in the field of nuclear safety.

In July 2015 remediation of the Radioactive Waste Storage Facility within the premises of the Institute Ruđer Bošković was performed. The remediation included partial waste segregation, characterization, conditioning and packing into lead containers and it was carried out by local TSO (EKOTEH Dosimetry Radiation protection Co.) with the assistance of Sandia National Laboratories, USA.

B. POLICIES AND PRACTICES

Croatian Parliament has adopted the Strategy which defines basic guidelines and goals for the management of institutional radioactive waste produced in the Republic of Croatia, radioactive waste and spent nuclear fuel from Krško NPP as well as for the remediation of locations with naturally occurring radioactive material (NORM). Pursuant to the Act and Directive 2011/70/Euratom, after the adoption of the Strategy the National Programme was developed and is currently waiting for adoption by the Government.

The Strategy defines short-term (2 years), mid-term (10 years) and long-term goals (more than 10 years) related to the management of radioactive waste, disused sources, spent nuclear fuel and remediation of NORM locations in Croatia. The goals set out in the Strategy include establishment of a long-term storage and then repository for institutional radioactive waste, spent sources and low and intermediate level radioactive waste from Krško NPP; establishment of a dry storage for spent nuclear fuel at Krško NPP location, and then disposal of high level waste (HLW) in deep geological formation at a location in the Republic of Croatia or the Republic of Slovenia (or in an eventual international repository in the EU); and a programme for informing and educating public on the management of radioactive waste, spent sources and spent nuclear fuel. These goals are broadly defined and elaborated for the each particular field of application. In order to fulfil the goals mentioned above the Strategy sets up general guidelines regarding the legislative framework, responsibilities, funding, human resources and public participation.

The National Programme sets out how the following Strategy goals will be implemented in the period up to year 2025:

- Establishment of the Central National Storage Facility (CNSF) for institutional radioactive waste and disused sources
- Construction and commissioning of storage facility for low and intermediate level waste (LILW) from Krško NPP and
- Remediation of sites with NORM¹.

Spent nuclear fuel from Krško NPP will continue to be stored at the location of the power plant, at least until year 2043, when common permanent solution will be sought with the Republic of Slovenia. As the long term storage for LILW is foreseen, the establishment of repository for LILW is not required before year 2058. Therefore, activities regarding the site selection, site characterization and confirmation are not planned to start in next 10 years, which is the period planned with the National Programme.

¹ As the Republic of Croatia has not declared any waste that contains only naturally occurring radioactive material as radioactive waste for the purposes of the Convention in further text the plans for remediation of NORM sites will not be discussed.

The National Programme underlines obligations that have been taken by the Republic of Croatia in the field of radioactive waste and spent fuel management prescribed under the respective conventions, bilateral agreements, directives, and laws.

In contrast to the spent fuel management that has not been practiced so far in Croatia, the management of radioactive waste has been practicing over the last 60 years. The experience gained include collection, segregation, treatment, conditioning, packing and storing of radioactive waste and disused sources generated in medicine, industry, science, education and the past public use (lightning rods and smoke detectors). There are two National Research Institutes and one technical support organisation that have been certified by State Office for Radiological and Nuclear Safety (SORNS) for providing services in the field of radioactive waste management in Croatia. These are Institute for Medical Research and Occupational Health (IMROH), Institute Ruđer Bošković (IRB) and EKOTEH private company.

B.1 Spent Fuel Management Policy and Practice

The Republic of Croatia shares ownership of the Krško NPP with the Republic of Slovenia. Therefore Croatia owns half of spent fuel that was generated so far and that will be generated up to expiration of the Krško NPP lifetime. The Bilateral Agreement (Articles 10 and 11) favours development of a common solution for spent fuel management. In accordance with aforementioned, the Republic of Croatia and the Republic of Slovenia are planning long-term dry storage of SF at Krško NPP location and then its disposal in deep geological formation at a suitable location in the Republic of Croatia or the Republic of Slovenia. The construction of Spent Fuel Dry Storage (SFDS) at NPP Krško location will start in year 2018 and SF will be transferred from SF pool to SFDS in year 2019. The costs of construction, operation and transfer of SF from the pool to the dry storage, as well as maintenance of SFDS facility will be financed in accordance with Bilateral Agreement (Article 11).

Approximately in year 2050, the site selection process for the disposal of SF and HLW, which will arise from Krško NPP decommissioning, in deep geological formation will begin. Location selection will be carried out in the Republic of Croatia or the Republic of Slovenia. Also, Croatia will actively participate in projects related to the international repository.

Meanwhile, the spent fuel generated in the Krško NPP has been managed safely on-site by the operator and it will remain there at least up to expiration of the plant lifetime. Therefore the spent fuel management has not been practiced in Croatia so far.

B.2 Radioactive Waste Management Policy and Practice

In Croatia, the radioactive waste and disused sources originate from medicine, industry, science, education and the past public use, and part of the waste pertains to legacy waste.

Regarding the radioactive waste generated in Krško NPP the Bilateral Agreement (Articles 10 and 11) favours development of a common solution for disposal of radioactive waste from Krško NPP. As the Republic of Croatia and the Republic of Slovenia have not achieved a mutually satisfactory common solution until the moment of the establishment of this National Programme, the Republic of Croatia, in line with the objectives of the Strategy, plans with National Programme a series of activities to establish the storage facility for low and intermediate level waste (LILW) from Krško NPP.

For management of the radioactive waste and disused sources originate from medicine, industry, science, education and the past public use the National Programme plans the establishment of the Central National Storage Facility. The preferred location for the CNFS is the location of Čerkezovac, the military logistic complex without perspective for future use by military. The location Čerkezovac is located in Dvor Municipality on the southern slopes of the massif Trgovska gora². According to the National Programme the start of operation of the CNFS is planned for year 2020.

In addition to the radioactive waste produced in the country, the Republic of Croatia has the obligation to take over half of the radioactive waste from Krško NPP. The location Čerkezovac was recognized also as a preferred location for the long-term storage facility for LILW from Krško NPP. In that way on the location The Radioactive Waste Management Centre (RWMC) would be established which would encompass all facilities necessary for management of radioactive waste in Croatia and also a centre for informing and educating public. The operator of the RWMC will be the Fund for the Financing of the Decommissioning and Disposal of Radioactive Waste and Spent Nuclear Fuel from the Krško Nuclear Power Plant. The process of confirmation of location will include participation of public in decision-making, planning in spatial plans, the environmental impact assessment process including the assessment of transboundary impact.

According to the Bilateral Agreement if there is no agreement on a joint solution by the end of regular designed lifetime of the Krško NPP (year 2023.) the parties have to take over the radioactive waste in two years from that time in equal proportions. In accordance, the long-term storage facility for LILW from Krško NPP has to be operational at the beginning of 2023. The National Programme, in accordance with the objectives of the Strategy, sets out a series of activities in terms of strengthening regulatory framework and necessary infrastructure for the timely and harmonized operation of the competent authorities in order to

² In Croatian National Spatial Plan Trgovska gora is designated as potential location for LILW repository as a result of site-selection process which included the whole territory of the Republic of Croatia.

fulfil its obligation under the Bilateral Agreement and to take over and safely manage half of LILW from Krško NPP.

The planned duration of long-term storage is 40 years. The site investigation process for the disposal facility will start after 2025 and the operation of the repository is not needed before year 2058.

Regarding the financing of the radioactive waste management: financing of management of newly generated radioactive waste and disused sources will be ensured by applying the polluter pay principle and financing of radioactive waste management from Krško NPP will be provided in accordance with the Bilateral Agreement (Article 11). For the financing of legacy waste management the Government has the subsidiary responsibility.

Radioactive waste generated in Krško NPP that belongs to the Republic of Croatia has been managed safely on-site by the operator and it will remain there at least up to expiration of the Krško regular lifetime. Therefore management of this radioactive waste has not been practiced so far in the Republic of Croatia.

