



REPUBLIC OF CROATIA

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**

4rd report

October 2010

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Section A. Introduction

Republic of Croatia signed “Joint Convention on Safety of Spent Fuel Management and on Safety of Radioactive Waste Management” (Joint Convention) on 9 April 1998, and ratified it on 5 February 1999. First National Report on implementation of the obligations under Joint Convention was prepared at the beginning of 2003, and Republic of Croatia participated at Review Meeting later that year. Preparation of the second and third National Report in 2005 and 2008 was also followed by an active participation at the Review Meetings in 2006 and 2009. This National Report contains updated information on matters covered in the third report, focusing on the advancement achieved in the matters of safety meanwhile. Report has the same structure as the previous one and in each section new developments are presented together with the most important previous statements which still stand. Also, adequate consideration is given to the issues raised during the last Review Meeting, which is briefly discussed in the Section K.

Major developments during period after the third report were:

- a) advances in the national SF and RW management policies,
- b) further advancement of the regulatory framework, and
- c) advances and challenges in specific RW management practices.

Advances in the national policy

Croatian SF and RW management strategy has been formulated in 2008 and approved in July 2009 by the Government. Major features of the strategy are:

- a) RW currently present in Republic of Croatia, as well as the future waste originating from medicine, scientific research, and industrial activities not related to nuclear fuel cycle, will be managed in a single central national storage facility (CNS).
- b) Republic of Croatia will undertake all reasonable and necessary activities to ensure safe and efficient management of SF and RW originating from the NPP Krško, in accordance with joint programmes with Slovenia. Available options shall be investigated and evaluated through revisions of the joint “Programme of NPP Krško Decommission-

ing and SF & LILW Disposal” (NPPK Programme).

In August 2008 ToR for the 2nd revision of Programme of Krško NPP Decommissioning and SF and LILW Disposal (DP) was confirmed by Intergovernmental Commission (IC) and work was entrusted to the Project team jointly formed by expert organizations from both countries. With new revision required by Agreement between the governments of Slovenia and Croatia regarding the status and other legal issues related to investment, exploitation, and decommissioning of the Nuclear Power Plant Krško (Agreement) both parties aimed at correct and as realistic description of decommissioning and RW and SF management in accordance with best available technologies. Detailed descriptions reflecting the actual situation have two goals: (a) assessment of future actions and their timing, including establishment of new facilities and (b) estimating expenses of all the activities, including construction of facilities. 1st revision of DP has been comprehensively revised and for that purpose new supporting studies were prepared. In those studies dismantling of NPP Krško was scrutinized, final quantities of operational and decommissioning waste was assessed together along with the expenses for some of the decommissioning activities. Respecting different interests of two parties, several decommissioning scenarios were conceived inside the framework defined by Boundary conditions. Scenarios are sets of activities harmonized in time needed to ensure safe decommissioning and RW and SF management. Scenarios take account of all the activities including establishment of facilities (number, capacity, time of operation and start of operation) in technically correct sequence in which precise time is reserved for each of the tasks. Costs of the integrated decommissioning and waste management programmes have been estimated and a financing model has been proposed: each country should accumulate half of the planned amount, through annual instalments by national power companies into the respective national decommissioning funds. Contrary to the understanding accomplished in joint 1st revision of DP stating that all LILW generated by operation and decommissioning of NPP Krško will be placed in a joint repository placed on an unspecified location on the territory of Croatia or territory of Slovenia, Slovenia initiated independent process of establishing repository for Slovenian half of LILW. Siting process finished with governmental decree in December 2009, confirming Vrbina in

municipality of Krško as the site for LILW repository, where silos type of near-surface repository should be established. During 5 years of site selection process and preparation of repository design, site investigations and safety analyses, Croatian side has not been offered to participate in the project or even officially notified on the activities. All activities were financed from Slovenian Fund. During the location selection process, particularly sizable fees were foreseen for local community. Based on the supporting studies and developed scenarios, new modules of 2nd revision were prepared in the first half of 2010. The revision encompasses five possible scenarios of NPP Krško decommissioning, updated according to recent developments between two revisions. Finished document is still waiting for the approval by the Slovenian side to be submitted to IAEA peer review.

Croatian electricity company HEP d.d payments to decommissioning Fund are regular and in line with bilateral agreement and first revision of decommissioning program. As Slovenian Fund is more mature and it existed before bilateral agreement, their financial asset is sizeably bigger because of the former NPP Krško payments. Slovenian fund had already been operating for about ten years, and DP estimates provided the basis for recalculation of annual contributions by the Slovenian power company. Croatian Parliament established in 2007 by the Act on Fund for Financing Decommissioning of Krško NPP and Disposal of Radioactive Waste and Spent Nuclear Fuel from NPP Krško special fund (Fund) for financing all LILW and SF management-related activities in accordance with the Agreement. Resources are regularly accumulated in the Fund by Hrvatska elektroprivreda d.d. (HEP), Zagreb in the amount periodically adjusted by the revisions of DP. Fund's purpose is to finance all the preparation, review and implementation of DP and disposal of LILW and SF, in accordance with the Agreement.

According to the present proposal of the Croatian SF and RW management strategy, it is expected that this revision of DP will lead, in particular, to more specific and definite decisions regarding management of LILW from NPP Krško.

Further advancement of the regulatory framework

Regulatory framework development during the previous period was primarily aimed at further strengthening of the regulatory capabilities and incorporation of the EU directives into Croatia's legal system. Most important change occurred in 2010, when the new Act on radiological and nuclear safety (Act) was promulgated. That Act merged former State Office for Radiation Protection and State Office for Nuclear Safety, establishing one State Office for Radiological and Nuclear Safety (SORNS) as a regulatory body. It is important to mention that Act has transferred inspection of nuclear materials and other radioactive sources and pertaining practices to the State Office for Radiological and Nuclear Safety. Before that, inspection of nuclear materials and pertaining practices was under the authority of the former State Office for Nuclear Safety and inspection of radioactive sources and pertaining practices under competencies of the Ministry competent for Health. At present, inspection of sources and pertaining practices is being shared between the newly established State Office for Radiological and Nuclear Safety and the Ministry competent for Health. Process of coordination between these two administrative bodies concerning the issues of inspections is still ongoing and is expected to be finished by the end of 2011. Act further improved legislative framework, based on the experience gained over the past three years, and the EU accession process. Second level legislation derived from the Act will transpose EU aquis and international standards in a more clear and non-ambiguous way.

These regulatory developments are described in more detail within the Section E, whereas the list of other relevant laws and regulations is given in the Annex I.

Advances and challenges in specific RW management practices

Within the scope of RW management practices in Republic of Croatia, significant advances and challenges were recognised:

a) In 2009 Government issued a Regulation stating the Institute Ruđer Bošković location of CNS facility for management of institutional radioactive waste in Croatia, according to setting of the Radioactive Waste and Spent Fuel Management Strategy cur-

rently in force.

b) Pertaining to d), State Office for Radiological and Nuclear Safety took over the initiative for establishment of necessary arrangements with administrative bodies and their existing staff and technical capacities, in order to find permanent solution to establishment and location of CNS.

c) Management of sealed sources, and in particular, control of orphan and vulnerable sources, has been advanced through inspection surveillance recently under competencies of the State Office for Radiological and Nuclear Safety.

d) Implementation of the Regulation from 2009 under a) did not commence due to the technical issues brought up by the IRB and public concern.

e) Process for Governmental decision on CNS operator as a radioactive waste management entity free from technical support organisation tasks, is ongoing from 2010. according to the Act.