Radioactive waste and disused sources from medicine, industry, science, education and the past public use are stored in two storage facilities. These are IMROH and IRB storage facilities and both of them are closed, so the project on development, construction and operation of the Central National Storage Facility is a priority. Basic design of the facility has been developed and preliminary safety assessment was performed.

B.3 Radioactive Waste Categorization

Radioactive waste categorization is covered under the Articles 13 and 14 of the Regulation on conditions and method of disposal of radioactive waste, spent sealed radioactive sources and ionising radiation sources which are not intended for further use, Official Gazette No. 44 of 16 April 2008. Given the physical and chemical properties, the radioactive waste is categorized into solid, liquid and gaseous. Given the toxicity the radioactive waste is divided into toxic and non-toxic categories. Further categorization of solid radioactive waste due the activity concentration or total activity and half-life of the contained radionuclides is described in Table B-1.

Table B-1: Radioactive waste categorization

Radioactive Waste Category	Typical Property
Exempt and cleared radioactive waste	Activity concentrations or total radioactive waste activity at or below prescribed exemption or clearance levels.
Low level short lived radioactive waste	Radioactive waste containing radionuclides with half-life less than 100 days which will decay below clearance levels within 3 years.
Low and intermediate level radioactive waste	Radioactive waste containing radionuclides with half-life less than 30 years and activity concentration or total activity which will remain above prescribed exemption or clearance levels 3 years after their creation, and having a heat generation rate below 2 kW/m ³ .
Short lived waste	Low and Intermediate level radioactive waste containing radionuclides with half-life less than 30 years (limitation of long lived alpha emitting radionuclides to 4,000 Bq/g in individual waste packages and to an overall average of 400 Bq/g in the total waste volume).
Long lived waste	Low and Intermediate level radioactive waste activity concentrations exceeding the limits for short lived waste.
High level radioactive waste	Radioactive waste thermal power above 2 kW/m ³ and activity concentrations exceeding limits for short lived waste.

Radioactive waste categorization described above is based on the recommendations given in Classification of Radioactive Waste, IAEA Safety Guide No. 111-G-1.1, 1994 and Commission Recommendation of 15 September 1999 on a classification system for solid radioactive waste, Official Journal L 265/37 of 13 October 1999. It should be noted that the abovementioned Regulation will be substituted with new Ordinance on Management of Radioactive Waste and disused sources which is currently in the process of adoption. The new Ordinance proscribes a new radioactive waste categorization which is in accordance with Classification of Radioactive Waste, IAEA General Safety Guide No. GSG-1, 2009.

C. SCOPE OF APPLICATION

Regarding the obligations under Article 3 of the Convention:

- (a) Republic of Croatia has not declared reprocessing to be a part of spent fuel management
- (b) Republic of Croatia has not declared any waste that contains only naturally occurring radioactive material and does not originate from the nuclear fuel cycle as radioactive waste for the purposes of the Convention and
- (c) Republic of Croatia has not declared any spent fuel or radioactive waste within military or defence programmes as spent fuel or radioactive waste for the purposes of the Convention.

D. INVENTORIES AND LISTS

In Croatia there are no spent fuel management facilities. Furthermore, there are no nuclear facilities in operation or in the process of decommissioning. The only two facilities for which Article 32 (paragraph 2) is applicable are:

- Radioactive waste storage facility at the Institute for Medical Research and Occupation Health (IMROH) and
- Radioactive waste storage facility within the premises of the Institute Ruder Bošković (IRB).

Both storage facilities are located in Zagreb (the capital) and contain the waste from medicine, industry, science, education and the past public use. The storage at the IMROH was operational in the period from 1959 till 2000. In June 2006 partial waste segregation, characterization, conditioning and packing into lead containers has been carried out with the assistance of the IAEA. The activities were performed under the supervision of former State Office for Radiation Protection. At that occasion more than 900 sources were recovered and characterised along with approximately 0.5 m³ of contaminated materials. The sources containing the radionuclide Ra-226 were transferred to the storage facility at the IRB. Remaining waste packages are still kept at the IMROH storage facility pending the transfer to the future CNSF. Further segregation and volume reduction of this waste is planned before the transfer. The storage at the IMROH contains some 0.5 m³ of short lived waste having the total activity of 6x10¹¹ Bq and approximately 1 m³ of long lived waste with the activity of 9x10¹¹ Bq. The total volume of the waste is estimated to 1.5 m³, while the total activity amounts to 1.5x10¹² Bq (Table D-1). More details about the inventory can be found in Annex L.1.

Radioactive waste storage facility at the IRB was formed in 1967 to allow for safe storage of the waste produced within this scientific institution. In 1987 the facility was enlarged so that the waste produced elsewhere can be accepted as well. Until 2013 this facility was authorized for the collection, processing and storage of all types of solid and liquid radioactive waste generated in Croatia. In 2009 the Governmental Decision was issued according to which the storage at the IRB was supposed to be upgraded to become central national storage for the radioactive waste. However, Decision has never been implemented due to the technical issues raised by the IRB and because of the public concern. In September 2013 the facility was put out of operation by the inspectors of the SORNS, as the storage conditions were not in line with the regulatory requirements. The project on remediation of the facility, meaning segregation, characterization, treatment, conditioning and packing into lead containers was carried out in July 2015 by local TSO (EKOTEH Dosimetry Radiation protection Co.) with the assistance of Sandia National Laboratories, USA.

The volume of short lived waste amounts to approximately 7,5 m³, while the volume of long lived waste is estimated to 3,8 m³ (Table D-1). More details about the inventory can be found in Annex L.1.

From the data provided in Table D-1 it is evident that presently there is no more than some 11,4 m³ of radioactive waste stored in Croatia. The total activity of the waste is estimated to 3.3x10¹² Bq, where the activity of the short lived waste amounts to 1.3x10¹² Bq, while the activity of long lived waste is approximately 2.1x10¹² Bq.

Table D-1: Estimation of the radioactive waste volume and characteristics

Radioactive waste type	IMROH storage		IRB storage		Total	
	Volume (m ³)	Activity (Bq)	Volume (m ³)	Activity (Bq)	Volume (m ³)	Activity (Bq)
Short lived	0.5	6.0×10 ¹¹	7,03	6,84E+11	7,53	1,28E+12
Long lived	1.0	9.1×10 ¹¹	2,81	1,14E+12	3,81	2,05E+12
Total	1.5	1.5×10¹²	9,84	1,82E+12	11,34	3,33E+12

The State Office for Radiological and Nuclear Safety operates a database where changes in the inventories of both radioactive waste storage facilities are tracked. The operators (i.e. the IMROH and the IRB) are obliged to report about every change and also to submit a complete inventory list to the SORNS on a yearly basis.

E. LEGISLATIVE AND REGULATORY SYSTEM

E.1 Legislative Framework

Following chapters summarize the basic legislative act, the new by-laws and other legislative and regulatory acts from the field of radioactive waste and spent fuel management.

E.1.1 Basic Legislative Act

In Croatia the issues related to the safety of spent fuel and radioactive waste management are almost entirely covered by the Act. The Act establishes measures for radiological safety, measures for physical protection and measures for non-proliferation of nuclear weapons in performing nuclear operations and operations involving sources of ionizing radiation. The goal is to ensure adequate protection of individuals, society and the environment against harmful effects of ionizing radiation, as well as to ensure safe performance of operations involving ionizing radiation sources, nuclear operations, radioactive waste management and physical protection of ionizing radiation sources and nuclear installations.