Section B. Policies and Practices

Policies

Croatian Government approved in July 2009 national Radioactive waste and Spent Fuel Strategy (Strategy) for the forthcoming ten-year period. Strategy, among other things, addresses management of Croatian half of LILW, as well as SF generated during the operation of NPP Krško. Strategy provides an analysis of the state, circumstances and methods for the management of RW and SF from 2009 to 2019, in order to ensure availability of sufficiently qualified staff and adequate financial services, in order to support the safety of facilities for SF and LILW management during their operating lifetime and for decommissioning, as well as the application of the provisions of Article 24 of Joint Convention (Operational Radiation Protection). In particular, Strategy confirms Croatia's intention to search for common solutions with Slovenia on the management of LILW and SF. Also, Strategy confirms Croatia's ongoing commitment to continue with activities related to site exploration for a potential LILW and SF storage and

disposal on Croatian territory, in case all other options should fail. Croatia will revise Radioactive Waste and Spent Fuel Strategy according to requirements set out in the EC CD on the management of spent fuel and radioactive waste from September 2011.

Spent fuel management practices

Spent fuel management has not been practiced in Republic of Croatia.

Radioactive waste management practices

Radioactive waste from waste producers in medical, industrial and scientific research fields have been managed in Republic of Croatia. Storage facilities for the waste which could not be disposed off as communal waste after brief on-site decay storage are described in the Section D. Plans for a new storage facility are discussed elsewhere in this Report. According to the Act on Radiological and Nuclear Safety, a Public Service (PS) is foreseen as an operator of CNS for management of the institutional radioactive waste, and RW and SF generated from decommissioning and operation of the NPP Krško. Currently, formal administrative arrangements are being prepared to establish a PS part responsible for management of the institutional radioactive waste in Croatia. In accordance with set strategic directions, by 2013 Croatia should decide among several options for LILW originating from NPP Krško: (a) reach an agreement with Slovenia regarding the location of objects for the disposal; or (b) should no such agreement be reached, Croatia should initiate preparations for taking over its half of LILW. In this case, LILW could be exported to third-country with operational repository, if commercial agreement for disposal of LILW could be accomplished. If no host country for LILW could be found, Croatian part of LILW generated by NPP Krško would be disposed on Croatian territory in the repository built for that purpose. Establishment of a PS part responsible for management of radioactive waste originated from NPP Krško will depend on Governmental decision on above described options.

Radioactive waste categorization

Regulation on radioactive waste, described in the Section E, defines solid, liquid and gaseous radioactive waste. For solid radioactive waste, categories are defined in the following table:

Radioactive waste class	Typical characteristics
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 2kW/m^3
2.1 Short lived waste	Radioactive waste containing radionuclides with half-life less than 30 years (limitation of long lived alpha emitting radionuclides to 4000 Bq/g in individual waste packages and to an overall average of 400 Bq/g in the total waste volume)
2.2 Long lived waste	Radioactive waste activity concentrations exceeding the limits for short lived waste
High level radioactive waste	Radioactive waste thermal power above 2kW/m^3 and activity concentrations exceeding limits for short lived waste

Table closely resembles the TABLE II from the IAEA safety guide 111-G-1.1. The existing Regulation on radioactive waste management will be updated according to Act on Radiological and Nuclear Safety to incorporate EC RP122 practical concepts of clearance and exemption, and to clearly address dependencies between pre-disposal and disposal activities for RW from Krško NPP and institutional RW, according to the new EC CD on RW and SF management.

Section C. Scope of Application

Regarding the obligations under Article 3:

- 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.

Section D. Inventories and Lists

Spent fuel facilities and decommissioning of nuclear facilities

No spent fuel is currently on the Croatian territory or under its effective jurisdiction.

No nuclear facilities are presently in operation or being decommissioned in Republic of Croatia.

Radioactive waste management facilities

No waste from nuclear cycle is presently on the Croatian territory or under its effective jurisdiction. The waste accumulated in the Republic of Croatia originates from medicine, scientific research and industrial applications in the country. Import and management of radioactive waste not originating in Republic of Croatia are explicitly prohibited by the Act described in the Section E.

There are two storage facilities for radioactive waste, both located in Zagreb, within national research institutes: Institute Ruđer Bošković (IRB) and Institute for

Medical Research and Occupational Health (IMROH). There are no radioactive waste repositories.

IRB Temporary Storage of Radioactive Material (TSRM)

According to the 2009. Governmental Regulation, IRB was designed location of the CNS facility, but the implementation of the Regulation did not take place due to the raised technical issue by IRB, and public concern. In order to assure safe management of radioactive waste, SORNS initiated formal arrangements to license other existing facility and pertaining location within administrative infrastructure for the purpose of institutional radioactive waste management as a permanent solution. Regulatory Body initiated national IAEA TC project with the goal to upgrade existing RW storage and establish CNS on TSRM at the IRB. As commencement of 2009. Regulation implementation did not take place, IAEA TC project focused on developing necessary technical capacities for CNS on other location, as described above in the text. In addition to national IAEA TC project, EU IPA2010 project has been initiated to facilitate necessary remediation activities in existing TSRM. Currently, arrangements are in progress to start EU IPA2010 project implementation. Such a characterised and conditioned material will be transferred to CNS facility once the facility is operational, as outlined in the Strategy. The facility consists of two separate storage rooms built in-ground and processing room built above storage room that was added in 1987. Improvements regarding security had been made and were reported in the 2nd report. Accesses to both levels of the building and its perimeter have been reinforced and an intrusion detection system has been installed. Alarm system is remotely controlled. In addition, building is under video surveillance enabling monitoring both from the central alarm station of the Institute and from the office of the general manager of the facility. Inventory of TSRM is presented in Annex II.

IMROH storage

IMROH hosts a closed storage facility for used sources. Facility is no longer in operation since last radioactive source was received 15 years ago. Most of the sources are of low activity (lightning rods, fire detection sources, medical sources and industrial gauges). Remediation works of storage area with conditioning, characterization, segregation and packing in lead containers of found radioactive sources were undertaken in

June 2006 with full assistance of IAEA. Work was performed under the supervision of former State Office for Radiation Protection. Overall, more than 600 sources were recovered and characterised along with approx. 500 l of contaminated materials. 226Ra sources were transferred to TSRM at IRB. Rest of the conditioned sources is temporary stored at this facility pending transfer to the future CNS facility, as outlined in the Strategy. Further segregation and volume reduction of the waste is planned before final placement in CNS. IMROH storage facility is under 24-hour surveillance with CCTV system. A new inventory list of the sources housed in storage has been compiled. Inventory of IMROH storage is presented in Annex II.

The third storage facility was identified as a result of unresolved issues in connection to implementation of 2009. Regulation, as described above. Storage facility is located within capacities of the administrative bodies in Croatia. Formal arrangements to licence it and establish its operator as a Public Service for institutional waste are currently ongoing.

Radioactive waste inventory

State Office for Radiological and Nuclear Safety took over a database with the central RW inventory from the former State Office for Radiation Protection. TSRM at IRB reports every change of the inventory and pursuant to its legal obligations annually submits a complete inventory list to the SORNS. A summary of data, representing spent sources inventory is reported annually to *IAEA Net Enabled Waste Management Database* (NEWMDB). Beside that, importers and exporters of radioactive materials have an obligation to report annually their yearly business pertaining to radioactive materials.

Section E. Legislative and Regulatory System

Basic laws

Basic laws which together constitute SF and RW management regulatory

framework are: Act on Radiological and Nuclear Safety published on 3 March 2010 in Official Gazette No. 28 and entered into force on 1 April 2010.

Act replaced former Act on Ionising Radiation Protection and Safety of Ionising Radiation Sources passed in 2006 (in further text “Act 2006”) and „Nuclear Safety Act“, both discussed in the previous reports. “Act” consists of 108 articles in 17 chapters:

I GENERAL PROVISIONS

- Subject matter
- Exemption from the application of the Act
- Definitions
- Council for Radiological and Nuclear Safety
- Information to the public

II STATE OFFICE FOR RADIOLOGICAL AND NUCLEAR SAFETY

- Establishment of the State Office for Radiological and Nuclear Safety
- Appointment of the head

III CARRYING OUT A PRACTICE INVOLVING IONISING RADIATION SOURCES AND WORK ACTIVITIES

- Licence for practice
- Work activities
- Licence for use of ionising radiation sources
- Derogation from the requirement of obtaining a licence for practice or licence for use
- Withdrawal of the licence for practice and the licence for use of ionising radiation sources
- Responsibilities of the licensees and licence holders

IV NUCLEAR ACTIVITIES

1. Notification of intention
 - Notification of intention to perform a nuclear activity
 - Notification of intention to import or export nuclear material or specified equipment
 - List of nuclear materials and specified equipment, nuclear activities, procedure and deadline for notification of intention and the format and content of the notification
2. Performance of nuclear activities
 - Licence for performing a nuclear activity
 - Withdrawal of a licence
 - Responsibilities of the licence holders

V PROTECTION AGAINST IONISING RADIATION

1. Principles of protection against ionising radiation
 - Principles of protection against ionising radiation
 - Justification principle
 - Optimisation principle
 - Dose limitation principle

2. Safety measures for sources of ionising radiation

Dose limits

Age limit for exposed workers

Protection during pregnancy and breastfeeding

Medical irradiation

Personal dose measurement

Technical competency

Medical examinations

Obligations of training institutions

Requirements concerning premises and devices

Establishment and application of measures for protection of exposed workers and supervision of work posts

Measurement method, scope and deadlines, quality control, contents of the quality assurance programme, contents of the report and reporting frequency, deadlines and procedure

Obligation of implementing self-protection measures

Person responsible for protection against ionising radiation

Authorised technical service

Prohibition of use of radioactive substances

VI NUCLEAR SAFETY

1. Guarantee of nuclear safety

Prohibition and guarantee of the safety of nuclear facilities

Authorised experts for nuclear safety

Granting of authorisations for nuclear safety experts

Use of operating experience

Provision of financial resources

Workers' qualifications

Quality assurance

2. Projects

Siting of a nuclear facility

Analysis of the safety of an area for the location of a nuclear facility

Environmental protection approval

Design quality certificate for a nuclear facility

3. Performance of construction works

Construction affecting nuclear safety

Approval for constructing a facility

Physical protection plan

Instructions, standards and methods

4. Trial operation of nuclear facilities

5. Operation of nuclear facilities

Approval of the use permit

Periodic safety review

Reporting on the operation of facilities

VII RADIOACTIVE WASTE AND SPENT NUCLEAR FUEL

1. Disposal of radioactive waste, spent sealed radioactive sources, disused ionising radiation sources, and spent nuclear fuel

- Public service for the disposal of radioactive waste and spent nuclear fuel
- Financing the work of the public service
- 2. Import, export, transport and transit of ionising radiation sources and radioactive waste, spent nuclear fuel, spent sealed radioactive sources and disused sources of ionising radiation and specified equipment
 - Prohibition of import of radioactive waste and spent nuclear fuel
 - Prohibition of export of radioactive waste and spent nuclear fuel
 - Import, export, transport and transit
- VIII RESPONSE TO EMERGENCIES
 - Plan and programme of measures for protection in case of emergency
 - Obligations of the licence holders in planning emergency response
 - International notification and cooperation
 - Remediation
 - Subsidiary responsibility of Republic of Croatia
 - Remediation in the case of permanent exposure
- IX PHYSICAL PROTECTION OF IONISING RADIATION SOURCES AND NUCLEAR FACILITIES
- X NON-PROLIFERATION OF NUCLEAR WEAPONS AND PROTECTION OF SPECIFIED EQUIPMENT
 - Licences and prohibition to produce, possess and use specified equipment
- XI MONITORING OF RADIOACTIVITY IN THE ENVIRONMENT
- XII REPORTING AND SELF-ASSESSMENT OBLIGATION
 - Reporting obligation
 - Content of the report
 - Obligation and implementation of self-assessment
- XIII RECORDS
 - Obligation to keep records and content of records
- XIV FINANCIAL OBLIGATIONS
- XV ADMINISTRATIVE AND INSPECTIONAL SUPERVISION
 - Administrative supervision and supervision during imports and exports
 - Inspectors
 - Official identification card and badge
 - Inspectors' rights, obligations and authorities
- XVI PENAL PROVISIONS
 - Misdemeanours
- XVII TRANSITIONAL AND FINAL PROVISIONS

Act establishes a new regulatory body responsible for radiation protection and nuclear safety - State Office for Radiological and Nuclear Safety as a state administration body competent for activities relating to protection against ionising radiation and nuclear safety. Article 106, paragraph 1 of the above mentioned Act states: “The State Office for Radiological and Nuclear Safety shall take over civil servants, equipment, archives and other documentation, operating resources, financial means, rights and obli-

gations from the State Office for Radiation Protection and the State Office for Nuclear Safety“. Act on the Internal Structure of State Office for Radiological and Nuclear Safety was passed on November 10th, 2010 (Official Gazette No. 125/2010). SORNS became fully operational and took over all the tasks and responsibilities of State Office for Radiation Protection (SORP) and State Office for Nuclear Safety (SONS) on November 19th, 2010, when Director General of SORNS has been appointed.