The Act provides solid basis for regulation, administrative processes and inspection and covers wide scope of activities. The provisions of the Act are harmonized with the following EU directives and regulations:

- Council Regulation (Euratom) No 1493/93 on shipments of radioactive substances between Member States,
- Commission Regulation (Euratom) No 302/2005 on the application of Euratom safeguards,
- Commission Regulation (Euratom) No 66/2006 exempting the transfer of small quantities of ores, source materials and special fissile materials from the rules of the chapter on supplies,
- Council Directive No 2006/117/Euratom on the supervision and control of shipments of radioactive waste and spent fuel,
- Council Directive No 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations
- Council Directive No 2011/70/Euratom establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste
- and partially Council Directive 2013/59/Euratom of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to

ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom³.

The Act is structured in 15 chapters (more information on the structure and contents is provided in Section L.2). Of highest importance for this National Report is Chapter 5, i.e. Articles 49 to 59. This Chapter regulates the management of radioactive waste, disused sources and spent fuel. According to Article 49, radioactive waste and spent nuclear fuel generated in Croatia has to be disposed, in general, on Croatian territory (two exemptions related to specific situations are envisaged). The costs of the waste management have to be covered by the producers. The obligation of the producers is to make sure that the radioactive waste, disused sources and spent fuel is managed in the prescribed manner and that the transfer of the burden of waste disposal to the future generations is avoided to the greatest possible extent. The producers also have to ensure that the quantities of the radioactive waste, disused sources and spent fuel are minimized.

The Act was amended in 2015 and the major changes were:

- definition of the Radioactive Waste Management Centre (RWMC)
- appointment of the Fund as the operator of RWMC and
- financing of the RWMC.

Article 4 defines the Radioactive Waste Management Centre as the organizational unit of the Fund which includes facilities for processing, conditioning, manipulation, long-term storage and disposal of radioactive waste and used sources originating from the territory of the Republic of Croatia, including the CNSF, as well as radioactive waste and spent nuclear fuel not produced on the territory of the Republic of Croatia according to the obligations from the Bilateral Treaty.

Article 51 prescribes that the Radioactive Waste Management Centre will be established and managed by the Fund and that the Fund is responsible for its work to the Government of the Republic of Croatia.

Article 52 prescribes that the financing of the RWMC will be ensured by applying the polluter pay principle and from the dedicated fund established by the established by the Act on the Fund for Financing the Decommissioning of the Krško Nuclear Power Plant and the Disposal of Krško NPP Radioactive Waste and Spent Nuclear Fuel (Official Gazette 107/07). The Government will prescribe by the decree the mode of financing of RWMC, the fees for management of radioactive waste and used sources, and the compensation to local and regional community in whose territory the Radioactive Waste Management Centre will be located.

³ The new amendment, currently in the enactment process, will harmonize the Act with all the provisions of the Council Directive 2013/59/Euratom.

E.1.2 The New By-Laws

The new by-laws which were issued in the period after the last National Report and which are related to the safety of spent fuel management and radioactive waste management are as follows:

- 1) Ordinance on the Content of a request for Approval for the Start or End of Operation or Decommissioning of a Nuclear Installation (Official Gazette 47/17)
- 2) Ordinance on the Validation of a Location for a Nuclear Installation (Official Gazette 38/17)
- 3) Ordinance on the Required Documents and their Content for Approval of Nuclear Activities (Official Gazette 29/17)
- 4) Ordinance on Content of the Request for Approval for the Commissioning of Nuclear Installation (Official Gazette 29/17)
- 5) Ordinance on the Safety Analysis Report for Nuclear Installations (Official Gazette 29/17)
- 6) Ordinance on Certified Expert Organizations in the Field of Nuclear Safety (Official Gazette 29/17)
- 7) Ordinance on Establishing Quality Assurance Programme for Management of Nuclear Facilities (Official Gazette 29/17)
- 8) Ordinance on Nuclear Safety Requirements for Nuclear Installation Construction (Official Gazette 36/16, 79/16)

The by-laws which were described in the previous National Report are listed in the Annex L.3.

The **Ordinance on the Content of a request for Approval for the Start or End of Operation or Decommissioning of a Nuclear Installation** prescribes the content of a request for approval required for obtaining consent for the start of operation or termination of operation of a nuclear installation, as well as the required content of a request for approval for the commencement or termination of nuclear installation decommissioning. In addition to the list of documents that these requirements must include for the purpose of proving compliance with the prescribed conditions, the Ordinance also provides general conditions for nuclear life-cycle phases.

The **Ordinance on the Validation of a Location for a Nuclear Installation** lays down the legislative framework for the criteria for assessment of the location for a nuclear facility, in order to fully establish the specific conditions of a location important for the safety of a nuclear facility.

The **Ordinance on the Required Documents and their Content for Approval of Nuclear Activities** prescribes required documents and their content which, in the process of issuing an approval for nuclear activities, prove that the conditions prescribed by the Radiological and Nuclear Safety Act are met. Scope and level of detail are proportional to the potential weight and nature of the hazard of the nuclear activity.

The **Ordinance on Content of the Request for Approval for the Commissioning of Nuclear Installation** prescribes the content of the request for approval for the commissioning of a nuclear installation and the list of documents that the request for approval must contain in order to prove the fulfilment of the prescribed conditions. The Ordinance prescribes: the general conditions for the pre-operational tests, content of the request for approval, content of the test programme, and the way of presenting the results of tests in the updated safety analysis report.

The **Ordinance on the Safety Analysis Report for Nuclear Installations** prescribes the content of project documentation and the structure and contents of the Safety Analysis Report for nuclear power plants. This Ordinance serves as a guideline for the development of the structure and contents of the safety analysis report for nuclear fuel manufacturing plant, research reactor, enrichment plant or spent fuel reprocessing plant. The content and detail level correspond to the level of complexity of the operation and the level of hazard in the relevant nuclear facility.

The **Ordinance on Certified Expert Organizations in the Field of Nuclear Safety** prescribes the conditions that must be met by certified expert organisations, the procedure for obtaining authorization, the method and scope of regular and emergency reporting and other related issues.

The **Ordinance on Establishing Quality Assurance Programme for Management of Nuclear Facilities** establishes the requirements related to the content, method, scope and deadlines of the quality assurance programme and the establishment of effective management system, management of safety and safety culture. This Ordinance applies to the establishment, implementation, evaluation and permanent improvement of the management system for: nuclear facilities, activities with sources of ionizing radiation, radioactive waste management, transport of radioactive material, radiation protection activities, all other activities or circumstances in which people may be exposed to radiation from natural and artificial sources and regulation of such nuclear facilities and activities.

The **Ordinance on Nuclear Safety Requirements for Nuclear Installation Construction** was amended to comply with the Council Directive 2014/87/Euratom of 8 July 2014 amending Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations.

It should be emphasized that the Regulation on Conditions and Method of Disposal of Radioactive Waste, Spent Sealed Radioactive Sources and Ionising Radiation Sources Which are not Intended for Further Use (Official Gazette 44/08) is the most important by-law in the area of interest and is currently being revised. The issuance of the new Regulation is expected till the end of 2017.

E.1.3 Other legislative and regulatory acts

In addition to the basic law and the most important by-laws outlined above, a number of other legal acts have some bearing in the area of the safety of radioactive waste and spent fuel management. Such legal acts are listed in Section L.3. The list includes acts, regulations, ordinances, strategies, plans, multilateral agreements and bilateral agreements.

It is believed that the Act on Radiological and Nuclear Safety together with its by-laws, the Strategy, the National Programme (to be adopted) and other legislative and regulatory acts form the framework which is capable of fulfilling all the requirements set within the Article 19 of the Convention.

E.2 Regulatory Body

The regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 19 of the Convention is the SORNS. According to the Act on Radiological and Nuclear Safety (Article 7) the SORNS, as the state administration body, is the competent authority for all activities pertaining to radiological and nuclear safety. The Act prescribes the duties and responsibilities of the SONRS. The regulatory body performs its functions in a manner that does not comprise its effective independence. According to the Act on Organization and Scope of Ministries and Other Central State Administration Bodies, supervision over the work of the State Office for Radiological and Nuclear Safety is performed by the Government of the Republic of Croatia, which means that regulatory body is responsible directly to the Government and it is separate and effectively independent from the authorized party.

SORNS is divided into two sectors: Radiological Safety and Nuclear Safety and Inspection. The number of staff necessary and the essential knowledge, skills and abilities for them to perform all the necessary regulatory functions are prescribed in the Ordinance on the Internal Organization of the State Office for Radiological and Nuclear Safety from 2012, 2013 and 2015 (changes and amendments). The number of working places according to this Ordinance is 49, but present number of employees in SORNS is only 20. The staff of the regulatory body has the necessary competence and remains focused on performing their functions in relation to safety. The SONRS does not have sufficient number of qualified and competent staff, but nevertheless all responsibilities and tasks of the regulatory body are fulfilled. The SONRS is going to launch new public announcements for empty and in the meanwhile a number of young experts are working on temporary positions. All jobs directly influencing safety and security are performed completely and rearranged among SORNS personnel when necessary.

The SORNS staff is regularly participating in trainings and workshops organized by various international organizations, such as the IAEA and/or international professional associations. Furthermore, SORNS was engaged in the project EuropeAid/130051/D/SER/HR

Strengthening Administrative Capacity of the State Office for Radiological and Nuclear Safety.

F. OTHER GENERAL SAFETY PROVISIONS

The provisions set in Articles 21 to 26 of the Convention are generally delineated in Act on Radiological and Nuclear Safety (Official Gazette 141/13, 39/15) and further specified by the regulations described in Section E.1.2 and listed in Section L.3. Considering Article 21, the Act prescribes that the holders of the licence for performing the activities involving ionizing radiation sources or nuclear activities are responsible for the implementation of radiological and nuclear safety measures and have to bear all associated costs. The measures have to be implemented in line with the principles of justification, optimization and dose limitation. Moreover, the licence holders whose operations result in radioactive contamination of the environment or the ones who incur damage because of the loss of control over the source or for some other reason have to cover the costs of the remediation. If the licence holder is not in a position to carry out the remediation, cannot be defined or is out of reach, the costs of the remediation have to be covered from the state budget. Related to Article 22 of the Convention, the Act requires for all personnel who handle ionizing radiation sources and/or is exposed to ionizing radiation to be adequately educated. The knowledge has to be refreshed and checked periodically. Similar is expected from the personnel employed in nuclear facilities. Considering Article 23, all licence holders have to establish and implement quality assurance programmes which have to be audited and re-certified periodically. Licence holders for nuclear facilities have to plan and systematically carry out quality assurance measures focused on the facility components, process control systems and maintenance. In relation to Article 24, the Act addresses a number of issues such as the dose limits, age limits, protection during pregnancy and breastfeeding, education, personal dosimetry, self-protection measures, requirements concerning the premises and devices etc. Considering Article 25, it is prescribed that each licence holder has to prepare the plan and programme of the measures to be implemented in case of emergency. Plans and programmes have to be verified by the SORNS. Croatian Emergency Preparedness and Response plans cover emergencies originating in Croatia and those originating abroad with the emphasis on potential accidents in Krško NPP in Slovenia. Related to Article 26, for radioactive waste and nuclear facilities appropriate decommissioning arrangements have to be established (where applicable) before the operational license is granted.

The regulations which were issued after previous National Report and which are relevant for Articles 21 to 26 of the Convention are as follows:

- 1) Ordinance on the Content of a request for Approval for the Start or End of Operation or Decommissioning of a Nuclear Installation (Official Gazette 47/17)
- 2) Ordinance on the Required Documents and their Content for Approval of Nuclear Activities (Official Gazette 29/17)

- 3) Ordinance on the Safety Analysis Report for Nuclear Installations (Official Gazette 29/17)
- 4) Ordinance on Establishing Quality Assurance Programme for Management of Nuclear Facilities (Official Gazette 29/17).

The Ordinance under 1) is relevant for Articles 21 to 26. It prescribes the content of a request for approval required for the start of operation or termination of operation of a nuclear installation, as well as the required content of a request for approval for the commencement or termination of nuclear installation decommissioning. The content includes programmes, documents and plans which refer to obligations set for in the Articles 21 to 26.

The Ordinance under 2) is relevant for Articles 22 to 26. It prescribes documents and their content required for the approval for nuclear activities. The content includes programmes, documents and plans which refer to obligations set for in the Articles 22 to 26.

The Ordinance under 3) is relevant for Articles 24 and 25. It prescribes the structure and content of the Safety Analysis Report for nuclear facilities, which includes the procedures in case of emergency as well as how the decommissioning process will be taken into account during operation of the facility.

The Ordinance under 4) is relevant for the Article 23, as it prescribes the required quality assurance programme for management of nuclear facilities.

G. SAFETY OF SPENT FUEL MANAGEMENT

Spent fuel management has not been practiced in the Republic of Croatia. As the Republic of Croatia and the Republic of Slovenia are planning long-term dry storage of SF at Krško NPP location and the site selection process for the repository will not begin before 2050., therefore, the safety of spent fuel management in the Republic of Croatia is not an issue. For the purpose of this report it should be noted that obligations prescribed under Articles 4 – 10 of the Convention are transposed into the Act (Article 55 – General safety requirements, Article 14 – Siting of proposed facilities, Articles 15 and 16 – Design and construction of facilities, Articles 40, 41, 42 and 43 – Assessment of facilities and Article 17 – Operation of facilities).

H. SAFETY OF RADIOACTIVE WASTE MANAGEMENT

Obligations that are prescribed under Article 11 (general safety requirements) of the Convention are fully transposed into the Act (Article 55) as well as into the Strategy (General Principles) and the National Programme (General Principles). Therefore, it is supposed that obligations prescribed will be applied as prescribed during the implementation of the Strategy goals.

There are two storage facilities for radioactive waste in Croatia. These are IMROH and IRB storage facilities. Radioactive waste and disused sources stored originate from medicine, industry, science, education and from the past public use (lighting rods and smoke detectors).

IMROH storage facility has been operated from 1995 up to 2000 when it is closed. Remediation works assuming segregation, characterization, conditioning and packing in lead containers were undertaken in June 2006 with full assistance of the IAEA. Work was performed under the supervision of former State Office for Radiation Protection. Conditioned waste and used sources are temporary stored at the IMROH facility pending transfer to the future Central National Storage Facility. IMROH storage facility is under 24 hour surveillance with CCTV system. Further segregation and volume reduction of this radioactive waste is planned before the transport and placement to the CNSF.

IRB storage facility was built in 1967 for the purpose of storing radioactive waste and disused sources generated within the Institute. As the time was passing by the storage facility has been used for storing radioactive waste and disused sources that was generated outside the Institute. Because storage capacity has become insufficient in 1987 it was expanded with the additional storing room and with room for radioactive waste treatment. According to the Government Decision in 2009 the IRB storage facility has been designated as the CNSF. Decision has never been implemented due to the technical issues raised by the IRB and because of the public concern. Nowadays, because storage conditions were not in line with the regulatory requirements the IRB storage facility is closed. In July 2015, the IRB storage facility was remediated. The project of remediation included segregation, characterization, treatment, conditioning and packing into lead containers of radioactive waste and disused sources.

Since both storage facilities are closed the newly generated radioactive waste and disused sources are kept at the owners facilities until the Central National Storage Facility is in function. Also, reuse or repatriation is strongly suggested wherever is possible. In cases when the licensed user does not have the appropriate funding or user of source cannot be identified, SORNS engages authorized technical service to safely manage the concerned source in its transport container until CNSF will be established.