Article 6 defines tasks of SORNS. Among other tasks, it approves carrying out of nuclear activities, practices involving sources of ionising radiation, procurement, import, export, transport and transit of ionising radiation sources and authorises use of ionising radiation sources. It also conducts an independent safety analyses and issues decisions or certificates regarding the location, design, construction, operation and decommissioning of a facility in which a nuclear activity is to be performed, takes part in procedure for issuing location permits, building permits, permits for removal and in procedure for issuing use permits for structures that accommodate sources of ionising radiation or in which practices involving sources of ionising radiation are carried out in accordance with *lex specialis*. SORNS approves and supervises professional operations of authorised technical services and authorised experts for nuclear safety, organises and supervises, and, where necessary, also carries out tests on the presence of the type and intensity of ionising radiation in the environment, food and feed, medicinal products and general use products under regular conditions as well as in cases of suspected emergency. SORNS is responsible for keeping records on licences, approvals, decisions and certificates which it has issued within the scope of its authority, as well as for maintaining and supervising records on ionising radiation sources, licensees and licence holders, beneficiaries, exposed workers, level of irradiation of exposed workers, as well as the level of irradiation of persons subject to medical exposure and of other persons. SORNS also elaborates technical platforms for teaching curricula and programmes for regular and additional education, as well as for renewal of knowledge in the field of protection against ionising radiation, ensures expert assistance in implementing the national plan and programme for procedure in the event of a nuclear accident and emergencies connected with sources of ionising radiation, informs the mass media, competent bodies, organisations, associations and international institutions on emergencies connected with

sources of ionising radiation, provides expert assistance and cooperation in activities for preventing illicit trafficking in nuclear and other radioactive material to state administration bodies competent for such activities, monitors safety conditions at nuclear power plants in the region and carries out assessments of the threat of nuclear accidents there, especially in the Krško Nuclear Power Plant in Slovenia and the Paks Nuclear Power Plant in Hungary, provides dosimetric assessments of exposure to ionising radiation of exposed workers, of the population from medical exposure and from exposure to ionising radiation originating from environmental radionuclides. SORNS is responsible for fulfilment of the obligations which Republic of Croatia has assumed through international conventions and bilateral agreements concerning protection against ionising radiation, nuclear safety and the application of protective measures aimed at the non-proliferation of nuclear weapons.

Basic principles of justification of practices, optimization of protection and safety, and of limitation of individual doses are explicitly formulated as provisions of the law. Authorization for all practices with ionizing radiation is mandatory, except for excluded or exempted sources of ionizing radiation. Conditions and procedure for authorization are formulated as provisions of the law, as well as the principles for exemption. Primary responsibility for implementation of prescribed radiation protection measures has the user, i.e. person or legal entity obtaining the authorization for conducting certain practice. By Article 59 of the Act, person responsible for the generation of radioactive waste, spent sealed radioactive sources, disused ionising radiation sources or spent nuclear fuel shall be obliged to ensure and bear the costs of their disposal. Situation when the costs of disposal at the moment of enforcement are not recoverable from the party obligated to bear such costs will be regulated by regulation which will be issued by the Government of Republic of Croatia at the proposal of the Director General of SORNS, on the basis of Article 61 of the Act. By the same regulation, selection criteria, obligations and working method of PS shall be prescribed. PS for disposal of radioactive waste and spent nuclear fuel will be the institution, organisation or agency designated by the Government of Republic of Croatia, at the proposal of SORNS, on the basis of the same article. According to Article 61 of the Act, work of PS shall be financed from the fees paid by the generators of radioactive waste and spent nuclear fuel, from

dedicated fund established by the Act on the Fund for Financing the Decommissioning of the Krško Nuclear Power Plant and the Disposal of KNPP Radioactive Waste and Spent Nuclear Fuel (Official Gazette 107/2007) and from funds of the State Budget of Republic of Croatia. By Article 62, import, processing, storing and disposal of radioactive waste and spent nuclear fuel which was not generated in Republic of Croatia are prohibited, unless prescribed otherwise by international agreements.

According to Article 80, inspectional supervision over the implementation of the Act and subordinate legislation adopted on the basis thereof is performed in the first instance by the inspectors for radiological and nuclear safety of SORNS (hereinafter referred to as: the inspectors). Sanitary inspection of the Ministry of Health and Social Welfare performs inspectional supervision in the second instance.

Act defines nuclear practices instead of nuclear facilities. These practices involve nuclear material (as defined in the IAEA Statute) and specified equipment (as defined in the “Protocol Additional for application of Safeguards in connection to the Non-Proliferation Treaty”). All spent fuel facilities are clearly under jurisdiction of this Act.

Act requires that in the process of determining the siting, planning, construction, operation and decommissioning of a facility in which a nuclear practice is to be performed, the conditions for nuclear safety and protection set forth in the Act and in conventions and other international agreements ratified by Republic of Croatia, as well as international recommendations and standards in the area of nuclear safety, must be met. These conditions have in the meantime been elaborated to a great detail in a subordinated regulation described below. Based on Articles 3, 14-16 and, nuclear material or specified equipment user shall be solely responsible for safety and protection in performing a nuclear activity. User is also responsible for emergency preparedness, environmental monitoring, education of personnel and record-keeping. All these requirements are specified in more detail in regulations. Holder of the license is also liable for any nuclear damage according to Act on Third Party Liability for Nuclear Damage. It is the responsibility of the regulatory body to control that the licensee fulfils these regulations.

Most important subordinated regulations

Most regulatory requirements on radioactive waste and spent fuel management are contained in three 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” (OG, 44/08), in further text “Regulation on radioactive waste”,
- "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" (OG, 99/08), "Ordinance on design and construction",
- “Ordinance on performing nuclear activities” (OG, 74/06), “Ordinance on nuclear activities”, and
- “Ordinance on conditions for nuclear safety and protection with regard to the sighting, design, construction, use and decommissioning of a facility in which a nuclear activity is performed” (OG, 71 /08), “Ordinance on nuclear facilities”.

The first one is subordinated to the “Radiation Protection Act”, and is primarily concerned with RW not originating from nuclear fuel cycle. The second one gives general conditions for design and removal of the structures accommodating sources of ionising radiation, also applicable to RW storage. The other two are subordinated to the “Nuclear Safety Act”, and regulate management of spent fuel and RW originating from nuclear fuel cycle.

“Regulation on radioactive waste” consists of 58 articles in 7 sections: General provisions, Classification of radioactive waste, Clearance and exemption from control, Disposal of radioactive waste, spent sealed radioactive sources and ionizing radiation sources not intended for further use, Disposal of spent sealed radioactive sources and ionizing radiation sources not intended for further use, Method of keeping records on radioactive waste, spent sealed radioactive sources and ionizing radiation sources not intended for further use and Transitional and final provisions. In "General provisions", it empowers SORNS to grant authorizations for carrying out practices involving radioactive waste or spent sealed radioactive sources, gives details of the authorization procedure, assigns responsibilities for the safety, operational radiation protection and protec-

tion of the environment. Regulation provides classification for solid waste, criteria for clearance and exemption, conditions and limit values for discharge into environment, methods for collection, treatment and packaging, requirements for protective containers, their labelling and records keeping. Liquid and gaseous waste treatment is addressed as well. Responsibility to decide upon RW repository is assigned to the Government. For such a facility, preparation of an environmental impact study is explicitly requested. However, details remain to be described in other, less general documents. To minimize waste accumulation in Republic of Croatia, Article 48 of Regulation obliges user to contractually bind the manufacturer to consent to the return of sealed sources with activities which remain above 100 MBq longer than 10 years after delivery. As a prerequisite for authorization, a programme of application of measures for protection against ionising radiation including the security and quality assurance programme and the plan of measures for prevention and elimination of potential consequences of an emergency event are required. Regulation will be updated according to Act in order to clearly transpose EC RP122 clearance and exemption practice document and to fully address requirements set out in new EC CD on radioactive waste and spent fuel management.

“Ordinance on nuclear activities” lays down the procedure for notification and licensing, and regulates the form and content of the applications. Nuclear activities include spent fuel management, as well as storing and disposing “*low level and medium level radioactive waste originating from the reactor in quantities requiring the application of nuclear safety and protection measures*”. Intent to perform nuclear activities must be notified to SORNS. Application for the issue of a licence to perform nuclear activities shall be submitted to SORNS one year after the notification at the earliest. When submitting the application, legal person should, depending on the types of nuclear activities, attach certain documentation. SORNS must notify the legal person of its decision within two years. In the case of negative evaluation of the documentation, SORNS shall refuse the application for license. SORNS shall keep the register of nuclear activities in Republic of Croatia as official records of nuclear activities. “Ordinance on nuclear facilities” establishes conditions for nuclear safety and protection with regard to the siting, design, construction, use and decommissioning of a facility in which a nuclear activity is performed. Chapter I contain a lengthy list of definitions, introducing the term

nuclear facility as “*a facility in which a nuclear activity is performed*”. Nuclear facilities include plants for the processing, as well as storage and disposal facilities for “*spent nuclear fuel or high level radioactive waste originating from a reactor*”, and also storage and disposal facilities for “*low and intermediate level radioactive waste in the part where radioactive waste originating from a reactor is being stored (or emplaced) in quantities that require the application of nuclear safety and protective measures*”. In Chapter II, conditions for nuclear safety with regard to the siting of a nuclear facility are regulated. Siting of all facilities shall be based on general exclusion criteria. Additionally, siting of nuclear power plants shall be based on particular exclusion criteria for nuclear power plants and comparative criteria for nuclear power plants. Also, siting of a waste disposal facility for low and intermediate level radioactive waste in the part where radioactive waste being emplaced originates from a reactor shall be determined based on particular exclusion criteria and comparative criteria. Government of Republic of Croatia issued a conclusion about determining aforementioned criteria in 1992. Similarly, in Chapter III conditions for nuclear safety in designing facilities are regulated. For designing all facilities in which a nuclear activity is performed, general conditions are given. Along with the general conditions, particular conditions for nuclear reactors must also be met. Also, along with the general conditions, particular conditions for designing RW disposal facilities are listed. Location and building permits for building facilities in which a nuclear activity is performed or permits for decommissioning of such facilities shall not be issued without a certificate of SORNS, concerning compliance of the preliminary and of the main design with the aforementioned conditions. Finally, in Chapter IV, conditions for nuclear safety for a facility with regard to the construction, commissioning, operation, decommissioning and closure, are regulated. Again, a list of general conditions for these activities is provided. Along with the general conditions, particular conditions for facilities with nuclear reactors are given for the construction, commissioning, operation, decommissioning and closure. Also, along with general conditions, principles for closure of the location of RW disposal facility are given.

“Ordinance on nuclear facilities” is a document which contains very detailed specifications along with the requirements to observe recognized international recommendations and good practices. For example, introductory article of the chapter on facil-

ity design requires (in first three paragraphs) that design must meet dozens of general and particular conditions listed in subsequent articles, and then the paragraph 4 adds: *“In designing all facilities in which a nuclear activity is performed under the conditions stipulated in paragraphs 1, 2 and 3 of this Article, the recommendations and standards of the International Atomic Energy Agency shall apply.”*

Other recent legislation

In addition to the above laws and regulations, which cover most aspects of RW and SF management addressed in Joint Convention, two new ordinances relevant to this field have been developed since the previous report, related to “Act”:

1. Ordinance on the official identity card and badge of the radiological and nuclear safety inspector - issued pursuant to Article 82 of “Act“ on 8 March 2011 in Official Gazette 28/11 and
2. Ordinance on required professional training for operating sources of ionising radiation and for the application of measures for protection against ionising radiation - issued pursuant to Article 29 of “Act“ on 8 June 2011 in Official Gazette 63/11.
3. Ordinance on the authorisation of expert technical services to carry out professional tasks of protection against ionising radiation – issued pursuant to Article 38 of “Act” on 17 June 2011 in Official Gazette 72/11.

According to Article 102 of „Act“, following legislation shall remain in force, with the exception of provisions that are contrary to “Act“, until ordinances issued pursuant to “Act enter into force:

1. Ordinance on medical requirements to be fulfilled by exposed workers, frequency of examinations and the content, manner and deadlines for keeping data on such examinations (Official Gazette 117/07),
2. Ordinance on methods, scope and time limits for measuring personal irradiation of exposed workers and persons exposed to medical radiation, inspection of sources of ionising radiation and working conditions and measurement of required elements

and quality verification, testing the working order of personal protection devices and equipment, testing the working order of measuring instruments, quality assurance measures, assessment of radioactive contamination of persons, objects, the environment, premises and air inside premises in which radioactive activities are performed or radioactive sources are located, content of surveillance and measurement reports, reporting procedure and requirement to keep records, content, methods and time limits for keeping records (Official Gazette 127/07),

3. Ordinance on conditions for application of ionising radiation sources in medicine and dentistry (Official Gazette 125/06),
4. Ordinance on limits of exposure to ionising radiation, and on conditions of exposure in special circumstances and in emergency situations (Official Gazette 125/06), in further text "Ordinance on exposure limits"
5. Ordinance on radiological and physical protection measures for ionising radiation sources (Official Gazette 39/08), in further text "Ordinance on security",
6. Ordinance on conditions, manner, places and deadlines for systematic testing and monitoring of the type and activity of radioactive substances in the air, soil, the sea, rivers, lakes, ground waters, solid and liquid precipitation, drinking water, food-stuffs and general use products and dwelling and working spaces (Official Gazette 60/08),
7. Ordinance on conditions and measures for protection against ionising radiation for carrying out activities involving x-ray units, accelerators and other devices generating ionising radiation (Official Gazette 125/06),
8. Ordinance on 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),
9. Ordinance on register of activities, requirements and manner of issuing, validity of licences for work with sources of ionising radiation and use of sources of ionising radiation (Official Gazette 125/06),
10. Ordinance on method of removal of radioactive contamination, disposal of radioactive source or undertaking other indispensable measures in order to reduce damage

to people and to environment or eliminate further threats, hazards or damages (Official Gazette 53/08),

11. Ordinance on performing nuclear activities (Official Gazette 74/06),
12. Ordinance on control of nuclear material and special equipment (Official Gazette 15/08),
13. Ordinance on special requirements which expert organisations must fulfil in order to perform certain activities in the field of nuclear safety (Official Gazette 74/06),
14. Ordinance on conditions for nuclear safety and protection with regard to siting, design, construction, use and decommissioning of a facility in which a nuclear activity is performed (Official Gazette 71/08),
15. Ordinance on manner and procedure for supervision during import or export of material for which there is a justified suspicion of contamination by radionuclides or of containing radioactive sources (Official Gazette 114/07),
16. Ordinance on confidentiality of data from State Office for Nuclear Safety (Official Gazette 15/09),
17. Ordinance on conditions and measures for protection against ionising radiation for carrying out activities involving radioactive sources (Official Gazette 125/06), in further text "Ordinance on protection measures"
18. Ordinance on fee amount, types and amounts of additional expenses and method of payment for tasks performed by State Office for Radiation Protection (Official Gazette 89/09).