According to the National Programme the start of operation of the CNFS is planned for year 2020. Furthermore, the start of operation of the long-term storage for LILW from Krško NPP is planned for year 2023. The projects of CNFS and long-term storage facility for LILW from Krško NPP are being developed in accordance with the safety requirements given in Predisposal Management of Radioactive Waste, IAEA Safety Standards, General Safety Requirements, No. GSR Part 5, 2009, Storage of Radioactive Waste, IAEA Safety Standards, Safety Guide, No. WS-G-6.1, 2006 and The Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste, IAEA Safety Standards, General Safety Guide, No. GSG-3, 2013. Also, it should be noted here that obligations prescribed under Articles 12 – 17 of the Convention are transposed into the Act as well as into the Strategy and the National Programme. The new Ordinance on management of radioactive waste and disused sources, currently being developed, takes in the consideration all safety requirements set forth in the Convention and in the IAEA safety requirements and guidelines. Therefore it can be concluded that obligations will be applied as prescribed during the implementation of the Strategy goals.

I. TRANSBOUNDARY MOVEMENT

The Act explicitly bans any import of radioactive waste, disused sources or spent fuel to the country, unless differently prescribed by international agreements. The Ordinance on the Supervision and Control of Transboundary Shipments of Radioactive Waste and Spent Fuel (Official Gazette 11/13) ensures that transboundary movement is undertaken in a manner consistent with the provisions of Article 27 of the Convention. The Ordinance is also in line with the provisions of the Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel.

In relation to the transboundary movement, it should be mentioned that sub-regional cooperation between ex-Yugoslavian countries regarding the cross-border control of nuclear and other radioactive materials is still active. This cooperation, initiated in 2007, involves Bosnia and Herzegovina, Montenegro, FYR Macedonia, Slovenia, Serbia and Croatia. Within the scope of the cooperation information and data exchange protocols are being established which enable survey of suspicious transports and control over potential illicit trafficking in or through the region. As an example, in July 2013 the Protocol on the Means of Information and Data Exchange between the State Regulatory Agency for Radiological and Nuclear Safety of Bosnia and Herzegovina and the State Office for Radiological and Nuclear Safety of the Republic of Croatia has been established. The Protocol contains step-by-step instructions on how to proceed if undeclared nuclear or other radioactive material is detected at the border crossing. It is focused on particular railway border crossings where the situation requires special arrangements. As the legislative and regulatory framework in Western Balkan countries continues to improve, it is planned to further strengthen already existing sub-regional cooperation.

J. DISUSED SEALED SOURCES

In Croatia ionizing radiation sources are used mainly in medicine, industry and scientific research. The data from the SORNS database indicate that in September 2017 there were 38 users of the sealed sources belonging to the categories 1, 2, 3 or 4 (according to the IAEA classification scheme). Those users were in a possession of 143 sources altogether (3, 13, 28 and 99 sources in the categories 1, 2, 3 and 4 respectively) (Table J-1).

Table J-1: Sealed sources in use (category 1,2, 3 and 4)

County	Sealed sources by categories				Total
	1	2	3	4	
Bjelovar-Bilogora					
Brod-Posavina		2	4		6
Dubrovnik-Neretva					
Istria				1	1
Karlovac					
Koprivnica-Krizevci				5	5
Krapina-Zagorje					
Lika-Senj					
Medimurje					
Osijek-Baranja			1	9	10
Pozega-Slavonia				3	3
Primorje-Gorski Kotar		2	3	12	17
Sisak-Moslavina			1	8	9
Split-Dalmatia				13	13
Sibenik-Knin					
Varazdin					
Virovitica-Podravina				1	1
Vukovar-Syrmia				4	4
Zadar					
City of Zagreb	3	9	18	38	68
Zagreb County			1	5	6
Total	3	13	28	99	143

Sealed sources which are currently in use are not distributed uniformly across the Croatian territory (Figure J-1). Actually, more than 75% of the sources are concentrated in 4 counties: the City of Zagreb (68), Primorje-Gorski Kotar (17), Split-Dalmatia (13) and Osijek-Baranja (10). All sealed sources belonging to the category 1 are located in the City of Zagreb, as well as 70% of the category 2 sources, 65% of the category 3 sources and 38% of category 4 sources. Since there are no sealed sources manufacturers in Croatia, all sources are being imported.



Figure J-1: Locations of the sealed sources in use (category 1, 2, 3 and 4)

The status of disused sealed sources within the framework of Croatian national legislation hasn't changed in the period after the submittal of the previous National Report. According to the Regulation on Conditions and Method of Disposal of Radioactive Waste, Spent Sealed Radioactive Sources and Ionising Radiation Sources Which are not Intended for Further Use (Official Gazette 44/08), the obligation of the owner or the user of disused sealed source is to ensure that the source is adequately managed and to cover all associated costs. Each disused sealed source firstly has to be offered to those who would use it for other purposes. If such users do not exist, the source has to be transported to storage facility. The

dismantling of sources and transport to storage facility can be performed only by authorized technical service and in the prescribed manner.

Owners/users are allowed to keep disused sources at their own storages for a maximum of 6 months. Short lived disused sealed sources of low activity can be kept in the local storages belonging to the owners/users until the criteria for the clearance are met, but only if this will be achieved within the period of up to 3 years. In order to minimize waste generation, the Regulation obliges users to contractually bind the manufacturers to take back each disused sealed source with activity which remains above 100 MBq longer than 10 years after the delivery.

The SORNS is keeping records on the sealed sources in use, on the disused sealed sources kept locally at storages of owners/users, as well as on the disused sealed sources kept at two radioactive waste storages.

K. GENERAL EFFORTS TO IMPROVE SAFETY

Croatian representatives were actively participating at the Review Meeting of Contracting Parties to the Convention organized in 2015. Questions put to the Croatian representatives were mostly related to the Croatian Strategy goals, long-term policies regarding the joint management of Krško NPP spent fuel and radioactive waste and the establishment of the Centralised National Storage Facility for the radioactive waste and disused sources generated in the country. These issues have received appropriate attention in this Report.

At the Meeting the following has been identified as the challenges to be dealt with in the forthcoming period:

- The IRB temporary storage facility remediation project and communicating the remediation project to the public
- Development of the National RWM Programme and approval including Strategic Environmental Assessment (SEA)
- Central national waste management site approval and public acceptance
- Human resources development at RWM Agency and regulator
- Interim storage (institutional waste) facility licensing and development (within 2 years)
- Interim storage (Krško NPP operational waste) facility licensing and development (within 8 years) and
- Public education, information, involvement and participation in decision making process.

The two challenges that were successfully resolved are remediation of the IRB temporary radioactive waste storage facility and the development of the National Programme. Most of the other challenges cannot be resolved until the National Programme is adopted by the Government.

The IRB temporary radioactive waste storage facility was remediated in July 2015 and the results of project were communicated to public. The National Programme was developed and it passed the Strategic Environmental Assessment process including the transboundary assessment. The National Programme was communicated to public and it passed several public hearings, including at the local community where the proposed site for the Radioactive Waste Management Centre is situated. The National Programme is waiting for the adoption of the Government. After the adoption of the National Programme the activities on the approval of the proposed site for the RWMC can be initiated which includes public participation in decision-making process. Before the approval of the site the activities on the licensing and development of Central National Storage Facility (institutional waste) and long-term storage facility for operational waste from Krško NPP cannot begin.

Regarding the human resources, the Fund, from the moment of being appointed as the operator of the RWMC, is working on the enhancement of the number of staff with required knowledge and skills as well as on the enhancement of knowledge, skills and abilities of current employees to perform all necessary functions. The number of qualified and competent staff in the regulatory body is still not sufficient, but with the great efforts and devotion of the present staff, all responsibilities and tasks of the regulatory body are fulfilled.

The work on public involvement started with the process of development and adoption of the Strategy. In the process of development of the National programme the public education, information, involvement and participation was even more emphasized. The various public involvement activities were organised by SONRS and Fund which included: available information for the public through different media, public hearings, workshops with local community and educational activities. Public consultation is implemented in legal and regulatory framework. Provisions are given in Environmental Protection Act (Official Gazette No. 80/13, and amendments 153/13, 78/15), Regulation on information and participation of the public and public concerned in environmental protection (Official Gazette No. 64/08) and Law on Freedom of Information Act (Official Gazette No. 25/13 and amendment 85/15).