Other elements of the legislative and regulatory framework

In addition to basic and/or new framework outlined above, a number of other legal acts have some bearing on the national practices in radioactive waste and spent fuel management.

- Some other acts affect implementation of these laws and their regulations.
- Ratified international conventions and treaties, as well as the bilateral agreements, should also be considered as constituents of a national framework in a broader sense.

These items are presented in Annex I on the regulatory framework. Although

they address some general aspects of radiological protection or nuclear safety, or their specific implementations, they are generally not discussed in this Report.

Regulatory body

As mentioned earlier, based on the provision of Act regulatory body responsible for radiation protection and nuclear safety is State Office for Radiological and Nuclear Safety (SORNS) as the state administration body competent for activities relating to protection against ionising radiation and nuclear safety. SORNS took over civil servants, equipment, archives and other documentation, operating resources, financial means and rights and obligations from the former State Office for Radiation Protection and State Office for Nuclear Safety. Act on the Internal Structure of State Office for Radiological and Nuclear Safety was passed on November 10, 2010 (Official Gazette No. 125/2010). SORNS became fully operational and took over all tasks and responsibilities of State Office for Radiation Protection (SORP) and State Office for Nuclear Safety (SONS) on November 19, 2010, when Director General of SORNS has been appointed.. Inspectional supervision over the implementation of “Act” and subordinate legislation adopted on the basis thereof is performed in the first instance by the inspectors of SORNS. Sanitary inspection of the Ministry of Health and Social Welfare performs inspectional supervision in the second instance.

About Article 19 specific requirements

Croatian regulatory framework adequately meets requirements which should be addressed in this section of the Report. General radiation protection provisions and nuclear safety requirements, as well as allocation of responsibilities, have been outlined within the above brief account of “Act on Radiological and Nuclear Safety”. More detailed requirements are supplemented by the subordinated new regulations listed in this section. Provisions on licensing, control, reporting and enforcement of safety for the spent fuel and radioactive waste management facilities are also generally introduced by this basic act. More specific requirements are subsequently provided by subordinated

regulations, in particular by “Regulation on radioactive waste”. New “Regulation on radioactive waste” based on new Act on Radiological and Nuclear Safety will be drafted in accordance with the EC RP122 document on clearance and exemption practice.

Section F. Other General Safety Provisions

Safety provisions of Joint Convention articles 21-26 are generally delineated in the Act and further specified by the regulations cited above. By the Act, the licensee is responsible for the implementation of radiological safety measures and shall bear the costs of their implementation (Article 13). Holder of licence for nuclear activities is responsible for the implementation of radiological safety measures and nuclear safety measures and shall bear the costs of their implementation (Article 19). By Article 68, licensee, licence holder or beneficiary whose operations result in radioactive contamination of the environment, premises, areas, objects and persons by radioactive substances above the limits set out in the ordinance or incurs damages owing to loss of control over the source or for some other reason, shall be liable for damages incurred and shall without delay ensure remediation at its expense. Inspection, enforcement and penalties are provided for in later articles. Regulations specify more details. In particular, “Regulation on radioactive waste” in its subsection "4.1 Responsibility" (articles 16-19) specifies that holder of authorization shall bear full responsibility for radioactive waste and spent radioactive sources produced as a result of its activities, including removal, transport and placing in the central storage facility. As described in the previous section, Act also sets appropriate nuclear safety requirements on the license holder. Act specifies that human and financial resources for safe waste management are among the general responsibilities of license holder. Act and “Ordinance on exposure limits” both provide for radiation protection in all practices involving sources of ionizing radiation. Additionally, „Regulation on radioactive waste“, in its subsection 1.3.2 “Protection against ionizing radiation” (articles 10, 11) briefly lists particular obligations. Further specific requirements are provided by “Ordinance on security”, that gives source categorization and stipulates appropriate security measures, and by “Ordinance on protection meas-

ures”. Management facilities for spent fuel and radioactive waste from nuclear fuel cycle are also subject to Act and subordinated regulations mentioned above. For their operation license, or earlier in their development, detailed design conditions and extensive safety analyses and reports are required to demonstrate that they will meet all operational radiation protection provisions. Quality assurance programme is requested in several sections of “Ordinance on facility development”, as appropriate for successive development stages. It is also addressed in subsection 1.3.1 “Safety” of „Regulation on radioactive waste“. Quality assurance programme and a plan of measures for prevention and elimination of potential consequences of an emergency are obligatory prerequisites for authorization. Appropriate decommissioning arrangements before operational license for radioactive waste and nuclear facilities (where applicable) are required by Act and existing ordinances and regulations.

Section G. Safety of Spent Fuel Management

Croatian legislative and regulatory framework contain basic provisions for safety of spent fuel management, although no spent fuel has yet been managed in Republic of Croatia, and no facilities for its management have been planned.

In addition, in 2009 Croatia adopted Strategy on radioactive waste and spent fuel management. In Strategy it is stipulated that as the possibility that the Republic of Croatia might have to overtake half of the waste from Krško NPP by 2025 has not yet been ruled out, under the provisions of the Bilateral Agreement in the case that an extension of the operating lifetime of Krško NPP is not agreed, the prerequisites must be ensured for long-term storage of SF at its proper expense in a third country (possible future joint projects, or commercially). Obligation of overtaking SF within two years after decommissioning of Krško NPP may be modified in agreement with Slovenia, as it will depend on technological solutions in the Programme (present version foresees four years for repositioning SF from Krško NPP basin).

Should in the meantime a storage of SF in Slovenia not be agreed even after 2025, it ensures from the aforesaid that Croatia must, no later than 2018, start with in-

tense preparations for storage of SF in a third country, but possible agreement on such disposal should already be reached by 2018. In case the implementation of these first two options proves to be impossible, the only remaining option is to continue with site exploration for a potential construction of an SF storage on Croatian territory.

Under Agreement, the last iteration of the Programme prior to the expiry of planned operating lifetime should be completed by 2019, and should also contain decision regarding storage of SF from Krško NPP.

Basic safety provisions for safe management of spent nuclear fuel have been addressed in Act. More detailed requirements will be introduced by subordinated new regulations, currently in preparatory phase and will be drafted in accordance with the proposal of EU Directive on management of spent fuel and radioactive waste, and promulgated after acceptance of Directive by EU Parliament.

Section H. Safety of Radioactive Waste Management

Elements of legal framework cited in the previous section on spent fuel similarly apply to the management of RW from nuclear fuel cycle. For example, “general conditions” from “Ordinance on nuclear facilities” are explicitly intended for low and intermediate waste store or repository as well (if RW originates from nuclear fuel cycle), although some of them (in particular the operational safety and defence in depth in case of accident) may appear too prescriptive for LILW facilities. In addition, Ordinance also contains several sections dedicated specifically to this RW. However, no waste from nuclear fuel cycle has yet been managed in Republic of Croatia, and no facilities for its management have been planned. Only RW from other application is stored within the country, and safety of its management in the existing facilities has been considerably improved in recent years (waste characterization, conditioning, packaging etc.), as described in previous report and elsewhere in this Report. Regulation on radioactive waste gives more detailed technical provisions on RW management, and explicitly refers to “*spent sealed radioactive sources and ionizing radiation sources which are not intended for further use*” as the waste types presently managed in Republic of Croatia. In addi-

tion, Regulation outlines specific provisions for RW management facilities. Ordinance on design and construction gives further requirements also applicable to planned new central national RW storage, for which Government has undertaken the responsibility to designate the appropriate site.

Section I. Transboundary Movement

The Act explicitly bans any import of radioactive waste or spent fuel in the Republic of Croatia, unless differently prescribed by international instruments. Apart from full commitment to binding international instruments no other particular issues of transboundary movement needed to be specifically addressed in Croatian regulations.

Sub-regional cooperation in the field of cross-border control

In 2007 SORP initiated sub-regional cooperation among ex-Yugoslavian countries regarding cross-border control of nuclear and other radioactive materials. This sub-regional cooperation involves Bosnia and Herzegovina, Montenegro, Republic of Croatia, FYR Macedonia, Slovenia and Serbia. Two meetings were held up to now: founding meeting in Zagreb and the second meeting in Belgrade, Serbia. Protocols for information exchange were established. Draft of the database is developed for information exchange among the participating countries enabling survey of suspicious transports and control over possible illicit trafficking in or through the region. Last meeting under this cooperation was a bilateral one and it took place in Banja Luka, Bosnia and Herzegovina in 2011. Meeting has been organised to agree on common procedure between Bosnia and Herzegovina in connection to a particular joint border crossing point where local situation requires for special arrangements. Sub-regional cooperation is still active and information is regularly exchanged as appropriate. As the regulatory situation in Western Balkan countries improved significantly over a past couple of years, it is planned to even further strengthen already existing sub-regional cooperation.

Section J. Disused Sealed Sources

General provisions

Safety of disused sealed sources is ensured by “Regulation on radioactive waste” which addresses spent radioactive sources and with several ordinances mentioned above. According to “Ordinance on protection measures”, authorization for usage of any source will be granted only if all protection measures against ionizing radiation are ensured. Since there is no producer or exporter of sealed sources in Republic of Croatia, there are no regulatory provisions for import of disused sealed sources returned to the manufacturer.

Management of spent sources and control over orphan sources

In last several years significant steps have been undertaken to increase safety of spent sources in Croatia. Regulatory Body was and still is engaged in international projects aimed at improvements of management of spent sources and control over orphan sources:

- **IAEA/CRO/9/009: Management and Safe Storage of Spent or Disused**

Sealed Sources

Project results are:

- storage container for sealed radioactive sources was produced custom made for the sources used on Croatian territory
- remote handling tongs along with transportable and portable transport containers type-A, lead brick and glass were provided to enable safe in field handling and conditioning of the sources during removal activities
- two regulatory staff members were trained in licensing procedure for a storage of disused sealed sources
- national radioactive waste management infrastructure was revised and recommendations for improvement were made
- annual radioactive waste arising estimate was made

-appropriate radioactive waste management technology was recommended for CNS facility;

• **IAEA/CRO/ 3002:** Establishing a National Radioactive Waste Storage and Processing Facility

Project objective: To establish a national radioactive waste storage and processing facility to set up an appropriate institutional radioactive waste management infrastructure.

This ongoing project is aiming to establishing the TSRM on Institute Ruđer Bošković as a CNS facility, but due to recent management decision of the Institute it was redefined to estimation of available capacity to host radioactive waste taking into account already occupied space, and to recommending upgrading measure to the store it self in order to appropriately house the existing radioactive waste. Additionally, request to the IAEA was made to certify already existing container custom made for sealed sources — used on Croatian territory for storage and transport. Intention is to use this certified containers in a newly established storage facility. Project is expected to finish in 2011.

• **IAEA-RER-9.073:** Implementation of National Strategies for Regaining Control over “Orphan Sources”

Project results are:

- national strategy for regaining control over orphan sources was developed and implemented;
- ionising radiation detection equipment was donated for outfitting search and recovery teams;
- 19 persons were trained in orphan sources search and recovery techniques;
- List of orphan sources and relevant locations has been compiled and verified;
- 27 ionising radiation sources were recovered from abandoned industrial sites or nearby locations.

• **U.S.A. Ministry of Defense and FBI:** International Counter Proliferation Programme.

Project results are:

- 23 persons were trained as secondary response teams³ in detection and response to trafficking of nuclear and other radioactive materials in cross border transport;
- equipment for detection of nuclear and other radioactive materials was donated.

In addition to aforementioned project, Croatia initiated national IAEA project to introduce Safety Assessment appropriately into already existing licensing procedure through couple of test cases based on a existing facilities and practices in the country.

Spent radium sources management

All spent radium sources in Republic of Croatia from medical applications had been collected, conditioned and properly stored. 3 Secondary response teams are a part of the emergency response teams within the scope of National Plan and Programme in case of radiological emergency. Several years ago, a thorough search followed by characterization and conditioning of all radium sources in Republic of Croatia was undertaken. Data on sources provided by regulatory body found in radiological histories, in hospitals records etc., were investigated and altogether 298 sources were found and collected, with approximately 1400 mg of ^{226}Ra . Sources were of different forms (needles, tubes, plates) all coming from medical applications. They were collected in Zagreb and conditioned in Institute Ruđer Bošković. Sources were first packed into stainless steel containers (approximately 50 mg of radium in each of the containers), which were then welded and bubble tested. Stainless steel containers (in bundles of 10) were placed into three lead containers. Lead containers were packed into standard 200 l drums filled with concrete: two containers in one drum, and the third container in another drum. Drums were properly marked. Characterization and conditioning of the sources were done by IAEA approved procedure and supervised by Agency. Presently, drums are at IRB store (TSRM). Their long term future is still not decided.

Cases of orphan source recovery

In last several years a few orphan sources were recovered. Orphan source (radioactive lightning rod with 3.7 GBq of $^{152,154}\text{Eu}$) recovery was made in November 2004, in a truck transporting scrap metal across the Croatian/Slovenian border. (In average, SORNS is involved in 10-12 interventions annually related to incidents with undeclared sources in cross-border transport. Lightning rods

are found as orphan sources during border controls 2-3 times a year.) Among impressive cases was the recovery of 17 caesium sources (level gauges, total activity 71.24 GBq of ^{137}Cs) in 2002, which had been used in a containers as weights on hay stacks, in a small village near Obrovac.