In June 2015 SONRS hosted Integrated Regulatory Review Service (IRRS) mission which gave two recommendations regarding the management of spent fuel and radioactive waste. The first recommendation refers to absence of active central storage facility for radioactive waste, disused sources or orphan sources and the IRRS mission recommendation is that the Government should implement the provisions for the safe management of radioactive waste in particular with the construction and operation of the Central National Storage Facility in compliance with the Strategy. As it was mentioned before, the adoption of the National Programme will facilitate commencement of the project for licensing and construction of the CNFS. The second recommendation states that SONRS should develop and approve Ordinance regarding the detailed requirements for licensing the site, construction, operation and closure of radioactive waste management facility as prescribed in the 2013 Act. In the period after the mission SONRS drafted the new Ordinance which is expected to be adopted till the end of 2017. The IRRS mission report was made public and can be downloaded from the SONRS web site.

Planned future actions to address identified issues and implement recommendations:

- Adoption of the National Programme and new Ordinance on Management of Radioactive Waste and Disused Sources
- Approval of the proposed site for the Radioactive Waste Management Centre in consultation with all stakeholders and public participation
- Licensing and construction of CNFS and long-term storage facility for operational radioactive waste from Krško NPP and
- Continuing human resources development at Fund and SONRS.

L. ANNEXES

L.1 Inventory of Radioactive Waste

Table L-1: Radioactive Waste at the Storage Facility Operated by the Institute for Medical Research and Occupation Health

Radioactive waste package	Radionuclide	Number of sources	Activity (Bq)	Total activity (Bq)
Cylindrical container (80 l)	Co-60	52	3.72×10^9	2.51×10^{11}
	Eu-152/154	102	2.47×10^{11}	
Cylindrical container (50 l)	Co-60	17	1.19×10^{10}	1.35×10^{11}
	Cs-137	10	6.99×10^{10}	
	Eu-152/154	15	5.34×10^{10}	
Lead container (80 l)	Co-60	111	2.06×10^{10}	1.36×10^{11}
	Cs-137	9	9.91×10^{10}	
	Eu-152/154	5	1.60×10^{10}	
Lead container (50 l)	Co-60	55	3.11×10^9	3.11×10^9
Standard drum (200 l)	Fe-55	16	2.37×10^{10}	9.85×10^{11}
	Co-60	46	4.33×10^9	
	Kr-85	6	1.13×10^{10}	
	Sr-90	339	2.23×10^{10}	
	Cd-109	1	1.85×10^8	
	Cs-137	17	4.86×10^9	
	Pm-147	8	-	
	Eu-152/154	41	8.00×10^9	
	Ra-226	39	9.06×10^{11}	
	Ra-226/Be	2	3.92×10^9	
	Am-241/Be	1	3.70×10^8	
	n/k	n/k	n/k	
Standard drum (200 l)	Am-241	n/k	n/k	n/k
	n/k	n/k	n/k	
Plastic containers (7x50 l)	Am-241	n/k	n/k	n/k
	Ra-226	n/k	n/k	
Wooden box (50 l)	Am-241	n/k	n/k	n/k
Plastic containers (4x50 l)	n/k	n/k	n/k	n/k
Plastic containers (4x25 l)	Co-60	n/k	n/k	n/k
	Ra-226	n/k	n/k	n/k
	Am-241/Be	1	1.11×10^9	1.11×10^9

n/k - not known

Table L-2: Radioactive Waste at the Storage Facility Operated by the Institute Ruder Bošković packed in EKO-KON 1 and EKO-NEUT 1 Containers

Packaging ID	Radionuclide	Activity (Bq)	Number of sources
EKO-KON 1 ser.no. 001	Eu-152/154	5,44E+10	36
	Eu-152/154	4,13E+10	25
	Eu-152/154	2,38E+10	16
	Cs-137	1,24E+11	59
	Co-60	6,68E+09	118
	Eu-152/154	1,31E+11	79
	Co-60	1,80E+08	8
	Eu-152/154	4,74E+10	36
	Eu-152/154	4,59E+10	32
TOTAL ACTIVITY		4,74E+11	409
EKO-KON 1 ser.no. 002	Ir-192	6,55E+09	294
	Ir-192	<1,00E+9	146
	Cd-109		5
	Ba-133	3,30E+08	1
	Fe-55	2,59E+10	11
	Gd-153	2,95E+10	2
	K3-82	7,38E+10	7
	Pm-147	2,00E+07	6
	Tl-204	9,30E+08	9
	Sr-90	1,00E+10	71
	Ra-226	7,70E+11	50
	Ra-226/BE+		4
	Am-241	6,66E+10	11
	Cm-247		1
	All sorts		3
	Cs-137	1,18E+10	1
	Cs-137	6,88E+10	1
TOTAL ACTIVITY		1,06E+12	623
EKO-KON 1 ser.no. 003	Ni-63	2,30E+09	5
	Co-60	7,58E+09	23
TOTAL ACTIVITY		9,88E+09	28
EKO-NEUT 1 ser.no. 001	Am-241/Be	1,16E+11	20
TOTAL ACTIVITY		1,16E+11	20

**Table L-3: Radioactive Waste at the Storage Facility Operated by the Institute
Ruđer Bošković packed in Standard 200l Steel Drums**

Packaging ID	Radionuclide	Activity (Bq)	RW Class (IAEA 2009)	Content description
RWP1	Ra-226	3,80E+10	DSRS	Conditioned 226Ra
RWP2	Ra-226	1,10E+11	DSRS	Conditioned 226Ra
RWP3	Ra-226		LLW	Metal plates, housing of devices, 4 instruments painted with radium, 3 plastic boxes with radium ore, bottle with radium, 2 metal boxes contaminated with radium, Phillips device
RWP4	Ra-226		LLW	Metal plates, big parts of some motor contaminated with radium
RWP5	Cs-137 and others		LLW	3 plastic bags
RWP6	Bi-207, Pb-210 and others		LLW	plastic bag Bi-207), plastic bag (Pb-210), 2 plastic bags with “hot” lab’s waste
RWP7	Eu-152		LLW	plastic bags containing various material used for testing contaminated with 152Eu
RWP8	Non specified		LLW	2 pieces of semicircular metallic plates, large plastic bag with clothes, papers, tissues..., cardboard boxes, plastic ampoules
RWP9	Eu-152, Cs-137		LLW	large plastic bags with various contaminated objects, clothes, papers, tissues, cardboard boxes,
RWP10	U-238, Th-234		LLW	large plastic bags with various contaminated objects, clothes, papers, tissues, cardboard boxes
RWP11	Eu-152		LLW	soil
RWP12	Eu-152		LLW	Small metallic pellets
RWP13	Cs-137		LLW	Large bags with mainly paper and tissue, gloves etc contaminated with 137Cs
RWP14	Cs-137		LLW	Large bags with mainly paper and tissue, gloves etc contaminated with 137Cs
RWP15	Eu-152		LLW	Small metallic pellets
RWP16	Mixed		LLW	Various plastic, glass, cardboard materials, vials, empty bottles, gloves etc.
RWP17	Mixed		LLW	Metallic bars, various metal pieces, boxes, plastic bag with, paper, glass, cotton wool etc.
RWP18	Mixed		LLW	Cardboard boxes, plastic bags, paper, glass, cotton wool, tissue, gloves, etc.
RWP19	U-238		LLW	Various materials contaminated with U238
RWP20	Mixed		LLW	Various objects: paper, clothes, wood, cardboard, tissue, gloves, shoes, etc
RWP21	Co-60		LLW	Plates-calibration of gamma cameras
RWP22	Co-60, Cs-137 and others		LLW	Plastic bags and bottles, dust, metal boxes, bags, paper, gloves, plastic tubes, paper pieces, some metal parts etc.
RWP23	C-14, Cs-137 and others		LLW	Mixed waste: plastic bags and bottles, dust, bags, paper, gloves, vials, plastic tubes, paper pieces, etc.
RWP24	Mixed		LLW	Mixed waste: plastic bags and bottles, dust, bags, paper, gloves, vials, plastic tubes, paper pieces, etc.
RWP25	Mixed		LLW	Mixed waste: 2 large plastic bags and bottles, metal parts, paper, gloves, vials, plastic tubes, paper pieces, etc.
RWP26	Mixed		LLW	Mixed waste: 2 large plastic bags and bottles, metal parts, paper, gloves, vials, plastic tubes, paper pieces, etc.
RWP27	U-238		LLW	U (“black” granular sand) in original steel drum