Other forms of contaminated materials are frequently found in transports of scrap metals. In 2007 and 2011 ^{226}Ra dial was detected in scrap metal in transit through Republic of Croatia from Hungary to the melting factory in Bosnia and Herzegovina. During 2008 transport of metal tubes produced in Republic of Croatia contaminated with ^{60}Co was detected on border. Raw material was imported from Italy where it was originally imported from China. Interpol has also been involved. Location of approx. 100 t of contaminated material (out of which 1 t ended up in Republic of Croatia) was determined.

Section K. Planned Activities to Improve Safety

Planned activities

As already indicated in this Report, the most important planned (or ongoing) activity is:

- site for the central national RW storage facility should soon be designated and the operator should be established in a form of Public Service according to Act on Radiological and Nuclear Safety and the Strategy.

Note on the last Review Meeting issues

Republic of Croatia was actively participating at Review Meeting of Contracting Parties to Joint Convention in 2009. Questions to Republic of Croatia were mostly concerned with the establishment of national decommissioning fund and financing for foreseen activities in connection to NPP Krško DP, and the long-term policies regarding NPP Krško SF and RW joint management, including the establishment of centralised national storage facility for institutional waste. These issues were given appropriate at-

tention in the current Report.

Section L. Annexes

Annex I Regulatory Framework

In addition to laws and regulations listed in Section E, a number of other legal acts have some bearing on the national practices in radioactive waste and spent fuel management.

Other acts

Several other laws are either related to nuclear safety or to the implementation of three basic laws from Section E:

- Act on Third Party Liability for Nuclear Damage (from 1998)
- Act on Criminal Procedure
- Act on Transport of Hazardous Material

Furthermore, based on Croatian Constitution, all announced and ratified international treaties also constitute an integral part of Croatian legislation and can be applied directly. So the following international legal instruments, to which Republic of Croatia is a party, should be mentioned as a part of Croatian legislative framework in this field:

- Statute of the International Atomic Energy Agency,
- Agreement on Privileges and Immunities of the International Atomic Energy Agency,
- Vienna Convention on Civil Liability for Nuclear Damage,
- Convention on Physical Protection of Nuclear Material,
- Convention on Early Notification of a Nuclear Accident,
- Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency,
- Convention on Nuclear Safety,
- Joint Protocol Relating to Application of the Vienna Convention and the Paris Convention,

- Joint Convention on Safety of Spent Fuel Management and on Safety of Radioactive Waste Management.

Finally, the bilateral agreements in this field also constitute a part of national legislative and regulatory framework:

- Agreement between Republic of Croatia and International Atomic Energy Agency for Application of Safeguards in Connection with the Treaty on Non-proliferation of Nuclear Weapons;
- Protocol Additional to Agreement between Republic of Croatia and International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on the Non-proliferation of Nuclear Weapons;
- Agreement between the Government of Republic of Croatia and the Government of Republic of Slovenia on regulating the status and other legal relations pertaining to investments, use and decommissioning of Krško Nuclear Power Plant
- Agreement between Republic of Croatia and Republic of Slovenia on Early Exchange of Information in the Event of a Radiological Emergency;
- Agreement between the Government of Republic of Croatia and the Government of Republic of Hungary on Early Exchange of Information in the Event of a Radiological Emergency.
- Agreement between European Atomic Energy Community (Euratom) and Non-Member States of the European Union on the Participation of the Latter in Community Arrangements for Early Exchange of Information in the Event of Radiological Emergency (Ecurie)

Annex II Radioactive Waste Inventory

The TSRM radionuclide inventory

Radionuclides with $T_{1/2} \leq 30$ years, activity = [GBq]; on December, 31st 2010, not decay corrected.

Nuclide	Neutron generator	A < 4 GBq		40 TBq > A > 4 GBq		A > 40 TBq		Conditioned	Category	Sum activity over groups
		Number	Total activity	Number	Total activity	Number	Total activity			
Ir-192				3	336,99			Y	3	337
Ir-192		15	32,9	15	330,9			Y	4	364
Ir-192		272	6,46					Y	5	6,46
Cs-137		178	29,14					Y	5	29,1
Cs-137		59	119,72	13	153,26			Y	4	273
Tl-204		9	0,003					Y	5	0,003
Sr-90		34	12,4	1	1			Y	5	17,8
Kr-85		5	7,71					Y	5	7,71
H-3				2	11,6			Y	5	11,1
Fe-55		8	0,008					Y	5	0,008
Eu-152		2	0,01					Y	5	0,01
Eu-152		152	433,33	36	163,74			Y	4	597
Co-60		105	4,19					Y	5	4,19
Co-60		21	22,5					Y	4	22,5
Co-60				1	48,87			Y	3	48,9
Co-60				1	11600			Y	2	11600
Co-57		7	0,04					Y	5	0,04
Cd-109		3	0,02					Y	5	0,02
Pm-147		8	0,0002					Y	5	0,0002
Ru-106		11	0,005					Y	5	0,005

Radionuclides with $T_{1/2} > 30$ years, activity = [GBq]; on December, 31st 2010, not decay corrected.

Nuclide	Neutron generator	A ≤ 2 GBq		A > 2 GBq		Conditioned	Category	Sum activity over groups
		Number	Total activity	Number	Total activity			
Am-241	Y			2	220	Y	3	220
Am-241	Y	6	10,24	11	72,15	Y	4	82,39
Ra-226	Y	1	0,37	1	73,86	Y	0	74,229
Am-241		1	1,1	6	66,03	Y	4	67,13
Am-241		16851	13,79			Y	5	13,79
Ra-226		701	51,34			Y	5	51,34
Ra-226		8	6,96	1	2,3	Y	4	9,26
Ni-63		3	1,07			Y	5	1,07

The IMROH storage inventory

Radionuclides with $T_{1/2} \leq 30$ years, activity = [GBq]; on December, 31st 2010, not decay corrected.

Nuclide	Neutron generator	A < 4 GBq		40 TBq >A>4 GBq		A > 40 TBq		Conditioned	Category	Sum activity over groups
		Number	Total activity	Number	Total activity	Number	Total activity			
Cd-109		1	0,00001					Y	5	0,00001
Co-60		191	6,42					Y	5	6,42
Co-60		92						Y		
Eu-152		107	211,24	6	26,8			Y	4	238,04
Eu-152		10	5,01					Y	5	5,01
Eu-152		40						Y		
Fe-55		16	0,09					Y	5	0,09
Kr-85		5	1,08					Y	5	1,08
Kr-85		1						Y		
Pm-147		8						Y		
Sr-90		9	3,59					Y	5	3,59
Sr-90		329						Y		

Radionuclides with $T_{1/2} > 30$ years, activity = [GBq]; on December, 31st 2010, not decay corrected.

Nuclide	Neutron generator	A ≤ 2 GBq		A > 2 GBq		Conditioned	Category	Sum activity over groups
		Number	Total activity	Number	Total activity			
Am-241	Y	1	1,1			Y	4	1,1
Am-241	Y	1	0,367			Y	5	0,367
Cs-137		36				Y		
Ra-226				5	243,52	Y	3	243,52
Ra-226				33	660,94	Y	4	660,94
Ra-226		1	0,0006			Y	5	0,0006
Ra-226		1				Y		
Ra-226	Y	2				Y		