Packaging ID	Radionuclide	Activity (Bq)	RW Class (IAEA 2009)	Content description
RWP28	U-238		LLW	U ("black" granular sand) in original steel drum
RWP29	U-238		LLW	UO ₂ yellow cake-powder
RWP30	Mixed		LLW	Plastic pieces (canisters), contaminated wood, plastic ample in plastic box
RWP31	Mixed		LLW	Plastic pieces (canister), plastic ample, plastic boxes, glass, bottles etc
RWP32	Mixed		LLW	Plastic pieces (canister), plastic ample, plastic boxes, glass, bottles etc
RWP33	Mixed		LLW	Various empty cans, plastic canisters, plastic and glass bottles, small pieces of metal
RWP34	Mixed		LLW	Powder samples in plastic boxes and cans, ores, soil, rock etc.
RWP35	Mixed		LLW	Cyclotron targets, contaminated lead containers
RWP36	Co-60, Cs-137, Eu-152		LLW	Canisters and bottles with solutions containing 60Co, 137Cs, 152Eu
RWP37	Co-60, Cs-137, Eu-152		LLW	Canisters and bottles with solutions containing 60Co, 137Cs, 152Eu
RWP38	Co-60		LLW	Big plastic canister placed into the drum
RWP39	Mixed		LLW	Various plastic objects: bottles, cans, canisters, broken pieces
RWP40	Mixed		LLW	Metal pieces of drums and containers
RWP41	Mixed		LLW	Paper, glass, clothes, gloves, plastic bags, cardboard, rubber gloves, shoes, etc.
RWP42	U-238		LLW	Various uranium and thorium compounds and objects NUCLEAR MATERIAL
RWP43	Mixed		LLW	Various contaminated materials: plastic sheets
RWP44	Am-241	5,50E+09	LLW	Smoke detectors. No. of sources: 24032
RWP45	Am-241	5,61E+09	LLW	Smoke detectors. No. of sources: 6491

Table L-4: Nuclear Material at the Storage Facility Operated by the Institute Ruder Bošković packed in Standard 200l Steel Drums

Packaging ID	Radionuclide / Material	Mass (g)	Content description
NM1	Th-232	12 405	Lab samples, ceramic samples, optical devices
NM2	U, UO ₂ , U ₃ O ₈ , UO ₂ SO ₄	20 903	Lab samples, U rod, solutions, powder, metallic parts
NM3	UF ₆ , U, U/Th, UO ₄	42 492	Yellow cake, U powder, ADU,
NM4	U-238	787 000	Defectosopes, Uranium parts, TH-232/U-232 rods,

L.2 Structure and Contents of the Act on Radiological and Nuclear Safety

In Croatia the basic legislative act related to the safety of spent fuel management and radioactive waste management is the Act on Radiological and Nuclear Safety No. 141 of 27 November 2013 and amendment Official Gazette No. 39 from 8 April 2015.

I. GENERAL PROVISIONS

Subject matter

Exemption from the application of the Act

Definitions

II. STATE OFFICE FOR RADIOLOGICAL AND NUCLEAR SAFETY

Competencies of the State Office for Radiological and Nuclear Safety

Appointment of the head

III. APPROVALS AND LICENCES

Approval for performance of operations involving ionizing radiation sources

Licence for use of ionising radiation sources

Exemption from the requirement to obtain the approval or licence for use

Announcement of the intention to perform operations

Approval for performance of nuclear operations

Analysis of the safety of the area selected for the location of a nuclear installation

Construction works affecting nuclear safety

Approval for the construction of a nuclear installation

Trial operation of a nuclear installation

Approval of the use permit

Withdrawal of the approval for performance of operations involving ionizing radiation sources, the licence for use of ionizing radiation sources and the approval for performance of nuclear operations

Responsibilities of holders of the approval for performance of operations involving ionizing radiation sources and holders of the approval for performance of nuclear operations

Import, export, transport and transit

IV. RADIOLOGICAL AND NUCLEAR SAFETY

1. Principles of radiological safety

2. Measures of radiological safety

Dose limits

Age limits for exposed workers, apprentices and students
Protection during pregnancy and breastfeeding
Medical exposure
Personal dose measurement
Medical fitness
Obligations of educational institutions
Requirements concerning premises and devices
Obligations of the holder of the approval
Method, scope and deadlines for measurements and inspections, content of the report, frequency, deadlines and reporting procedure
Obligation to implement self-protection measures
Person responsible for protection against ionizing radiation
Prohibition to use radioactive substances

3. Nuclear Safety

Prohibition and responsibility for the safety of nuclear installations
Use of operating experience
Periodic safety review
Reporting on the operation of an installation

4. Authorised professional technical services and authorised nuclear safety experts

Authorised professional technical services
Authorised nuclear safety experts
Foreign legal or natural persons

5. Quality assurance

6. Professional competency

V. RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL

Management of radioactive waste, disused sources and spent nuclear fuels

Approval for performance of operations involving management of radioactive waste, disused sources and spent nuclear fuel

Centre for management of radioactive waste

Financing the management of radioactive waste, disused sources and spent nuclear fuel

Prohibition to import radioactive waste and spent nuclear fuel

Strategy for management of radioactive waste, spent nuclear fuel, disused sealed radioactive sources and ionizing radiation sources which are not intended for further use

VI. REPONSE TO AN EMERGENCY

Plan and programme of measures for protection in emergency cases

Obligations of the holder of the approval in the planning of an emergency response

International notifications and cooperation

Remediation

Subsidiary liability of the Republic of Croatia

Remediation of an area of permanent exposure

VII. PHYSICAL PROTECTION OF IONIZING RADIATION SOURCES AND NUCLEAR INSTALLATIONS

VIII. NON-PROLIFERATION OF NUCLEAR WEAPONS

Licenses and prohibition to produce possess and use nuclear materials and special equipment

IX. MONITORING THE STATUS OF RADIOACTIVITY IN THE ENVIRONMENT

X. REPORTING AND SELF-ASSESSMENT OBLIGATIONS

Reporting obligation

Content of the report

Obligation and implementation of self-assessment

XI. REGISTERS

Obligation to keep registers and their content

XII. FINANCIAL OBLIGATIONS

Provision of financial resources for ensuring safety of a nuclear installation

XIII. INSPECTION SUPERVISION

Inspectors

Official identification card and badge

Inspectors' rights, obligations and powers

XIV. PENAL PROVISIONS

Misdemeanours

XV. TRANSITIONAL AND FINAL PROVISIONS

L.3 Relevant Legislation in Force (as of July 2017) and Relevant Reports

The list provided below includes all legislation and regulation cited in Section E, as well as other legal acts relevant for the spent fuel management and/or radioactive waste management.

L.3.1 Acts

- Act on Liability for Nuclear Damage (Official Gazette 143/98)
- Act on Civil Protection System (Official Gazette 82/15)
- Dangerous Goods Transport Act (Official Gazette 79/07)
- Act on Fund for Krško NPP Decommissioning, Radioactive Waste and Spent Nuclear Fuel Management (Official Gazette 107/07)
- Act on Sanitary Inspections (Official Gazette 113/08, amended 88/10)
- Act on Criminal Procedure (Official Gazette 152/08, amended 76/09, 80/11, 121/11, 91/12, 143/12, 56/13, 145/13, and 152/14)
- Act on Radiological and Nuclear Safety (Official Gazette 141/13, amended 39/15)

L.3.2 Regulations

- Regulation on Conditions and Method of Disposal of Radioactive Waste, Spent Sealed Radioactive Sources and Ionising Radiation Sources Which are not Intended for Further Use (Official Gazette 44/08)
- Regulation on Measures for Protection Against Ionising Radiation And Interventions in Case of Emergency (Official Gazette 102/12)

L.3.3 Ordinances

- Ordinance on the Content of a request for Approval for the Start or End of Operation or Decommissioning of a Nuclear Installation (Official Gazette 47/17)
- Ordinance on the Validation of a Location for a Nuclear Installation (Official Gazette 38/17)
- Ordinance on the Required Documents and their Content for Approval of Nuclear Activities (Official Gazette 29/17)
- Ordinance on Content of the Request for Approval for the Commissioning of Nuclear Installation (Official Gazette 29/17)
- Ordinance on the Safety Analysis Report for Nuclear Installations (Official Gazette 29/17)

- Ordinance on Certified Expert Organizations in the Field of Nuclear Safety (Official Gazette 29/17)
- Ordinance on Establishing Quality Assurance Programme for Management of Nuclear Facilities (Official Gazette 29/17)
- Ordinance on Nuclear Safety Requirements for Nuclear Installation Construction (Official Gazette 36/16, 79/16)
- Ordinance on the Manner and Procedure for Supervision During Import or Export of Material for Which There is Justified Suspicion of Contamination by Radionuclides or of Containing Radioactive Sources (Official Gazette 114/07)
- Ordinance on Radioactive Decontamination, Radioactive Source Management and Carrying Out Of All Other Necessary Measures in Order to Reduce Impacts on Human Health and Environment or to Avoid Additional Risks, Dangers or Damages (Official Gazette 53/08)
- Ordinance on the Requirements for the Design, Construction and Removal of Structures Accommodating Sources of Ionising Radiation or in Which Practices Involving Sources of Ionising Radiation Take Place (Official Gazette 99/08)
- Ordinance on Required Professional Training for Operating Sources of Ionising Radiation and for the Application of Measures for Protection Against Ionising Radiation (Official Gazette 63/11, amended 10/16)
- Ordinance on Giving Permissions to the Expert Technical Services to Perform Expert Tasks Related to the Ionizing Radiation (Official Gazette 72/11)
- Ordinance on Physical Protection of Radioactive Materials, Nuclear Materials and Nuclear Objects (Official Gazette 38/12)
- Ordinance on the Personal Dosimetry on the Examination of Ionizing Radiation Sources and Working Conditions and on the Reports and Inquest Registers (Official Gazette 41/12, amended 89/13)
- Ordinance on Permissions and Allowances for the Application and Transport of the Ionizing Radiation Sources (Official Gazette 71/12, amended 89/13)
- Ordinance on the Scope and Content of the Plan and Programme of Measures in the Event of an Emergency and of Informing the Public and Competent Bodies (Official Gazette 123/12)
- Ordinance on the Supervision and Control of Transboundary Shipments of Radioactive Waste and Spent Fuel (Official Gazette 11/13)
- Ordinance on Conditions and Measures for the Protection Against the Ionizing Radiation in Performing the Activities with Radioactive Sources (Official Gazette 41/13)

- Ordinance on the Conditions and Procedure for Issuing and Withdrawing the Approval for Packaging Used for Transport of Radioactive and Nuclear Materials (Official Gazette 42/13, amended 19/17)
- Ordinance on Exposure Limits (Official Gazette 59/13)
- Ordinance on Health Conditions of the Exposed Workers and Persons Being Educated to Work with the Ionizing Radiation Sources (Official Gazette 80/13)
- Ordinance on the Monitoring of the Radioactivity in the Environment (Official Gazette 121/13)

L.3.4 Strategies and Plans

- National Energy Strategy (Official Gazette 130/09)
- Protection and Rescue Plan for the Republic of Croatia (Official Gazette 96/10)
- Threat Assessment for the Republic of Croatia for the Case of Natural and Technological Disasters and Severe Accidents (2013)
- Strategy for Management of Radioactive Waste and Spent Nuclear Fuel (Official Gazette 125/14)
- Strategy on Radiological and Nuclear Safety for the period 2017-2025 (Official Gazette 65/17)
- National Programme for Implementation of the Strategy for Management of Radioactive Waste and Spent Nuclear Fuel (2017)

L.3.5 Multilateral agreements

- Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention (Official Gazette 12/93)
- Convention on Nuclear Safety (Official Gazette 13/95)
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Official Gazette 03/99)
- Convention on the Physical Protection of Nuclear Material (Official Gazette 05/01, amended 05/06)
- Vienna Convention on Civil Liability for Nuclear Damage (Official Gazette 01/06)
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Official Gazette 01/06)
- Convention on Early Notification of a Nuclear Accident (Official Gazette 01/06, amended 05/06)

L.3.6 Bilateral agreements

- Agreement Between the Republic of Croatia and the International Atomic Energy Agency for Application of Safeguards in Connection with the Treaty on Non-proliferation of Nuclear Weapons (Official Gazette 13/94)
- Agreement Between the Republic of Croatia and the Republic of Slovenia on the Early Exchange of Information in the Event of a Radiological Emergency (Official Gazette 06/98, amended 3/00)
- Agreement Between the Government of the Republic of Croatia and the Government of the Republic of Hungary on the Early Exchange of Information in the Event of a Radiological Emergency (Official Gazette 11/99, amended 03/00)
- Protocol Additional to Agreement Between the Republic of Croatia and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-proliferation of Nuclear Weapons (Official Gazette 7/00)
- Agreement Between the Government of the Republic of Croatia and the Government of the Republic of Slovenia on Regulating the Status and Other Legal Relations Pertaining to Investments, Use and Decommissioning of the Krško Nuclear Power Plant (Official Gazette 09/02)
- Protocol on the Means of Information and Data Exchange Between the State Regulatory Agency for Radiological and Nuclear Safety of Bosnia and Herzegovina and the State Office for Radiological and Nuclear Safety of the Republic of Croatia (2013)

L.3.7 Official National and International Reports Related to Safety and Reports on International Review Missions

- National report - "On the Implementation of the Obligations under The Convention on Nuclear Safety", Zagreb, August 2016
- IAEA-NS-IRRS-2015/09 "Report of The Integrated Regulatory Review Service (IRRS) Mission to The Republic of Croatia", June 2015

L.4 List of Abbreviations and Acronyms

Act	Act on Radiological and Nuclear Safety, Official Gazette No. 141 of 27 November 2013 and amendment Official Gazette No. 39 from 8 April 2015
Bilateral Agreement	Bilateral Agreement between the Government of the Republic of Croatia and the Government of the Republic of Slovenia on the settlement of status and other legal relations with respect to investments, utilization of and decommissioning of the Krško NPP, Official Gazette No. 9 of 23 July 2002
Convention	Joint Convention on Safety of Spent Fuel Management and on Safety of Radioactive Waste Management
CNSF	Central National Storage Facility
HLW	High Level Waste
IAEA	International Atomic Energy Agency
IMROH	Institute for Medical Research and Occupational Health
IRB	Institute Ruđer Bošković
LILW	Low and Intermediate Level Waste
NORM	Naturally Occurring Radioactive Materials
NPP	Nuclear Power Plant
RWMC	Radioactive Waste Management Centre
SFDS	Spent Fuel Dry Storage
SORNS	State Office for Radiological and Nuclear Safety
Strategy	Strategy on Radioactive Waste and Spent Fuel Management Official Gazette No. 125 of 27 October 2014
TSO	Technical Support Organisation